

**INNOVATION AND AGRICULTURAL EXPORTS: THE CASE OF SUB-SAHARAN
AFRICA**

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Abstract

The multifaceted nature of agricultural innovation makes it evident that technological, industrial, human and economic factors define and redefine agricultural innovation to new cultural and technological contexts. Juxtaposing the African condition to the earlier understanding of the cross cultural dimensions of agricultural innovation, this paper shall propose that technological insufficiencies in Africa shall necessitate the creation of an enabling environment and using an indigenous approach to agricultural innovation- where agricultural innovation shall basically use intellectual capital based on human potentials and also indigenous approaches to enhance long term economic growth in the African context especially in the area of trade liberalization and agricultural exports both within the region and outside the continent of Africa.

Introduction

Agricultural innovation is important for economic development in Africa (World Development Report, 2009). This outcome can be in the form of increased agricultural exports, although innovation has been slow in sub-Saharan Africa (van Rijn et al. 2012) and at times it is difficult to really understand what constitutes innovation (Landry et al. 2002). Because of the elusive nature of innovation, there is a need for policies that are proactive and realistic in reducing the agricultural crisis in Sub-Saharan Africa. The service sector can be improved by the use of extension services that disseminate information on the latest research on indigenous innovation. Indigenous innovation should be encouraged because it is sustainable and farmers are more willing to accept the technology because of their familiarity with the method of production.

Innovation is the new idea or ways of doing things, which can be new or familiar to the adopters (Barnett, 2004). Innovation in agriculture occurs through several means as a response to the disequilibria caused by the activities of entrepreneurs, when they exploit new opportunities, in the market place and not necessarily through agricultural research (Hall, 2009). In other words, the relationship between innovation and agricultural research is context specific. Taking into consideration the nature of economic activities in Sub-Saharan Africa it will be logical to encourage advancement of indigenous technology through local production of food where it is possible because this will create employment along the value chain and reduce ecological footprints. All innovations are not necessarily environmentally friendly. For instance, Crouch (1995) argues that biotechnology is not compatible with sustainable agriculture though there are dissenting views about this (e.g. Manion and Morse, Apr. 2013). Crouch (1995) suggests that there should be an active program that supports local production of food and reduces reliance on industrial agriculture.

This paper examines the nexus between innovation and agricultural export in Sub-Saharan African. This will be analyzed by taking into consideration the environmental sustainability of the innovative practices in Africa, focusing on indigenous mechanisms which might be less publicized or recognized. Finally, a conceptual framework is developed that explains the prevailing situation in Africa and the way forward.

This paper will specifically address the following issues

- A global assessment of innovation in agricultural exports bearing in mind the nexus between technology, indigenous approaches and trade liberalization in determination of the best practices of agricultural innovation in the modern world.
- An assessment of the position of Africa in the context of these global practices. Again in this aspect the benefits and the limitation of the global practices on the African condition should be critically assessed.
- An elaboration of Sub-Saharan African examples focusing on indigenous approaches that are less publicized but can be invaluable to the process of making the practice of innovation in agricultural export more sustainable bearing in mind the challenges of the political economy of Africa on trade, innovation and the practice of agriculture.

Agricultural Innovation in Africa: A Literature Review

Introduction

The agricultural sector is often addressed when discussing poverty reduction in various parts of the world. Part of the discussion focuses on the notion that innovation and advancement in agriculture is crucial to poverty reduction. Some believe the achievements in agricultural innovation have been very impressive as they have fueled agricultural productivity and increased food supply that outpaced population growth and increased personal consumption (Wright and Shih 2010). The notion of utilizing the agricultural sector for poverty reduction is complicated when taking into consideration the wide diversity of rural communities and the difficulties associated with mobilizing agriculture in very dire rural communities. Questions around agricultural advancement are also invigorated by a more specific criticism. Some claim that agricultural research and innovation has been developed, promoted and transferred in accordance with a model that is elitist, top-down, reductionist, supply driven rather than participatory, as well as commodity and productivity focused as opposed to emphasizing improved livelihoods and sustainability (Sumberg 2005).

Trade liberalization: A framework for agricultural innovation?

