Transforming Sub-Saharan Africa's Agriculture through Agribusiness Innovation

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Abstract: Agribusiness offers promising opportunities to accelerate Africa's agricultural sector development, increase food security, address poverty, youth employment and drive agriculture-led economic growth. This desk research offers a snapshot of the agribusiness activities in Africa with emphasis on the contribution of higher education institutions that are members of the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and selected public universities in Ghana. Our review shows that agribusiness yet in its infancy is gaining traction and longer-term prospects are promising based on initial success and encouraging outcomes in some countries. Various initiatives are taking place in the region, including agribusiness incubation; capacity building, education, and agribusiness knowledge transfer programs at different levels. Partnerships among stakeholders such as government, international groups and private sectors are also growing to boost and encourage better value chain management for agriculture across the African continent. A few RUFORUM university members are setting up the pace in terms of investments to nurture agricultural entrepreneurs through curriculum enhancement; intellectual property and technology transfer policies, and technology commercialization models for conventional and modern technologies through business incubation parks and spin-off companies. Some of the successes and milestones in agribusiness development have yet to happen in many RUFORUM members and in public universities in Ghana. Drawing upon published reports, scholarly articles, and our primary analysis, we highlight several key actions and recommendations that can inform policy and practice to expand and sustain the growth trajectory of agribusiness as a new developmental platform for Africa.

Keywords: Agribusiness, incubators, entrepreneurship, innovation, technology transfer, technology commercialization.

1. INTRODUCTION

The United Nations forecasts that the global population will reach more than 9 billion by 2050, with increase in numbers coming mostly from less developed nations, where clear majority of the world's hungry and undernourished people live. This issue of population growth is evident in sub-Saharan Africa (SSA), which accounts 13% of the global population [1] and where 75% of the world's poor live in rural areas and 30% of the population is undernourished [2]. Rapid population growth will affect the ability of SSA and the rest of Africa to assure stable supply and access to food for Africans, create wealth for them, and to conserve natural resources for future generations. The Millennium Development Goals (MDGs) now coined Sustainable Development Goals (SDS) reflect these important challenges.

Substantial body of literature indicates that accelerated agricultural growth is crucial for addressing the developmental issues linked to rapid population growth such as hunger and malnutrition, food insecurity and poverty in SSA. According to the World Bank "*the potential of agricultural growth to reduce poverty is four times greater than the potential of growth from other sectors*" [3].

SSA's agriculture, the continent's dominant and most important sector, supports over 60% of the region's labor force, composed mainly of smallholder farmers and rural poor that depend on agriculture as the primary source of subsistence, employment and income. It contributes 17% of aggregate gross domestic product, accounts for 40% of the region's total economic output and accounts for more than 75 percent of domestic trade by value providing a livelihood for most the economically active population [1, 4]. SSA's agricultural sector, especially its technical efficiency and productivity have slightly improved and accelerated but have not yet stabilized in the recent years [2, 4]. Improving the performance and competitiveness of agricultural sector, hence, continue to be of strategic importance for the region.

The linkage and dynamic integration of agriculture sector to other important sectors such as the business and trade sectors open value-added opportunities and increased performance. Agriculture needs to link with commercial principles dealing with produce and services for increased productivity and farmers' income. Agribusiness promoting new approaches and business models focused on the access, generation and practical use and deployment of innovations to

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improve productivity, competitiveness, and economic development opportunities should create a new and vibrant agriculture for Africa [3, 4]. Putting investments in agribusiness as outlined in World Bank's reports few years ago will result to a trillion-dollar food market by 2030 for Africa [3, 5]. Private sector companies such as Karuturi, Zeder, and AGCO that are engaged in flower, agri-food businesses and agricultural equipment, respectively, realized Africa's agribusiness huge potential. There is a growing list of private sector companies now investing in the continent's agribusiness sector. These continuing investments and public-private sector partnership will produce significant multiplier effects through their forward and backward linkages, generating demand for agricultural products and associated inputs and services and creating on- and off-farm employment.

