

## Supporting bioscience innovation in Eastern Africa: the role of the public sector

### Introduction

One of the great challenges of this century is to feed a world population of well over 9 billion without significantly expanding the land area devoted to agriculture. But apart from the dramatic global increase in demand for food and feed, there is also a rapidly growing demand for non-food, non-feed agro-industrial products for applications spanning many sectors, including chemicals and energy.

Increasing the quality and quantity of primary agricultural products is key to raising the potential for economic growth in Eastern Africa. Smallholder farmers in the region produce more than 75% of the total agricultural output, but are to a large extent unable to increase their productivity.

The question is, how can smallholder farmers be connected to markets, value chains and agro-processing opportunities? Making these connections can be one of the most important ways to increase agricultural productivity, decrease poverty and improve rural livelihoods. In particular, the agricultural and agro-processing sector in Eastern Africa is a vital part of the economy and crucial for creating demand and value chain opportunities for farmers. So, a sustainable transformation of the agro-processing sector so that it is more effective and innovative will add value to the primary production of smallholders, improve agricultural productivity, create new jobs and boost profits for farmers and agribusinesses.

At the same time, global trade regimes, growing demand for renewable bio-resources and the revolutionary advances in the field of biosciences are changing conditions for the agricultural sector worldwide. Countries without competence to use modern biosciences are at a disadvantage when it comes to developing productive, resource efficient and environmentally friendly systems for crop production and agroprocessing of food, feed, and value-added agro-industrial products.



© S.Kilungu / CCARF / Flickr

### Key messages

- Applied modern bioscience is slowly but surely penetrating the agricultural and agroprocessing sector in Eastern Africa improving its sustainability and productivity.
- The public sector has a central role in adopting and disseminating promising bioscience innovations to agricultural and agroprocessing actors in Eastern Africa. A strong public sector research base is therefore a crucial condition for knowledge development, innovation and deployment.
- Structural and policy constraints, rather than scientific and technical knowledge, are the main barrier to bioscience technologies contributing to a more dynamic agricultural and agro-processing sector.
- The main structural and policy constraints are: a) unfavourable conditions for entrepreneurship, both in the private and public sector; b) weak markets and ineffective or absent market incentives; c) unfavourable and disconnected policy regimes; and d) severe lack of access to affordable financing and credit.
- Relatively modest improvements in institutional infrastructure, national and institutional policies, priority setting, and modest but well-targeted investment can greatly enable public research institutions and universities to act as hubs for local innovation. Many improvements could be made in the short term and at moderate cost.

### The BEA study

Our study – Supporting Bioscience Innovation in East Africa: the Role of the Public sector (BEA) – investigated agricultural biosciences and agro-processing innovation systems in Uganda and Tanzania. The study, funded by Sida, was carried out from 2011 to 2015 by Stockholm Environment Institute (SEI), the Tanzania Commission for Science and Technology (COSTECH) and the Uganda National Council for Science and Technology (UNCST).

With the aim of empowering small-scale farming systems, the study evaluated ways to strengthen the ability of, and options for, public institutions to strategically adapt biosciences to local needs, as well as traditional African crops and agroprocessing systems. A central issue was to investigate to what extent public institutions in Eastern Africa can move beyond research and forge formal links with other parts of the innovation chain.

In Europe and North America, bioscience innovation is largely driven by the private sector (although public interventions have also been important as a source of R&D funding, regulation and incentives). But in most parts of Africa the private sector alone is not yet sufficiently capable or incentivized to drive forward bioscience innovation. As a result, in Eastern Africa there may be a need for a stronger emphasis on the so-called “triple helix” model (see Figure 1), in which the private sector,

