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How to overcome the challenges faced by private companies engaged in agricultural research and development

Executive Statement

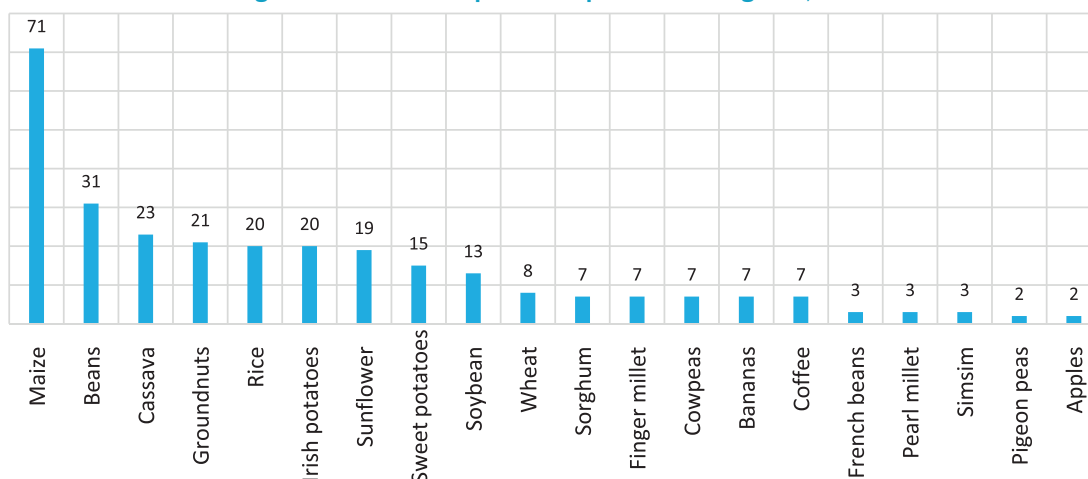
In line with their mandates, public institutions, particularly the National Agricultural Research Organisation (NARO), have developed several improved technologies for crops, animals and fisheries. However, most of the developed technologies are yet to be adopted by the intended end-users. Some private companies are making significant contribution towards closing the gap between research, technology generation, dissemination and uptake by farmers. Nonetheless, private companies face various challenges, which limit their overall contribution. This brief recommends specific actions that could ease private sector engagement in agricultural research and development.

Agricultural research is spearhead by Public research institutions

Agricultural research and development is very crucial because it leads to development of crop varieties and animal breeds with superior attributes. In Uganda, the National Agricultural Research Organisation (NARO) is the apex public body that guides and coordinates all agricultural research activities. NARO has 16 research institutes distributed across different regions of the country. In the subsequent paragraphs, we highlight key technologies generated by agricultural research institution.

A number of improved crop varieties exist for at least twenty crops grown in Uganda (**Figure 1**). The highest number of released varieties is recorded for maize (71). The improved crop varieties possess special attributes which can be broadly outlined as: resistant to diseases, drought tolerant, tolerant to field pests, water efficient, early maturing, resistant to storage pests, resistant to lodging, high yielding, tolerant to acidic soils, low nitrogen tolerant, stress tolerant, low aflatoxins accumulation, good taste, good canning quality, non-shattering, good cooking properties (e.g. fast cooking, non-sticky, etc), good processing quality, high oil content, and rich in vitamins and proteins. Consequently, farmers have a wide range of varieties from which to choose for adoption.

Figure 1: Number of improved crop varieties in Uganda; 1960-2015



Source: [http://tasai.org/wpcontent/themes/tasai2016/info_portal/Uganda/National%20Crop%20Variety%20List%20for%20Uganda%20\(2015\).pdf](http://tasai.org/wpcontent/themes/tasai2016/info_portal/Uganda/National%20Crop%20Variety%20List%20for%20Uganda%20(2015).pdf)

Table 1: Cattle breeds and their performance in terms of beef and milk production

Type of improved breed	Mature weight (Kg)				Milk production (Litres)		
	Bulls		Cows		Per lactation	Per day	
	Min	Max	Min	Max			
DUAL PURPOSE	Brown Swiss	1,000	1,200	600	700	6,300	-
	Sahiwal	500	700	340	400	1,574	5 to 10
	Simmental	1,200	1200	750	750	5,100	-
DAIRY	Aryshire	800	900	500	600	5,967	30
	Guernsey	700	850	500	600	5,520	25
	Holstein-Friesian	1,000	1,200	600	700	8,000	40 to 50
	Jersey	540	820	400	500	4,000	22
BEEF	Bonsmara	892	1,200	560	900		
	Boran	550	880	400	550		
	Brahman	720	990	440	630		
	Charolais	892	1,200	560	900		
	Romagnola	1,100	1,200	650	750		
	Angus	800	850	500	550		

Source: National Animal Genetic Resources Centre & Data Bank (NAGRC & DB); Cattle breeds (Breed Information)