The success of agricultural innovation and the potential for utilizing agricultural innovation as a tool for poverty reduction largely depends on the examination of the framework under which innovation in the agricultural sector takes place (Tendler 1993; Urey 2004; Rijn et al. 2012). It is the framework that largely decides the type of innovation that will occur and where and how it will be transferred. As suggested above, there are elevated criticisms regarding agricultural innovation. Read and Parton (2009) examine the role of trade liberalization in Eastern Africa. Trade liberalization was supposed to encourage economic growth and provide developing countries with a better chance of competing on the level of international markets. In the 1990s, trade liberalization was accepted as the most successful means of economic growth and development (Hinderink and Sterkenburg 1985; Hunter 2003 as cited in Read and Parton 2009). Trade liberalization was touted as to guaranteeing sustainable economic growth by increasing access to world markets and international competition and improving efficiency in domestic markets. Others have also argued that it can improve the targeting and distribution of resources, improve intermediate goods, improve access to technologies and generate innovation (Dornbusch 1992; Winters, McCulloch and McKay 2004). Hinderink and Sterkenburg (1985) and Winters et al. (2004) believe trade liberalization gives developing countries the opportunity to specialize in an area where they have an international advantage. This allows countries to be more efficient in allocating resources and faster dissemination of technology. On a more local level this is a way to create new jobs, increase income, reduce prices for domestic consumers and develop skill sets. Winters et al. (2004) suggest that trade liberalization can also limit government corruption and ineffectiveness, further advancing the growth of developing countries.

Others are more critical of trade liberalization. Brooks and Loevinsohn (2011) claim trade liberalization has contributed little to the agricultural sector over the past few decades, especially in Africa. Trade liberalization's foundation rests upon the notion that state intervention is unnecessary and harmful to development. The acceptance of trade liberalization as a tool for development resulted in the elimination of regulatory controls in agricultural inputs

and outputs as well as subsidies and in some cases privatizing state-owned agricultural organizing (Urey 2004). Although these may have resulted in some positive outputs, in many poorer rural areas, these changes have been harmful. In terms of initiating cereal based intensive growth in poorer areas, the private sector has not provided farmers with inputs, outputs or services that are well priced, timely and reliable (Urey 2004). Some claim trade liberalization can negatively impact the economic development of developing countries and hinder technological development (Read and Parton 2009). Trade liberalization as a tool for development and reducing poverty assumes strong and functioning capital markets, banking systems, institutional and technical capacity, distribution networks, property rights and regulatory frameworks (Read and Parton 2009). These, however, may not be present in many developing countries, especially within Africa.

Trade liberalization in Sub-Saharan Africa

Some also claim the poverty found in Sub-Saharan Africa has been exasperated as the result of World Bank and International Monetary Fund (IMF) policies and programs such as Structural Adjustment Policies (SAPs) (Tendler 1993; Urey 2004; Sachs 2005 as cited in Read and Parton 2009). Urey (2004) claims Sub-Saharan Africa has been the greatest victim of SAP's reductionist model. In the 1990's the reduction of global poverty was less than half the rate required to reduce poverty by 50 percent in 2015. In Sub-Saharan Africa, poverty reduction was far less than the global level. Tendler (1993) claims that although economic analysis may predict great improvements, trade liberalization programs do not produce significant outputs, yields or income. Huwart's (2002 as cited in Read and Parton 2009) study claims that after trade liberalization policies and programs were introduced to Africa, Africa's share of world markets fell from 5 percent to 2 percent. Critics also state that trade liberalization can increase inequality, undermine democratic values, can contribute to the destruction of infrastructure due to lack of government intervention and often encourages hostility rather than respect and empathy (Read and Parton 2009).

Brooks and Loevinsohn (2011) assert that the 2007-2008 and 2010-2011 food crises were the result of an inadequate framework under which agricultural innovation takes place. The Food and Agriculture Organization (FAO) (2009 as cited in Brooks and Loevisohn 2011) report claims the food crisis was not a result of poor harvests but due to a global economic crisis, which disproportionately impacted the poor. Read and Parton's (2009) evaluation of trade liberalization in Tanzania, Kenya and Uganda illustrate that since deregulation took effect in the late 1980s and early 1990s, these countries have experienced an increasing deficits rather than gains. Uganda was the only country to have a positive trade balance at one point between 1980 and 2007. Overall however, Uganda's trade deficit increased from US \$300 million to US \$1300 million between 1990 and 2007 (Read and Parton 2009). Tanzania's deficit in 2007 was US \$2600 and Kenya's US \$4300 million (Read and Parton 2009). It is based on this evidence that Read and Parton (2009) conclude that trade liberalization does produce growth and has failed in producing sustainable growth.

An example of the framework in Sub-Saharan Africa

The elitist and top-down model towards agricultural innovation has negatively impacted the agricultural sector in Sub-Saharan Africa. Maize was introduced to Africa as a cash crop by European settlers. Maize became a staple for several post-independence African countries,

including Kenya, Malawi, Zambia and Zimbabwe. In the post-independence era there was a lot of optimism surrounding maize (Brooks and Loevinsohn 2011). High yielding hybrid maize originally developed for European farmers during the colonial era was part of a package to modernize the agricultural sector and improve national food security and economic growth. By the mid 1980s the optimism for maize was compromised due to mixed results. McCann et al. (2007 as cited in Brooks and Loevinsohn 2011) attribute some of the failure to the notion that the agricultural innovation system was developed to meet the needs of the European commercial farmer, rather than small farmers, who in terms of acreage, dominate maize cultivation in Sub-Saharan Africa.