Incubation is one of the many possible approaches to agribusinesses development [6-8] and within this ecology of business formation and economic development, higher education institutions (universities) are increasingly being called to play an active role [9-11].

The World Bank report Higher Education in Developing Countries: Peril and Promise has further rationalized the importance of universities: "As knowledge becomes more important, so does higher education. The quality of knowledge generated within higher education institutions, and its availability to the wider economy, is becoming increasingly critical to national competitiveness" [12]. Most research in Africa is conducted at universities, placing these institutions at the centre of their national innovation systems [13]. Increasingly, many African universities now are adopting strategies to become research-led flagship universities. Ranking groups like The World University Rankings captures the performance and strength of African universites every year and latest report indicated increased in the number of graduates and research outputs in many of the African universities [14]. The relevance of academic research and how knowledge and technologies from research are brought to market, however, need more documentation. Through academic research, education and strong linkage to outreach/engagement, African universities can continue to play a central role in producing innovation-oriented yet practical solutions to local agricultural challenges [15, 16] and can be a critical player in strengthening the link of agriculture and business to create a competitive and indigenous agribusiness sector.

This paper supports these propositions on the benefits of treating agriculture as a business enterprise and the important roles of universities in knowledge creation and agribusiness formation to enhance performance of SSA's agriculture. This paper also supports documentation of latest efforts and success stories of enterprising African universities and linking university research to market. To strengthen these arguments, this paper begins with a review of the evolution of agribusiness in select African countries and institutions. It then presents efforts on agribusiness incubation as one of the possible approaches to entrepreneuralizing universities. Finally, this paper presents few actions to fill gaps, fast track wide scale adoption and maximize benefits of agribusiness incubation to reinvigorate SSA and rest of Africa's agricultural sector.

This research drew from secondary data and analysis of published studies, reports, and statistics, selected articles and policy documents. The authors recognize and respect that, the countries in SSA are at different stages in terms of size, governance, policies, regulations, infrastructure, investments, funding, among others that can influence management of agriculture, business, and higher education for economic growth. The key actions and recommendations may apply broadly but due to these limitations, recognition of these differences are considered. The overall aspiration of this paper is to contribute in the limited scholarly publication in agribusiness incubation in SSA and help create awareness and understanding on existing agribusiness incubation efforts, including actors and stakeholders, and identify success stories, gaps and potential solutions to addressing the gaps. Findings will serve as reference in designing future collaborative programs on agribusiness incubation, entrepreneurship and technology transfer and commercialization.

2. AGRIBUSINESS IN AFRICA: REVIEW OF CHALLENGES AND OPPORTUNITIES

Agribusiness is an endeavor strategically placed to drive future development for global agriculture. Agribusiness is the "sum of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing, and distribution of the resulting farm commodities and items" [17, 18]. Over the years, this discipline has evolved remarkably with the definition now transforming from farm centric to now becoming market centric: serving consumers globally and locally

through innovation and management of multiple value chains that deliver valued goods and services derived from the sustainable orchestration of food, fiber and natural resources [19]. Whether a farm or a market centric, both definitions provide that agribusiness encompasses agriculture conducted on commercial principles that deal with management of produce and provision of services, particularly when advanced technology is involved. There are four main groups for agribusiness products: (1) agricultural input industry for increasing agricultural productivity, such as agricultural machinery, equipment and tools; fertilizers, pesticides, insecticides; irrigation systems and related equipment; (2) agro-industry: food and beverages; tobacco products, leather and leather products; textile, footwear and garment; wood and wood products; rubber products and construction industry products based on agricultural materials; (3) agro-processing: equipment for processing agricultural raw materials, including machinery, tools, storage facilities, cooling technology and spare parts; and (4) various services, financing, marketing and distribution firms, including storage, transport, information technology, packaging materials and design for better marketing and distribution [4]. Commercialization of these products and services and linking them across agricultural value chain at local, national and regional levels, can bring added value to agriculture resulting to increased production and creating significant market, employment and wealth opportunities.

There is increasing importance of agribusiness to wealth creation globally. McKinsey's Group recent analysis reveals growing global investments in the agribusiness sector. Investments grew to more than $100 billion in 2013 and many investors, especially in advanced nations where 98% of agricultural production undergoes industrial processing, are racing to capture value from innovations that can create more business opportunities in agriculture [20].