Apart from crops, the National Animal Genetic Resources Centre and Data Bank (NAGRC&DB) is in charge of livestock genetic improvement and conservation of indigenous animal genetic resources for the country. Indeed, various cattle breeds are available at NAGRC&DB, they include: local dual purpose breeds (Ankole Long-horn, East African Short horn Zebu, and Nganda); improved dual purpose breeds (Brown Swiss, Sahiwal, and Simmental); improved dairy breeds (Aryshire, Guernsey, Holstein-Friesian and Jersey); and improved beef breeds (Bonsmara, Boran, Brahman, Charolais, Romagnola, and Angus).¹; **Table 1** summarises selected performance attributes of improved cattle breeds.

In the fisheries sub-sector, the National Fisheries Resources Research Institute (NaFIRRI) is mandated to conduct basic and applied research of national and strategic importance in aquaculture, capture fisheries, water environment, socio-economics and marketing, and information communication management. In line with its mandate, NaFIRRI has developed the following technologies/innovations:

- Cost effective feed formulae for Nile tilapia and catfish; and technologies for mass production of starter fish feeds.
- Appropriate cage design and development densities, and recommendations for different water bodies.
- Fast growing genetically modified brood stock of Nile tilapia and African catfish.
- Technologies and methods for high quality seed production and culturing for different fish species, and for protection of fish breeding/nursery sites.
- Fish biomass of the major lakes and appropriate fishing gears/methods for Mukene, Ragoogi, Muziri, Angara and Ngassia.

- Methods and guidelines for riparian community management of water quality, aquatic weeds and nutrient content and quality.
- Post-harvest fisheries technologies that optimize quality, safety and profitability along the fish value chain.

Low uptake of improved agricultural technologies

Although substantial public resources have been devoted to the research and development of improved agricultural technologies, adoption rates of generated technologies remain very low. For example, at national level, only 11 percent of farming households grow improved crop varieties. Less than 10 percent of dairy farmers in Uganda use artificial insemination. In the fisheries sub-sector, almost all producers of fish use the conventional hunter-gatherer capture fish method. A negligible proportion of fish farmers (0.02 percent) use the floating fish cage system, an innovation that is 12 times more productive than the capture fishery system.

There are private companies that are making a contribution towards bridging the gap between research, technology generation, dissemination and uptake by farmers. An example in case is Agro Genetic Technologies (AGT) laboratories, which we discuss in detail in **Box 1**. However, private companies are faced with multiple complexities, and this limits their potential to significantly promote technology generation and uptake.

Box 1: Illustration of the role of private sector in R&D; the case of AGT Laboratories s**Agro Genetic Technologies (AGT) Laboratories**

Agro Genetic Technologies (AGT) laboratories is a private company in Uganda that uses biotechnology through tissue culture techniques for micro propagation of different crops on a commercial basis. The company produces tissue cultured plantlets of bananas, pineapples, coffee, tea, cassava, sweet and Irish potatoes, ornamentals, and forest trees. For banana, AGT produces over 20 local varieties. These plantlets are of high quality—they are uniform, pathogen and pest-free, and grow with vigour. Tissue cultured plantlets are produced in large quantities within a short period of time (it takes 10 months to propagate a plantlet and thousands of plantlets can be propagated at the same time). The technique thus allows availability of quality planting materials all year round. AGT Laboratories is currently the biggest tissue culture laboratory in East and Central Africa with the capacity to produce up-to 10 million plantlets per year. In addition to producing tissue cultured planting materials, the company offers training and advisory services on general agronomic practices to its customers—thus, the company is complementing MAAIF in provision of extension services. Indeed, tissue culture technology has received good response amongst local farmers in Uganda, and consequently, AGT Laboratories has set up several nurseries (sales points) and demonstration gardens in local farming communities, where farmers can access the plantlets and are trained about management of tissue culture crops, respectively. AGT Laboratories has 30 plant nurseries (distribution centres) to ensure that farmers access clean planting materials, 26 of those are operated by local agents in Uganda and Rwanda. The company organises national banana workshops annually, and these are attended by stakeholders in banana business.

Source: Key informant interview with the founder of AGT Laboratories - Mr. Erostus. W. Nsubuga

The role of private companies in agricultural research and development

Box 1 presents the case of Agro Genetic Technologies (AGT) laboratories, a subsidiary private company of AGT group of companies that started operations in January 2002. This company has contributed to generation and commercial distribution of productivity-enhancing technologies (tissue culture plantlets), which when managed appropriately, increase crop yields by 30 to 40 percent compared to conventional plants.

It is complex for private companies to engage in R&D

Despite their contribution to agricultural research and development, private companies face numerous challenges. Again we use the case of AGT laboratories to highlight the key constraints.