In the 1990s the focus in Sub-Saharan Africa began to shift to small farming systems (Hinderink and Sterkenburg 1985; Cecarelli and Grando 2007; Brooks and Loevinsohn 2011). Participatory research methodologies recognized the value of small farmers' knowledge and their ability to adapt to various environments. The farmers and users are included in the decision making process of the innovation. An example of this methodology is participatory plant breeding (PPB). Within this methodology, varieties are developed to suit local conditions in less favourable farming regions. PPB allows those often silenced by the elitist model to voice their opinions including women and poor farmers. The three major differences between conventional plant breeding and PPB are the testing takes place on a local farm, not a research station; decision making includes farmers and reproduction of the process to a wide variety of locations (Cecarelli and Grando 2007). A wide variety of programs have been developed under this framework. PPB has been very successful amongst female farmers growing subsistence crops such as pearl barley and phaseolus bean (Brooks and Loevinsohn 2011).

A more recent example of an elitist and top-down program for farmers in Africa can be found in Malawi. The government of Malawi introduced a maize seed and inorganic fertilizer combination as a response to the 2004-2005 and 2008-2009 food crises. The Fertilizer Subsidy Program (FSP) was to encourage farmers to use higher yielding hybrid seeds and inorganic fertilizers as a way to break what was perceived as unproductive subsistence farming. The program was to also minimize country's food aid (Chinsinga 2007; Brooks and Loevinsohn 2011; Dorward and Chirwa 2011). Some authors believed the program worked as it increased the country's food availability, increased income and reduced poverty (Chinsinga 2007). Others continue to question the economic and environmental sustainability of the program (Dorward and Chirwa 2011). Others have argued that the support for maize in Malawi developed a dependence on maize, which some have attributed to the 2001-2002 famine (Andersson 2011; Dorward and Chirwa 2011). Some claim the introduction of inorganic fertilizers does not address the underlying causes of the famine (Brooks and Loevinsohn 2011; Dorward and Chirwa 2011). Research illustrates that during the famine, people gravitated towards areas growing cassava. Farmers grow more cassava when their maize crops are poor. Studies also suggest that this crop should be incorporated into regional food security plans as a buffer crop as well as a potential for value added products. Brooks and Loevinsohn (2011) suggest investing more resources into research and potential of cassava, rather than continue investing in maize.

Despite evidence that suggests further investigation into cassava, international donors and research bodies continue to focus on hybrid maize development programs. Since 2008, two large scale maize breeding programs have been launched, the Drought Tolerant Maize for Africa and Water-Efficient Maize for Africa. Brooks and Loevinsohn (2011) argue these programs do not take into consideration the lessons learned from the PPB programs, as they leave very little room

for farmer input, adaptation and evolution of ideas. The Malawi famine points to the limits of the maize-based programs but also helps realize the potential of local and farmer based strategies, as illustrated by the cassava example. The potential of adaptive strategies in Malawi are however, underestimated and not taken into consideration in the maize-dependent economy. Plant breeding remains a much closed activity that does not take into consideration informal seed systems. The question is whether the plant breeding system is decentralized and how to develop a successful communication system between the formal and informal system.

Another example which illustrates the failure of agricultural innovation policy in Sub Saharan Africa is the case of livestock in West Africa (Patrick and Russo 1987). Livestock yield is of great political, religious and social importance in that region and yet most policies around livestock have not been successful. An example of a project was the Mixed Farming and Resources Management Project in Gambia from May 1981 to June 1986. The project was to encourage intensification of livestock and integration into the existing farming system. The project called for the fattening of cattle with maize. This was never extended to farmers, as it was not socially accepted to take grain away from the family to feed cattle. Patrick and Russo (1987) blame improper design for the failure of livestock policies and programs. Agricultural innovation must take into consideration the knowledge of the region and the people to evaluate the potential of the innovation. .

Agricultural innovation

Agricultural development and more specifically innovation in agriculture are different than in any other industry (Biggs and Clay 1981; Brooks and Loevisohn 2011). Innovation in farming is uniquely dependent upon the environment, on its biological processes, natural selection, genetic vulnerability and various instabilities. The environment play a significant role in the direction the industry takes. Although some aspects of the environment can be controlled via capitalization, Biggs and Clay (1981) argue this is only possible in industrialized farms. The environment and climate largely determine the type of seeds planted as well as the methods of cultivation. Environmental diversity is also essential in the discussion of agricultural innovation transfer between different environments or geographical locations.