The benefits of the global success of agribusiness, however, as expected has been uneven, especially in Africa where the link of agriculture and business sectors is still relatively weak. Africa's weak agribusiness incubation infrastructure is due to many gaps and challenges. These challenges include: (1) unequitable access to land due to land reform issues, and (2) limited skills and knowledge to improve production efficiency and move away from subsistence level. In addition, limited access to capital to purchase agricultural inputs and financing for start-up or expansion and new technology [21]; and weak institutional environments and support systems, market intelligence and information [22-26] affect the incubation infrastructure of the continent. Addressing these and many other gaps to help strengthen the link of agriculture and businesses, hence, continues and remains a development challenge in Africa [27-29].

However, emerging interests in Africa as a production basin for agribusiness continue to grow for many reasons and opportunities, including SSA's huge reservoir of agricultural, natural and human resources, uncultivated land suitable for farming, the large population of African youth that can be agro-entrepreneurs, the expansion of global market for agricultural produce, and demand for high value food products. An urgent need for increased intervention and investment in agriculture as a business, the need to modernize and diversity African agriculture, and create avenues to engage along the agriculture value chain, was, thus, constantly called for [4, 27, 30]. These are expected to accelerate economic growth and poverty reduction while contributing to achieving the continent-wide agriculture policy CAADP (Comprehensive African Agricultural Development Programme) and broader Millenium Development Goals and Sustainable Development Goals of the continent.

3. AGRIBUSINESS INCUBATION – A NEW ALTERNATIVE TO AGRIBUSINESS DEVELOPMENT

Five interlinked approaches contribute to a competitive and indigenous agribusiness sector. These approaches include: (1) increasing productivity at the farm level; (2) strengthening farmers' groups; (3) investing in large-scale agribusiness; (4) value chain development; and (5) agribusiness incubation. Within this spectrum of complementary options, agribusiness incubation specifically aims to facilitate new, indigenous, firm entry by nurturing early-stage innovative enterprises that have high growth potential [7]. Agribusiness incubation links agricultural research, technology and innovation, which are found mostly in universities, higher education institutions and research and development (R & D) institutions.

For a very long time, innovation in agriculture has been restricted within laboratories. Agribusiness incubation complemented with national and institutional intellectual property rights (IPR) and technology transfer management, provided a new context for incubating ideas coming from the public research laboratories and commercializing these innovations.

This process has encouraged use of formal and innovative processes of technology transfer and shifted away from informal outreach and free exchange of agricultural discoveries [31, 32]. It also creates an environment where agri-based start-up companies can be nurtured and allowed to flourish. Specifically, this process enables and provides support to entrepreneurs, which come in the form of shared facilities and equipment, business development, market access, technology assessment, financial, mentoring and networking services [7, 30, 33, 34] - all of these support contribute to increased success and survival rate of start-up businesses [35, 36].

The process of business incubation, now a standard part of the academic landscape especially in U.S., Europe and some advanced countries in Asia, facilitate the creation and growth of innovation-based companies [10, 30, 33, 34]. For the agricultural sector, successful businesses coming out of the incubators resulted to commercialized products, latest farm technologies, new seed and planting materials, new markets, business linkages benefiting universities, several industries and local farming communities.

In the developing world, perhaps one of the most successful story and proven model of agribusiness incubation in a public sector setting is that of the Agribusiness Innovation Platform (AIP) setup by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), a non-profit international organization based in Patencheru, India. ICRISAT's AIP, an agricultural research commercialization incubator, provides prototype innovations, knowledge and expertise, training and co-location with researchers for close interaction; while the entrepreneurs fine-tune the prototypes, and take them to market, including bearing the risks and reaping the rewards involved. It has benefited more than 158 ventures in agribusiness since 2003. Through the agribusiness incubators, ICRISAT helps enhance its public-private partnerships as a model for fostering agro-business to bring research for development innovations of ICRISAT (e.g. seeds, varieties, breeding techniques, biotechnology crops, etc.) and its partners to the market for faster, wider-scale impact [37]. This platform is enhancing ICRISAT's inclusive market oriented development strategy; many groups within Africa are following up on this success.