- 1) Although the National Agricultural Research Act, 2005² provides for patents and payment of royalties, currently technology developers do not receive such kinds of rewards. Public research institutions have got protocols and technologies that they do not want to release to private research companies because this would only benefit the latter, who are profit-oriented. For example, the CEO of AGT laboratories informed;

“There exists an Irish potato protocol that was developed by Makerere University, but due to non-enforcement of rights of patents, it cost AGT Laboratories huge sums of money to hire an expert from India to develop a similar protocol for the company”.

- 2) Poorly planned and ad hoc procurement processes: Private companies have limited capacity to meet fully any ad-hoc demands. For example, since 2016/2017, NAADS has been

procuring tissue culture banana plantlets from AGT Laboratories but usually places its order very late. Thus, it is advisable to place orders much in advance because complete propagation of tissue culture banana plantlets takes almost one year.

- 3) Limited access to credit by private investors in agriculture research and development, especially in areas that are not very well understood and appreciated such as tissue culture. The CEO of AGT Laboratories reported that;

“Many times I have failed to access credit from financial institutions on grounds that they do not understand what tissue culture is all about”

- 4) Weak synergies between public and private institutions: For example, NAADS procures tissue culture planting materials from AGT Laboratories, but does not liaise with the company to offer the required training to farmers who receive the planting materials. Generally, private sector and farmers lack a functioning platform to contribute to agricultural research. This reflects weak institutional linkages and suggests that the NARO council has not fully operationalised the NARS system.
- 5) Weak and sometimes non-existent regulations to ensure that technology development and multiplication is done by technically competent individuals and companies—this often times compromises the quality of technologies supplied to end users (farmers, in this case). AGT Laboratories, for example, scaled down production of tissue culture for coffee seedlings because some political leaders and other influential individuals set up coffee nurseries to supply seedlings under UCDA’s coffee-planting programme. Whereas AGT

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About the Authors

Mildred Barungi is a Research Fellow at the Economic Policy Research Centre, Kampala, Uganda.

Florence Nakazi is a Research Analyst at the Economic Policy Research Centre, Kampala, Uganda.

Francis Mwesigye is a Research Fellow at the Economic Policy Research Centre, Kampala, Uganda.

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Laboratories was producing and supplying disease-free coffee seedlings, the company faced unfair competition from these other suppliers of lower quality seedlings.

- 6) Limited demand for improved technologies, which forces private companies not to fully utilise their installed capacities. AGT Laboratories has the capacity to produce up to 10 million tissue culture plants per annum, however, currently the company produces 3 million tissue plants per annum, implying that it is utilizing only 30 percent of full capacity.
 - 7) Unstable supply and high cost electricity make engagement in technology generation through biotechnology costly and hence less profiting. For instance, tissue culture plantlets need many hours of light (at least 16 hours) to grow well in the laboratories. The high cost of lighting cannot be fully passed on to farmers since this would raise the price of plantlets and further curtail the already low demand.
 - 8) Other challenges that complicate the participation of private companies in agricultural research and development are: increasing cost of laboratory equipment and chemicals; and inadequate qualified personnel to carry out laboratory activities.
- b) The governing body of NARO (Council) should ensure that all members regularly attend meetings of the council because it is one platform that brings together members of the National Agricultural Research System (NARS).³
 - c) Government should further support investment in strategic interventions (e.g. provision of extension services) that are aimed at stimulating demand for improved technologies. This can in part be accomplished through increased budget allocation for recruitment and facilitation of extension staff; as of 2017/18, there was a staffing gap of 35% at local government level.⁴
 - d) Government should improve transmission of power and put systems in place to minimise power thefts. This can help reduce electricity tariffs and minimise costs of technology development. Also, private companies are urged to venture into use of alternative sources of energy (such as solar) that are actually cheaper than electricity in the medium and long run.

Emerging areas for action

- a) In accordance to the National Agricultural Research Act, 2005, NARO should enforce rights of patents and ensure that indi-

Endnotes

- 1 National Animal Genetic Resources Centre & Data Bank (NAGCR&DB). Cattle Breeds (Breed Information)
- 2 National Agricultural Research Act, 2005.
- 3 The NARO Council consists of the following members: eminent Scientists in Uganda; representatives of farmers, private sector, Uganda NGO forum, Universities, public agricultural research institutes, private agricultural re-

search providers, and Uganda Local Authorities Association; PS MAAIF; PS MFPED; DG NARO; ED NAADS; and Executive Secretary of Uganda National Council for Science and Technology.

- 4 MAAIF (2018). Ministry of Agriculture, Animal Industry and Fisheries Performance Report. August 2018. Financial Year 2017/2018.

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Address:

Economic Policy Research Centre
51, Pool Road, Makerere University Campus,
P. O. Box 7841 Kampala, Uganda
Tel: +256414541023/4 Fax: +256414541022
Email: eprc@eprcug.org, Website: www.eprc.or.ug