Thornton et al. (2011 as cited in Brooks and Loevisohn 2011) and Wright and Shih (2010) foresee rapid changes in the food system stemming from a variety of sources including climate change, an increasing population, increasing urbanization, income growth and the globalization of diets. Global interdependence of food supplies, changing demands on kinds and amounts of resources used, changing policy environments and roles of institutions, the increasing interventions by the private sector and civil society and liberalized markets alter the nature of agricultural innovation and may also act as obstacles for agricultural innovation (Hinderink and Sterkenburg 1985; Urey 2004; Wright and Shih 2010). Although these are global changes, they will have very specific impacts at the local level. Increasing temperatures as a result of climate change will also force many producers to quickly change methods and systems. Brooks and Loevisohn (2011) argue these changes present novel challenges to farmers, disproportionately impacting middle and low income farmers who, they claim, play a significant role in eliminating poverty in developing countries. As such, incremental adaptation found in formal systems will not be sufficient in providing support during these changes.

The model under which maize programs are developed in Africa reflect the interests of private sector and discourage diversity and seed exchange between individual farmers (Brooks

and Loevinsohn 2011). This is an example of an innovation system that is supply driven and set by international actors and donors. Some authors suggest it is the lack of organized farmer demand for agricultural innovation, which impacts the accountability to citizens (Tendler 1993; Brooks and Loevinsohn 2011). Farmer organizations, civil society actors and other mediators have had limited access and impact to agricultural innovation processes or are often ignored during the innovation process. Some argue that it is the interdependence among the various actors and the joint learning, networking and social interactions between them will contribute significantly to the success in an agricultural sector in Sub-Saharan Africa (Rijn et al. 2012). Rijn's et al. (2012) study in Africa suggests that social capital and innovation are positively linked as improved social capital can help in the developed of innovation, the transfer of information as well as the reduction of transaction costs.

Agricultural innovation is also distinct from other industries in that it possesses a large number of producers and there is potential for great flexibility and combinations of inputs (Biggs and Clay 1981). Not only can agricultural research institutions innovate, but so can farmers. Within agriculture, every farmer has the potential to innovate to some degree. They can do so with seeds, animals, using novel technologies they have or have not developed themselves. The notion that the farmer interacts with the physical, socio-economic and the ecological environments all play a role in technological developments and their usage. Farmers themselves play a role in how technological innovation is adapted to suit various circumstances. A common example found in the developing world is turning a diesel pump set into a mobile piece of equipment by mounting it onto a cart or boat and offering services for sale (Biggs and Clay 1981). Informal innovation was most common in the developing world until after World War II (Biggs and Clay 1981). As such, many of the current agricultural technology stemmed from informal innovation. Local farmers' detailed knowledge of local environments and lack of knowledge and access to technological potential makes informal innovation systems in agriculture very common in the developing world.

Although informal innovation is common, Hinderink and Sterkenburg (1985) suggest that majority of investments in the agricultural sector are put into technology that benefits large corporate farmers and leaves little room for spontaneous innovation for small farmers as they are sometimes seen as a threat to government organizations. Resources are also geared towards the needs of international and private sector rather than local needs. As such, agricultural research and innovation is geared towards improving the capacity organizations via direct funding and technical assistance (Tendler 1993). The opportunity for farmers to innovate can be questioned as patenting of seed technologies has been increasing and has made significant impacts in the developing world, including Sub-Saharan Africa. Rijn, Bulte and Adegunle (2012) claim that innovation among small farmers is very slow in promoting the adaptation of new technology, even if the technology was successful locally. However, even in such cases, farmers perform adaptive innovation. An example includes the exchange and development of restricted genetically modified seeds by Gujarati farmers. These farmers were also successful in stopping the government from destroying the restricted crops (Wright and Shih 2010). Global political and economic factors also play a role in where agricultural innovation can take place and where and how the innovations will be transferred. These factors can result in disproportionate distribution of benefits that agricultural innovation can yield.

Pant and Odame (2010) indicate that a framework that encourages the linkage between Research and Development and entrepreneurship, especially when it comes to adding value to

agricultural production and specifically in the context of high value agriculture should be encouraged. This is referred to as the systems of innovation, a situation where the stakeholders including the public and private sector (especially non-profit) are involved in the innovation process. According to Juma (2011, p. 51) 'A more realistic view is to treat economies as "systems of innovation." The process of technological innovation involves interactions among a wide range of actors in society, who form a system of mutually reinforcing learning activities. These interactions and the associated components constitute dynamic "innovation systems." Furthermore, the advancement of indigenous knowledge requires the recognition of the role of emerging technology and the development of appropriate institutions (Juma 2011).