In Africa, agribusiness incubation is slowly receiving attention to help transform the agricultural sector. Several agribusiness incubators recently established in Africa, including those established through ICRISAT, international groups supported through grant funding, and African governments setting up incubator hubs offer funding and business development assistance and initiatives for strengthening agribusiness capacity and education in various universities [8, 37, 38]. Agribusiness incubators in Africa are of three types: (1) agribusiness value chain/sector development incubators; (2) agricultural research commercialization incubators; and (3) technology transfer incubators [7]. Agribusiness value chain/sector development incubators are "one-stop incubators" with complex design structure, develops value chains or entire sectors, including those specializing in providing market access to small-scale farmers. Most often, research centers or universities implement agricultural research commercialization incubators. Technology transfer incubators nurtures a diversity of small-scale businesses focused on new productivity-enhancing farm products, consumer products and services for rural-urban links that benefit undeserved rural areas.

Crop related risks, access to long-term financing, and administrative hurdles are some of the many challenges that African agribusiness incubators face [8]. Despite these challenges, initial success is already noted especially the impact of incubators to integrate smallholder farmers into the agribusiness sector and facilitating job creation, especially for the youth [4, 8, 27]. For example, Afri Banana Products Ltd, an agribusiness innovation incubator for banana sector value-chain development, is a business incubation hub in Uganda established through ICRISAT. This incubator involves a consortium of public universities and research institutions that include Kyambogo University as the lead institution, Uganda Industrial Research Institute for agribusiness, Mbarara University of Science and Technology, Kenya Agricultural Research Institute, the Uganda National Council for Science and Technology. It identified and promoted entrepreneurs to take agribusinesses in the banana value chain. Activities include production of tissue culture seedlings, Matooke (Uganda's staple food), banana fiber products, briquettes and biogas using banana peel and other wastes through incubation. Since establishment in 2015, the incubator has, so far nurtured 39 entrepreneurs; commercialized six conventional and modern biotechnologies; and helped generate employment for over 420 people [39]. Table **1** presents few examples of agribusiness incubators that currently operate in Africa.

Table 1: Types of Agribusiness Incubation in Africa, their Features and Case Examples

Example	Crops/Products	Country	Type of Organization	Local	Source of Information
Type 1. Agribusiness Value Chain / Sector Development					
Technoserve	cashew, legumes, bananas, poultry	Mozambique	Non-profit	No	[40, 41]
Afri Banana Products Ltd	banana	Uganda	Non-profit	Yes	[38, 42]
2Scale	vegetables, fruit, dairy, poultry, rice, maize, and others	Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Mozambique, Niger, Nigeria, South Sudan, Togo, Uganda	N/A (Grant funded)	No	[8, 43]
BOMA Rural Entrepreneur Access Project	livestock	Kenya	Non-government organization	No	[8, 44]
ESAI: Ethiopia Sustainable Agribusiness Incubator	sesame, honey, dairy	Ethiopia	N/A (grant funded)	Yes	[8, 45]
One Acre Fund	farm inputs for maize and other crops	Kenya	Non-profit	Yes	[8, 46]
Type 2. Agricultural Research Commercialization Incubators					
CURAD: Consortium for Enhancing University Responsiveness to Agribusiness Development Limited	coffee	Uganda	Non-profit	Yes	[38, 47]
Uganda Industrial Research Institute	potatoes, peanuts, fruit, meat	Uganda	Government	Yes	[8, 38, 48]
AgBIT: Agri-Business Incubation Trust	mango and other fruits	Zambia	Non-profit	Yes	[38, 49]
WAARI: West African Agribusiness Resource Incubator	shea butter, honey, and tea	Mali	Non-profit	Yes	[38]
CCLEAr: Creating Competitive Livestock Entrepreneurs in Agribusiness	livestock and poultry	Ghana	Non-profit	Yes	[38, 50]
SVCDC: Sorghum Value-Chain Development Consortium	Sorghum	Kenya	Non-profit	Yes	[38, 51]
Type 3. Technology Transfer Incubators					
Acorn Technologies		South Africa	Non-profit	Yes	[33]
KFIE:Kenya Feed the Future Innovation Engine	dairy, livestock, horticulture and staple crops	Kenya	N/A (grant-funded)	Yes	[8, 52]
Timbali Technology Incubator	flowers, fruit, vegetables	South Africa	Non-profit	Yes	[8, 53]