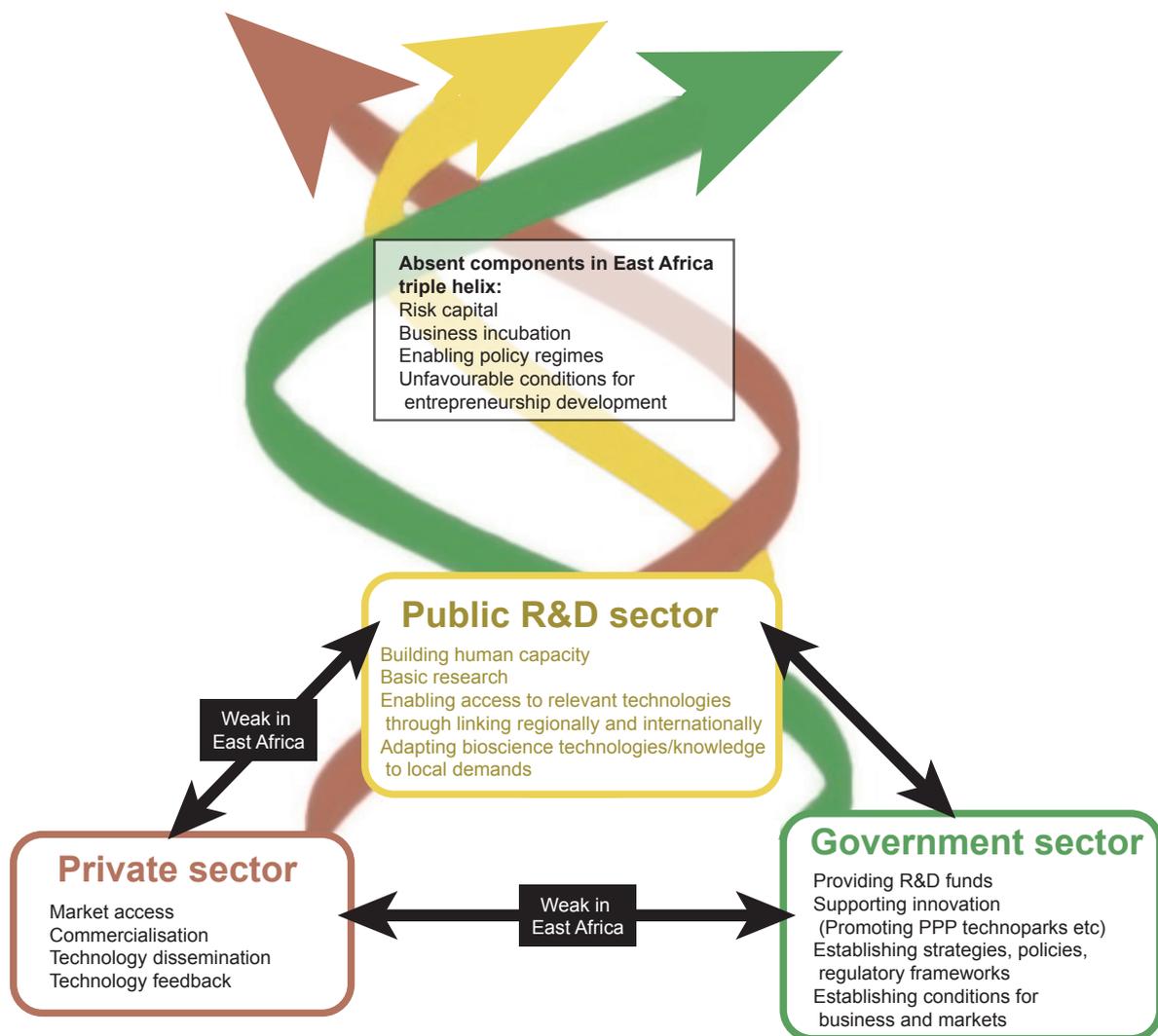


Figure 1: Model of triple helix linkages between the private sector, public R&D sector, and governments in Eastern Africa

**Box 1: What key processes support the development of a modern bioeconomy in Uganda and Tanzania?**

The BEA project examined three processes that are driving innovation in agricultural bioscience.