A novel model for agricultural innovation

Brooks and Loevinsohn (2011) argue for agricultural innovation system that enhances community capacities, builds flexibility and resilience to shocks. They refer to this as "systems of innovation". Formal agricultural innovation systems seek to re-establish stability rather than strengthen the ability to accept and thrive in times of rapid change. For Brooks and Loevinsohn (2011) the move towards a 'system of innovation' begins with how innovation is defined. For them innovation is "a cumulative process that is path dependent, but open to change" (Mugwagwa et al. 2010 as cited in Brooks and Loevinsohn 2011). This type of innovation moves away from formal research and development to a more holistic method which contains a wide range of actors, institutions, policies on both the demand and supply side. It is often the users that encourage this type of innovation and drive research and extension to do better (Tendler 1993). This approach to innovation has not been common due to the dominance of the formal, elitist, top-down model of which trade liberalization is part (Tendler 1993; Sumberg 2005; Brooks and Loevinsohn 2011). It is thereby not clear how an alternative innovation system would impact the agricultural sector and poverty reduction in Sub-Saharan Africa (Brooks and Loevinsohn 2011).

The agricultural innovation system (AIS) is defined as a "set of agents (individuals, organizations and institutions) that contribute to the development, diffusion and use of new agricultural technologies and that directly or indirectly influence the process of change in agriculture" (Brooks and Loevinsohn 2011: 186). Here innovation stems from the actions and interactions that take place between actors. The boundaries of innovations are thereby not set and evolve over time. Agricultural innovations can vary in terms of scale, inclusiveness, density of interactions and knowledge flow. Barnett (2004:1 as cited in Horton et al. 2010) defines innovation as a process that involves "the use of new ideas, new technologies or new ways of doing things in a place or by people where they have not been used before". Rogers (1983 as cited in Patrick and Russo 1987) utilizes five characteristics that define successful innovation. They include compatibility of the innovation with existing values and history, the innovation must be perceived as better than the previous concepts, the innovation must have the ability to be experimented with by farmers, the benefits must be observed by the farmers and finally the innovation must be easily explained and understood by farmers (Patrick and Russo 1987).

Leeuwis and Ban (2004 as cited in Rijn et al. 2012) believe that innovation is shifting from a linear and exogenous 'technical device' to a systemic and endogenous 'novel working whole'. The emphasis is placed on the process rather than solely the outcome. Hall (World Bank, 2006 as cited in Brooks and Loevinsohn 2011) outlines two ways in which innovation can arise. Within the 'orchestrated trajectory', governmental intervention is responsible for agricultural innovation. Clear goals and centralized coordination play a significant role here. However, this

system can be often closed to a wider set of actors. Private and non-governmental sectors are responsible for innovation within the 'opportunity-driven trajectory'. Here, innovation is more responsive to markets and environmental changes as well as open to new actors and knowledge systems that allow innovation to evolve. This trajectory is threatened by the lack of coordination that will allow it to expand to other areas. Brooks and Loevisohn (2011) claim the best type of trajectory from which innovation should arise is one that includes elements from both. The balance between coordination and openness will be significant in responding to the unique and unforeseen challenges in the farming sector. Brooks and Loevisohn (2011) argue for agricultural innovation that takes into account and benefits from the multifunctionality of agriculture, such as protecting biodiversity and local culture; one that encourages diversity and builds capacity from the bottom-up.

Finding a way to formulate constructive relationships between formal and informal innovation systems that operate at different levels is also of great importance to the sustainability and success of agricultural innovation. This form of communication can begin in the development stages of the innovation process. Wright and Shih (2010) suggest that the lack of resources and investments applied to agricultural research and innovation can improve with public-private partnerships of which there are very few. These are few because they are difficult to establish, they come under greater scrutiny and if not established appropriately can weaken the regulatory role of the government. From a trade liberalization perspective, these collaborations can discourage innovation and technology adaptation, due to the high costs of regulatory compliance (Wright and Shih 2010). Read and Parton (2011) claim that even public-private partnerships are dominated by elitist and corporate funding which continues to silence the voices of alternative opinions and wider stakeholders. Successful and sustainable partnership in Sub-Saharan Africa ought to take into consideration the history, race and power relations and distribution. These partnerships should be a tool of organizing research rather than an end in itself (Read and Parton 2011). In some cases, Rijn et al. (2012) suggest that the history and norms of a region may promote conservatism and conformity which may limit creativity.