Recently, membership groups, clusters and networks are being formed to support agribusiness incubation in Africa. For instance the African Agribusiness Incubators Network (AAIN), a private

sector-led initative based in Accra, Ghana and its more than 100 members are helping Afri Banana Products Ltd and other incubators help fill existing gaps and challenges, strengthen agribusiness incubation capacity and commercialize agricultural technologies and innovation in Africa [54]. AAIN serves individuals, organization or firms interested in agribusiness incubation in Africa while providing technical support in agribusiness development through incubation and mentorship, off-taking innovations and technologies from research for commercialization.

4. AGRIBUSINESS INCUBATION: ROLE OF AFRICA'S HIGHER EDUCATION

Higher education institutions (universities) are key institutions for the generation and transfer of knowledge and high-level skills that are critical to building and nurturing a knowledge-based economy [9, 10]. Increasingly, across the globe, higher education has become the central areas in government's knowledge policies. There is also a vast literature supporting claims that universities can contribute to economic revival and growth in their surrounding regions when they facilitate agribusiness development. This contribution of universities can come in various ways. Through its faculty, researchers and students, the university can conduct research that will address crop-related risks and develop crops that are climate resilient and yield enhancing, e.g., crops developed through modern biotechnology [55, 56]. Universities can also conduct upstream research that will benefit the agribusiness industry [15, 57, 58].

Repositioning African universities with emphasis on research, development and technology transfer requires an institutionalized IPR and technology transfer strategic policies and institutional support structures. These policies and support structures will help facilitate public-private sector technology commercialization. Universities do not often possess the expertise, resources or incentives to convert technological innovations to market-ready products, which the private sector has capacity and resources and can fill in. This cooperative agreement between university and private sector will ensure that research is relevant to the greater community and the universities have begun to have a more entrepreneurial orientation. Beyond collaborative research, private sector linkage of universities can facilitate creation of spin-off firms and investments in capital formation projects such as technology parks and business incubator facilities. Universities can also be involved in securing capital funding to build and support operations of technology parks and agribusiness incubator facilities [59, 60] that will support agricultural research commercialization and public-private sector linkages. Universities can also create its own spin-off firms out of university-based ideas and technologies [11, 61, 62]. Again, IPR and technology transfer policies and support systems at the national and institutional levels will provide researchers and future entrepreneurs with the incentive to engage in agribusiness activities and commercialization of new innovations. Furthermore, universities are hotbeds of creative talents for agribusiness and entrepreneurial activities. With the international climate of access to education and an internationalizing economy that rewards talent mobility, universities should provide the best training and provide local talents with agribusiness curricula that engage them with entrepreneurial endeavors [63, 64, 65].

The next section presents two case studies on a group of universities across Africa and Ghana on their agribusiness initiatives. Selection for the case studies included the following criteria: (1) agribusiness curriculum; (2) IPR/technology transfer policies to facilitate public-private sector partnerships for technology commercialization; and existing infrastructure and programs for agribusiness incubation such as (3) incubation parks or technology centers, and (4) spin-off firms.

4.1. Case Study 1: RUFORUM

The 2016 summit held in Cape Town, South Africa sponsored by Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) recently reemphasized the roles of universities in creating a pipeline of talent, generating scientific discoveries, driving innovations and regional economic growth from university research and commercialization of agriculture. RUFORUM, formed in 2004 as an international non-governmental organization, is a consortium of 67 African private and public universities helping transform agriculture in 26 Eastern, Central, Western and Southern African countries [66]. RUFORUM network is composed of over 30,000 faculty and non-academic experts, non-governmental organizations, regional R&D agencies, bilateral and multilateral donors and private sector. RUFORUM exists to: (1) foster regional centers of excellence and academic exchanges to produce the next generation of agricultural scientists; (2) connect universities to national agricultural research system, the private sector and rural communities; and (3) champion national and

regional policies supporting postgraduate agricultural training and research. RUFORUM is now central to the development strategy of Africa 2024.