1. *Increased crop productivity using advanced biotechnology tools*, such as DNA-marker assisted breeding, tissue culture and genetic engineering. These techniques make crop breeding more effective and precise, so crops can be developed that are more tolerant to constraints, including drought, pests, or poor soils. Such techniques also enable development of crops with specific characteristics, (e.g. improved or tailor-made nutritional profiles).
2. *Adding value to crops using modern agroprocessing systems* for high quality food products (e.g. new functional food products) and agro industrial products (e.g. biofuels, fibres, starch products, “green” chemicals, biodegradable plastics, oils, lubricants and detergents).
3. *Converting agrowaste to useful products* using modern agroprocessing to realize the full potential of bio-based products and biorefineries. This includes highly efficient fermentation processes and bioreactors that convert agro-waste into valuable products such as feed and energy, helping the agro-industry to become more productive while at the same time reducing environmental impacts.

public agencies and universities collaborate and cooperate, as well as a bigger role for the public R&D sector compared with Europe and the U.S. Public R&D institutions in Eastern Africa therefore have a strategic role in developing new knowledge and vital agricultural technologies, and in transforming these into innovations for farmers and agroprocessing industries.

The problem is that public institutions in Eastern African countries, while often pursuing excellent R&D, are not sufficiently equipped, structured or supported, either to disseminate technologies or to work with innovation processes that adapt modern biosciences to local needs and smallholder farming practices. Furthermore, there is not enough knowledge or experience on how public policy can intervene to strengthen the ability of and options for public institutions to contribute to a more productive, resource efficient, and sustainable agricultural sector.

**Results and discussion**

**Extending the impact of public R&D**

In the richer world, the private sector invests heavily in R&D and applied research in knowledge intensive areas such as bioscience innovation. However, across Asia, Africa and Latin America it is most often the public R&D sector that is driving bioscience innovation. Here, public R&D plays a strategic role in moving knowledge and technology to the market and to various sectors. We have seen that modern, relevant bioscience technologies are now successfully adopted by public

R&D institutions in Tanzania and Uganda. This is important since the private sector in the two countries, with some exceptions, invests very little in their own R&D or in adopting promising bioscience technologies. In addition, the private sector and market actors are seldom effectively engaged with the public R&D sector to disseminate and deploy technologies, which has resulted in limited bioscience innovation. Our study shows that to convert the promise of the bioscience revolution into market opportunities, there needs to be strong public R&D institutions able to engage in innovation in partnership with the private sector. This would require support for public R&D to do the following:

- *Link with the private sector:* technology transfer is resource intensive and time consuming. For public organizations to engage in innovation and link with the private sector, they need to ensure that they have a minimum capacity in areas such as technology transfer. For example, this might be a technology transfer office, or designated staff to support scientists on technology dissemination (e.g. advising on IP issues, patent searches, and identifying appropriate market actors).
- *Build capacity to assess the economic potential of R&D activities:* the ability to assess the commercial potential of technologies and products is often lacking at public R&D institutions. The public sector is often unaware of market and private sector needs. Therefore, researchers in public R&D institutions need access to expertise that can assess the economic potential of public R&D.
- *Reward and support entrepreneurship:* for public organizations to play a key role in adopting bioscience applications and moving them to market, there is need for mechanisms and policies to reward entrepreneurial staff working in innovation and knowledge dissemination.

#### **Building businesses: incubating R&D and linking it with the market**

The existence of private sector actors that look for and exploit market opportunities is often a key condition for entrepreneurship and market creation. Consequently, it is critical to support links between the public sector and market actors. However, our study shows that in Uganda and Tanzania public-private partnerships in bioscience innovation are very limited. The research also suggests that mechanisms and policies that enable scientists in public R&D to set-up spin-off companies can be an important way to develop business opportunities.

But linking the public sector with the market is often not enough: there is also a need for mechanisms to help incubate businesses to ensure that all actors in the innovation system are properly linked and supported so they can play complementary roles. Thus, there may be a need for professional business incubation services to assist innovation actors with:

- business case development, viability analysis, technology assessment (including IP assessment)
- market assessment, business plan development (e.g. in terms of the feasibility of commercialization, strategies and market testing), and
- finding sources of finance for development and commercialization.