Horton et al. (2010) also remind us that agricultural research does not equate with innovation. It was assumed that research results flow through the 'innovation pipeline' from basic research to the development of strategy to the application of research. The relationship between the various stages is not that simple, but rather complex and interactive. Hall (2009 as cited in Horton et al. 2010) argues agricultural innovation is rarely triggered by research and is often a response to entrepreneurs who faced a novel market opportunity. Successful agricultural innovation required the input of various actors and constant interaction between the various actors. The interactions are often context specific which is shaped by history, culture, politics and policies. Improving the levels of knowledge, attitudes, skills and social capital will strengthen the capacity to innovate and will have greater and long lasting impacts (Horton et al. 2010; Rijn, Erwin and Adekunle 2012). Strong social capital plays an important role in adapting novel agricultural technologies (Rijn et al. 2012).

From an economic point of view, studies illustrate that risk, heterogeneity, consumer preference, political interests and the appropriateness of the technology are all crucial for adaptation of agricultural innovation by farmers (Hinderink and Sterkenburg 1985; Wright and Shih 2010). Wright and Shih (2010) suggest that if a technology or innovation is very attractive, the farmers will not only adopt it quickly, but will also partake in adaptive innovation themselves, indicative of what regulations or policies state. Innovation can at times be hidden as

a form of tacit knowledge which can only be acquired through social interaction and informal structure. However, the informal innovation system also has its limitations including the lack of ability to transfer innovation and the lack of ability to anticipate long term opportunities or challenges (Biggs and Clay 1981). The limitations of the informal system leave room for formal innovation systems for exploitation.

The Forum for Agricultural Research in Africa (FARA) developed an idea referred to as Innovation Platform (IP) that encourages the participation of the local stakeholders in the development of innovation. This project has three pilot schemes in three corridors in SSA and success has been recorded though sustainability might be a problem because the initiative is from FARA. 'Innovation Platforms serve as the environment for diagnosing problems, exploring opportunities and investigating solutions. The IP actors are organized in partnerships/teams to bring about mutually desirable change, are competent and have incentives to jointly innovate and are constituted to include sources of the key competencies and knowledge required to address the problems, opportunities and/or entry-points that prompt its establishment' (FARA 2010 p. 2)

There are presently three IPs in SSA. The Kano-Katsina-Maradi (KKM), Lake Kivu and the Zimbabwe-Malawi-Mozambique (ZMM). The involvement of indigenous knowledge and informal innovation in the IPs has led to successes such as: The KKM Pilot Learning Site in the Sahel under the vegetable IP has produced a scenario where vegetables can be produced under the rainy season. The Musawa Cereal/Legume IP in Katsina State and the Bunkure Cereal/Legume IP in Kano State has been scaled up while Natural Resource Management technologies have been adopted in the Ikarra Maize/Legume IP in Kaduna State of Nigeria (FARA 2010).

In the case of Lake Kivu Pilot Learning Site, there has been the development of improved cassava cuttings for better yield in Congo, the quality and post-harvest handling of potatoes have improved in Rwanda to the extent that farmers are now well connected to the hotels and supermarkets in Kigali. And in Uganda, a traditional sorghum variety is now used for producing non-alcoholic sorghum juice (Mamera) and this value addition is done by local processors (FARA 2010)