4.1.1. Approach and Impact

The RUFORUM model uses a high advantage concept that brings about broad change in universities [67]. By operating in a network mode, RUFORUM creates economies of scale in achieving these objectives and delivering its services. Over the years, RUFORUM fulfills its mandate, through providing competitive sub-grants, undergraduate and post-graduate training, skills development, specialized training sessions, capacity building, resource mobilization, and intensive knowledge sharing. These activities expose member universities to both demand and opportunities to produce more relevant graduates and strategic research to serve poor rural communities, increase youth participation in enterprise development and business incubation [66]. The learning network for RUFORUM has been able to influence attitudes, curricula, and pedagogical standards. As of August 2016, RUFORUM has served over 1798 postgraduate students (1433 MSc and 356 PhD); 94% of RUFORUM scholars live and work in their country of origin. RUFORUM has also mobilized about 100 million dollars on behalf of member universities, awarded 348 grants and organized more than 400 networking events. Its Biennial Conferences attract over 700 participants from inside and outside Africa. Its impactful community action programs have drawn support from numerous funders from research organizations, universities, industry extension, government ministries and NGOs.

Collaboration among RUFORUM member universities and non-government organizations (NGOs) are also taking place giving students, staff, and farmers' access to the knowledge and facilities and commercialization of university-products that benefit smallholder farmers. RUFORUM universities are also building ties to business enterprises to provide role models, case studies and attachment opportunities [68]. For instance, the development of PREP-PAC, a product for nutrient replenishment in smallholder farms were co-developed by two of its members from Kenya: Moi University, University of Nairobi and local NGOs and now taken by entrepreneurs for distribution following the successful validation of its profitability by farmers in Western Kenya [68, 69]. University of Nairobi's legume inoculant for beans, cowpeas and groundnuts was licensed by MEA fertilizers and now marketed as BIOFIX® and is the only commercial inoculant produced in East and Central Africa for smallholder farms. When paired with BIOFIX®, legumes reduce or eliminate the need for nitrogen fertilizers. There are now many innovations from other RUFORUM member universities and innovations from these universities will increase.

4.1.2. Benchmarking Agribusiness Incubation

In terms of the four important components of agribusiness incubation program, a quick survey of RUFORUM member universities indicate that there are more universities with existing agribusiness curriculum in place while there are less proportion of universities with spin-off firms (Figure **1**). More than 60% (41/67) of the members have agribusiness curriculum to build students skills in agribusiness and engage them with entrepreneurial endeavors. More than 50% (35/67) of

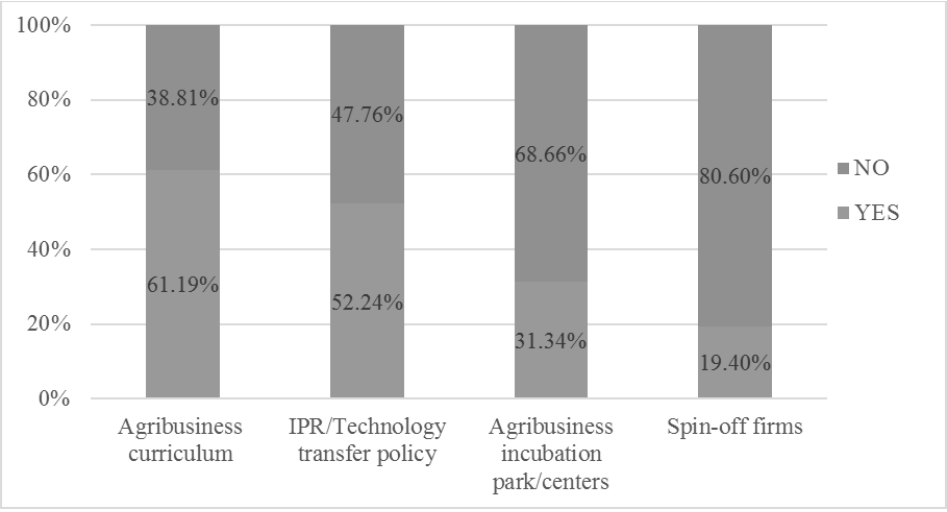

Figure 1: Proportion of RUFORUM member universities that have agribusiness curriculum, technology transfer policy, agribusiness incubation park/centers and spin-off firms.