© Esther Havens / DfWATUSAID / Flickr

#### **Creating market demand**

Coherent long-term policies, effective national regulatory systems and various incentive systems are important factors for creating much needed market demand for bioscience innovation. While both Tanzania and Uganda have put significant effort into developing national science, technology and innovation (STI) policy frameworks, to a large extent these are often too general and, on the whole, have had little positive effect on innovation. There are also policies that are actually counterproductive and prohibitive, such as non-functional biosafety regulatory regimes and high import tariffs on agroprocessing equipment.

For bioscience to flow from R&D to the market, there needs to be targeted policies providing incentives and guiding frameworks that clearly benefit innovation, not only on the supply side, but also to create demand. Such policies might include certification regimes and standards, financial and tax incentives and targeted public procurement to promote and assist innovation. It is also important to tailor interventions based on a comprehensive social, technological and economic analysis of the problems, barriers and opportunities for the innovation systems that are a priority for the country in question.

#### **Financing innovation and the importance of continual support**

Access to capital and credit facilities under reasonable terms is critical for innovation and long term impact, but is currently not adequate in either country. While public funding is often the basis for R&D efforts in academia, in order to successfully bring R&D products to market, new funding partnerships are going to be necessary in which innovation costs are borne by several different parties. For example, matched funding programmes may be developed, where R&D institutions co-invest with industry partners, thereby ensuring commitment from the industry partner while at the same time reducing the risks for all parties. Today, investment and support to biosci-

## Policy considerations

There is no one-size-fits-all solution for how to promote successful bioscience innovation. Indeed, there may be a number of possible pathways to success for each individual innovation system. The question is, how can public policy strengthen the conditions for successful bioscience innovation? Below is a shortlist of action points for policy-makers in Uganda and Tanzania. These points are also relevant for other countries in Eastern Africa (e.g. Ethiopia, Kenya, Tanzania and Rwanda).

- **Establish national bioeconomy** strategies that support the medium- and long-term development goals of the countries
- **Build and sustain capacity in the public R&D sector** by employing highly trained scientific and technical staff who have the capacity to link to market actors, and create opportunities and incentives for them to engage in innovation.
- **Develop incentive mechanisms and enabling rules in R&D institutes** to reward and support entrepreneurship and interactions with the private sector.
- **Develop business incubation and “technopark” infrastructure** and services to assist emerging innovation actors with product and enterprise development.
- **Implement enabling policies and regulatory frameworks that create demand** for the commercialization of bioscience technologies, including certification and standards, public procurements, tax incentives and presidential initiatives.
- **Establish a comprehensive financing mechanism framework** for bringing bioscience technologies to the market along the growth path, from small incubation grants, matching grants, soft loans, “angel” investment, public and private equity/venture capital, and commercial loans from specialized banks.

ence innovation remains concentrated in the R&D phase of the innovation cycle, with inadequate provision for pilot tests and large-scale application and commercialization of technologies or products.

We also see how a lack of access to capital and credit facilities at reasonable terms is blocking the innovation systems in all the cases we have studied. Mechanisms to share financial risks, access to bridging funds, venture capital and credit facilities at reasonable terms are largely lacking, and this severely restricts innovation efforts.

Longevity and follow through of donor and government support is also important. Innovation is a long-term non-linear and complex process, difficult to predict and manage. All innovations come up against unexpected barriers and unforeseen events, and go through backlashes as they move through the “valley of death”. Access to long-term support and capital to enable iterative improvement to products and the innovation processes is often crucial for success. This pattern is well known in developed-world innovation processes in areas such as electric vehicles, solar and wind power, and we have seen similar patterns across all cases examined in this study.



### Published by:

Stockholm Environment Institute  
Linnégatan 87D, Box 24218  
104 51 Stockholm  
Sweden  
Tel: +46 8 30 80 44

### Author contact:

Ivar Virgin  
ivar.virgin@sei-international.org

### Media contact:

Tom Gill  
tom.gill@sei-international.org

**sei-international.org**  
2016

Twitter: @SEIresearch, @SEIclimate