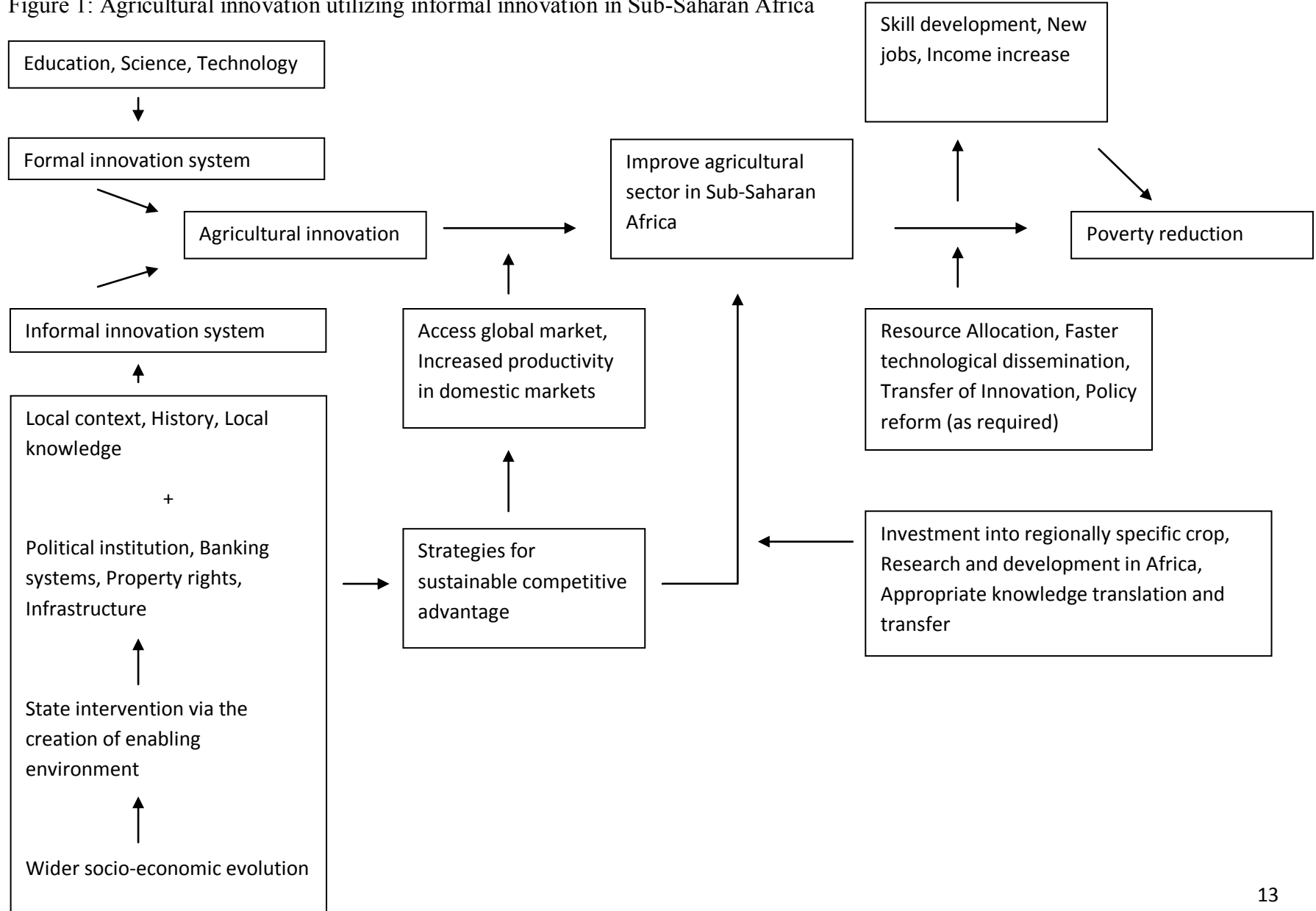
Conceptual Framework

In this section, we present our conceptual framework on how agricultural innovation can be enhanced through the appreciation of the role of informal innovation. As presented in Figure 1, Agricultural innovation for the purpose of poverty reduction does not only occur via the avenue of formal innovation which stems from formal education institutions such as schools, universities and research institutes. Formal education often encourages innovation through conventional methods of science and technology. Science and formal education stress objectivity universality, rationality and logic. The focus on these criteria often limits the types of ideas and knowledge that are considered having potential for innovation and other social goals such as poverty reduction. The informal innovation system, on the other hand takes into consideration knowledge

types that fall outside the formal knowledge system. Local context, culture, history and people's local experiences and knowledge are very important and can produce ideas that are innovative, sustainable and successful. Informal innovation systems can create unique and diverse ideas and products that can build resilience against crises in the global market economy. It is important to mention that formal and informal innovation systems can operate alongside one another. For local knowledge to proceed from a knowledge system to an innovation system, it requires infrastructure to aid in that transition. In addition to having the suitable and appropriately functioning political institutions, banking systems and property rights, it is important to recognize the potential and validity of knowledge and ideas that local experiences and local people can bring forward. For example the PPB programs have been successful as it allowed small farmers, who are often ignored in the decision making process, to view their experiences and perspectives (Brooks and Loevinsohn 2011). It also helped engage female farmers who are often neglected by the elitist programs of agricultural innovation (Brooks and Loevinsohn 2011).

The validity of local and indigenous knowledge ought to be woven through the policies and programs supporting innovation. This means policies would be context specific and suitable for local conditions, rather than formulated using a generic formula (Read and Parton 2009; Horton et al. 2010). Taking the local context and indigenous knowledge into consideration also shifts the focus from market issues to social betterment, community and nation building during the process of policy development. The roles of institutions in SSA can also change as a result. Nevertheless, institutions are essential to the success of informal innovative system as much as the formal innovative system, if not more. Informal agricultural innovation requires intervention of the state to create environments that will encourage and enable indigenous knowledge to thrive and be translated into practical and successful innovations. The acceptance of indigenous knowledge as a valid form in the decision making process, will also require a larger social change that accepts indigenous knowledge as a valid form of knowledge with potential of creating successful solutions. Sub-Saharan Africa has been operated under the elitist system for an extensive amount of time and it may be difficult to accept indigenous knowledge as a tool for agricultural innovation.