these universities have IPR/technology transfer policies that guide the universities in managing university-based inventions such as in agriculture for patenting, licensing and private commercialization. Relatively few African universities (less than 40%, 21/67) manage agribusiness incubators or science parks at their institutions that serve as formal structures to develop, mature, and showcase novel technology solutions and nurture newly formed companies (less than 20%, 13/67).

4.1.3. RUFORUM in the Future

RUFORUM hopes to serve as a sustainable resource for Eastern, Central, Western and Southern Africa. More focus on sustainable value chains in both crops and livestock, and upscaling of its regional undergraduate and postgraduate programs in agribusiness are expected. New approaches in facilitating knowledge transfer through modern communication and pedagogical technologies; enhancing and impact evaluation of regional collaboration and integration along the agricultural value chain; and new investments to scale up university research outputs and operational uptake will all be explored and introduced effectively and sustainability to transform Africa's agriculture.

4.2. Case Study 2: Ghana's Higher Education Agribusiness Incubation Efforts

Ghana, a country on the West Coast of Africa, is one of the most thriving democracies on the continent. Arguably, Ghana is one of the countries that met most of the United Nation's Millennium Development Goals and central to this milestone is the improvement of the country's agriculture sector [70]. Ghana has a flourishing agricultural sector that produces a variety of fresh fruits and vegetables like pineapples, mango, papaya and tomatoes. Recent statistics on the growth of Ghana's agriculture provide encouragement to further agricultural development opportunities for the country. Like other advanced African countries and rest of the world, Ghana is looking at higher education as an important instrument for sustaining and further improving the country's development status [71]. Higher education sector in Ghana comprises six public universities, ten polytechnics, and three professional institutions, all operating under the oversight role of the National Council for Tertiary Education. The enrolment in these schools are expanding rapidly opening more education and career opportunities, especially for agriculture and agribusiness programs.

The Ghana case study focuses on agribusiness incubation in Ghana's public universities. Seven public

Table 2: Universities in Ghana and Agribusiness Institutional Capacity

CRITERIA	YES	NO
Agribusiness Curricula	Univ of Ghana KNUST Univ of Cape Coast Univ of Development Studies Univ of Energy and Natural Resources	Univ of Education Winneba Univ of Mines and Technology
IPR/Technology Transfer Policy	Univ of Ghana KNUST Univ of Development Studies	Univ of Cape Coast Univ of Education Winneba Univ of Mines and Technology Univ of Energy and Natural Resources
Agribusiness Incubation Park	KNUST Univ of Cape Coast Univ of Development Studies	Univ of Ghana Univ of Education Winneba Univ of Mines and Technology Univ of Energy and Natural Resources
Spin-off Firms	KNUST	1. Univ of Ghana 2. Univ of Cape Coast 3. Univ of Education Winneba 4. Univ of Development Studies 5. Univ of Mines and Technology 6. Univ of Energy and Natural Resources

universities in Ghana directly and indirectly offer courses that touch on agriculture. Applying the same analysis made for RUFORUM member universities, the level of engagement of Ghana's public universities is also uneven. Majority (5/7, 71%) of the public universities have agribusiness curriculum to build students skills in agribusiness and engage them with entrepreneurial endeavors. Less than 50% (3/7, 43%) of these universities have IPR/technology transfer policies and incubation parks that highlight university technologies and products. Only one of the public universities (Kwame Nkrumah University of Science and Technology, KNUST) has a spin-off firm and has agribusiness curriculum, technology transfer policies, operates an agribusiness incubation park and has start-up companies.