Figure 1: Agricultural innovation utilizing informal innovation in Sub-Saharan Africa



The contributing factors of the informal innovation system have the potential of creating strategies for sustainable competitive advantage. This can increase access to global markets and increase productivity in domestic markets, which will aid in transforming agricultural innovation into a tool for improving the agricultural sector in SSA. A strategy for sustainable competitive advantage, based on the criteria that contribute to informal innovative systems, such as local context and indigenous knowledge also significantly contributes to improving the agricultural sector in SSA. For those strategies to be successful in improving the agricultural sector, several factors are necessary, including investment into regionally specific crops, research and development in SSA, appropriate knowledge translation and transfer. Investment into crops such as cassava and sweet potatoes can help during periods of food crises and famines. An example of the Malawi famine demonstrates the significance of diversifying agriculture and strategies as well as the ability of local people to adapt during periods of stress (Brooks and Loevinsohn 2011). Research and development is also necessary but should not be limited to the conventional methods of research and development that are encouraged under the elitist models. This limits the type of innovation that can occur (Hinderink and Sterkenburg 1985; Horton et al. 2010; Riji et al. 2012). Taking into consideration indigenous knowledge and utilizing more participatory and joint learning methods can create innovation that is linked with social capital (Riji et al. 2012). Innovation linked to social capital can directly improve their communities by utilizing innovation that is suitable to their local context and can also empower local communities by giving them credit for their contribution.

For poverty reduction to occur as a result of improved agricultural sector, it is necessary to allocate appropriate and necessary resources as well as policy reform. This will help transfer innovation via suitable outlets and to those in need of the agricultural innovation. It will also increase the speed of technological dissemination. Agricultural innovation that was developed with the consideration of local voices is more likely to be supported and adapted by those people. This is in contrast to the elitist, dominant agricultural programs that often seek to improve their own capacity and are not open to sometimes much needed collaborations (Tendler 1993; Wright and Shih 2010). Tendler (1993) illustrates that dissemination is most successful when groups such as small farmers are involved and their work, experiences, knowledge and challenges are validated. The inputs of resources, policy reform, transfer of innovation and technology dissemination can create novel employment opportunities, increase income and develop new sets of skills. This can directly help reduce poverty. Although some argue that there is a lack of focus on agriculture and agricultural innovation as a tool for poverty reduction overall (Urey 2004; Sumberg 2005), it is important to also take into consideration informal innovation systems as a valid, sustainable and successful way of reducing poverty in SSA.

Conclusion

It is precisely because of the unique challenges the agricultural industry faces that the system of agricultural innovation has to be examined. It is important to recognize the lack of success in the elitist framework and trade liberalization and find an alternative strategy for improving the agricultural sector in Sub-Saharan Africa. In addition to the notion that many developed countries have double standards in terms of protecting their own markets and expecting high levels of trade liberalization they expect from developing countries, trade liberalization was produced and implemented without considering the opportunities and challenges in the developing world. Judd et al. (1987 as cited in Wright and Shih 2010) and

Hinderink and Sterkenburgh (1985) suggest that it is the lack of interest and investment in regionally specific crops, such as cassava and sweet potatoes in the 1970s that relates to the low influence and input from staple food producers and small farmers in further agricultural research and innovation agendas. Investment into agricultural research and innovation is generally increasing in all continents with the exception of Africa (Wright and Shih 2010). Ceccarelli and Grando (2007) suggest the reason for such unbalance between the agricultural innovation and technologies developed by formal methods and the small amount that are utilized by farmers is the lack of input from the local farmers and environment. The improvements in agriculture as a result of trade liberalization have generally not occurred in Sub-Saharan Africa. It appears that too much effort may have been put into market forces and too little into the assumptions of the market and the conditions necessary for those market forces to operate successfully (Hinderink and Sterkenburgh 1985; Read and Parton 2009; Rijn et al. 2012). A change in the way indigenous experiences and knowledge are recognized is also required. As Horton et al. (2010) claims, it is not only about developing new skills and creating new jobs, it is the issue of profound changes in attitudes and perceptions and the systemic and cultural levels. This change can lead to significant improvements in poverty reduction. The knowledge and understanding of the informal innovation system that is so prominent in Sub-Saharan Africa is important in developing a thriving agricultural sector in Sub-Saharan Africa (Biggs and Clay 1981).

Furthermore, there should be a framework that supports a common agricultural market with similar products that boost intra-regional trade, and dumping should be discouraged because it can serve as a dis-incentive for the development of informal and indigenous innovation (Mazoyer and Roudart 2006; Adekunle and Gitau 2013). In as much as boosting regional trade is important for economic development, innovation will still not advance if the environment is not conducive and appropriate. An enabling environment can be created through workable and desirable policies that promote stable prices, support international agreement on a product by product basis, redefining of property rights through guaranteed access to land and security of tenure (Mazoyer and Roudart 2006). On a final note, we recommend research and development that enhances the improvement of indigenous technology and informal generation of ideas with emphasis on best management practices that leads to sustainable development.

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