5. SUMMARY, CONCLUSION AND WAY FORWARD

Africa's agricultural development model will remain challenged as poverty, hunger and food insecurity due to burgeoning population impact the continent. Transforming agriculture from subsistence farming to commercialization of agriculture and strengthening the agribusiness sector can be a catalyst for addressing these challenges and help African agriculture fast track into 21st century productivity and growth.

Drawing from published reports and scholarly literature, this paper has discussed the agribusiness model as a platform for this transformation. Specifically, the paper has highlighted the opportunities and requirements for Africa to reap benefits from agribusiness and agribusiness incubation as a transformational process to strengthen the link of agriculture and business and integrate higher education institution into the agricultural value chain. It has also presented a documentation of some of the successful models and types of agricultural incubation in Africa, including discussion of existing gaps and challenges. Looking at two case studies, it presented the various initiatives and investments of RUFORUM member universities and Ghana's public universities in implementing agribusiness curriculum for youth development, setting up institutional IPR and technology transfer policies and support structures that nurture university-industry partnerships, and setting up infrastructure to encourage incubation of ideas coming out of university-research and formation of new firms.

Agribusiness activities and agribusiness incubation are gaining traction in many countries in Sub-Saharan Africa. Various initiatives are taking place in the region, including setting up of rural agribusiness incubators, capacity building, education, and agribusiness-linked knowledge transfer programs at different levels. Establishment of partnerships among stakeholders such as government, international groups and private sectors will continue to boost and encourage better value chain management for agriculture across the African continent. Findings also demonstrate that many African universities, including those that are RUFORUM member universities and Ghana's public universities have started undertaking efforts to institutionalize agribusiness and agribusiness incubation in their institutional agenda and as part of their outreach mission. As expected, the efforts, level of engagement and successes to support creation of enterprises and entrepreneurs from agriculture are not the same across the countries and institutions.

The case study of RUFORUM highlighted the importance of network to leverage and complement university resources for human development, capacity building in agribusiness, and policy setting in technology transfer and commercialization. This network will encourage convergence to Africa's higher education system, which is diversely structured along geographical, colonial, linguistic and structural lines. On the other hand, the case study on public universities in Ghana provides an encouraging result in terms of the presence of agribusiness curriculum in majority of the universities that can help generate graduates with academic foundation and entrepreneurial and business skills that are required in creating enterprises.

Overall, this review brought together evidence that agribusiness and agribusiness incubation can be one of the many tools to transform Africa's agriculture into a competitive sector. However, like any other developmental tools, they need to be nurtured, sustained and reassessed. Gaps and challenges remain but can serve as areas of opportunities with appropriate support, models and strategic investments in human capital, policies, infrastructure and partnerships. Additional suggestions include:

1. Agribusiness is diverse and there is not a "one size fits all" solution for all agricultural products. It needs to context-specific, by addressing issues of supply and demand. Demand should drive activities by countries and not by donors.

2. Conducting a benefit cost analysis of existing agribusiness incubation models is worthwhile

before other countries and institutions embark on developing and adopting the same models. There is a need for documentation and sharing of stories of direct benefits to smallholders.

3. Strong leadership, commitment and linkages between governments, public and private industries to strengthen Africa's agribusiness sector remain critical. Local government will be essential for institutionalizing an enabling policy environment, especially for regulation, market access, and financing. Universities in partnership with critical sectors in the value chain will be the key institutions for intellectual capital development and knowledge creation activities that address agricultural, business and societal needs. The expertise of industry, on the other hand, in agro-processing and value addition to agricultural products, as well as improved post-harvest operations, storage, distribution and logistics are very important.

4. Human resources development remains a high priority to transforming African agriculture into a business opportunity. Well-trained and skilled expertise in African universities and other core sectors will generate research outputs and knowledge vital to agribusiness development. More agribusiness workers need skills and training to increase the value of products, develop and manage businesses and build the capacity to adapt with change and risks. This is an area where African universities can collaborate with universities such as in the United States to develop training programs for research management, entrepreneurship and agribusiness management.

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