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Enhancing Innovation in the Ugandan Agri-Food Sector: Progress, Constraints, and Possibilities

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Uganda's performance as an innovation economy has been improving consistently, particularly in comparison with other low-income and Sub-Saharan African countries. Since 2015, the Global Innovation Index (GII) has ranked Uganda as an 'innovation outperformer,' a title given to countries that, over a number of years including the two most recent, have been identified as innovation achievers and pillar outperformers.[1] This laudable progress stems from sustained economic growth coupled with a commitment to private-sector development and innovation policy reforms.[2] Though encouraging, this nascent progress will translate into real benefits for the broader Ugandan population only if policy makers understand and address specific constraints in the innovation systems of the agri-food sector—the largest sector in the Ugandan economy.

Agriculture is the backbone of Uganda's economy, employing about 73% of the country's labour force predominantly in rural areas, but it made up 27% of the country's GDP in 2014.[3] Given that many households in Uganda rely on agricultural production for their livelihoods, innovation in this sector can have direct and potent welfare effects. This potential is particularly striking given that the Ugandan agri-food sector is hampered by low productivity and profitability. Annual growth in agricultural output has also been lower than expected, declining from 7.9% in 2001 to 3% in 2014 and falling short of the 6% growth target for the per capita agricultural GDP set by the African governments under the Comprehensive Africa Agriculture Development Programme.[4]

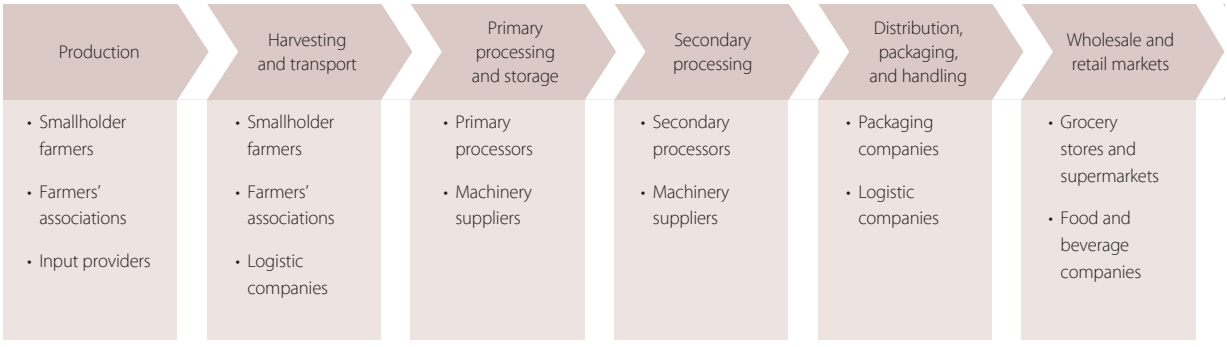
Increasing agricultural productivity through improved technology and production practices has been a persistent priority at the national level. To be effective, this priority must prompt policy actions that specifically and explicitly account for the underlying innovation systems that will ultimately generate real productivity improvements.

Distinctive features of agri-food value chains in Africa

The agri-food value chain components range from the supply of agricultural inputs such as seeds by input suppliers, wholesalers, and retailer agro-dealers to farming activities such as planting, farming, and harvesting and to post-harvest activities such as bulking and processing of raw output, branding, and marketing of value-added agri-food products that reach end consumers (see Figure 1).

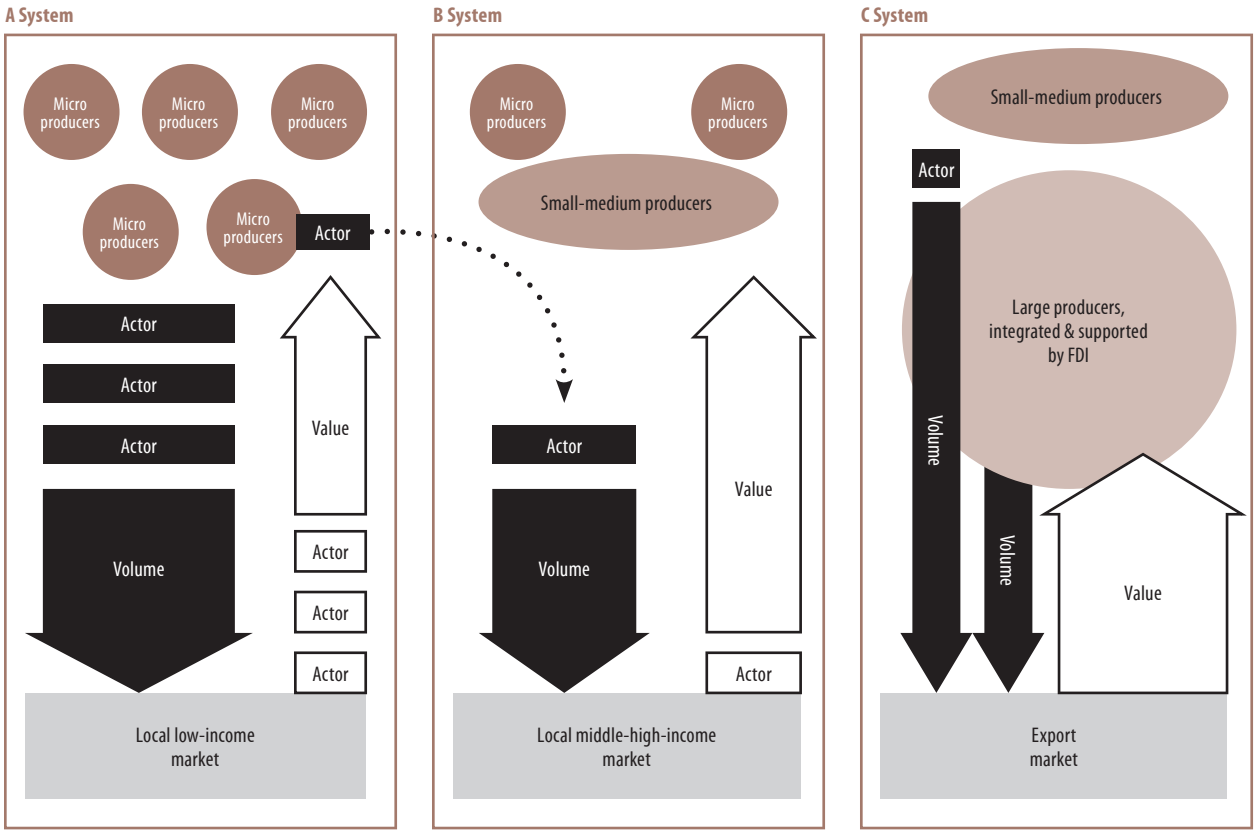
With these important dimensions in mind, it is easy to appreciate the marked heterogeneity that characterizes agricultural value chains in Africa. Indeed, this heterogeneity is often so pronounced that it results in three distinct and parallel systems of

Figure 1: Agriculture value chain with links between consumers and producers



Source: Authors, based on A.T. Kearney, 2016.

Figure 2: Heterogeneity in production and marketing constraints: Three parallel agri-food value chains in developing countries



Source: Adapted from Trienekens, 2011; originally from Ruben et al., 2007.

value chains. In the A system shown in Figure 2, local value chains consist of low-value-added staple foods; low-income and low-productivity farmers; and local, low-value-added spot markets. The B system comprises larger local farmers with access to improved input markets and products as well as higher-value crops; these farmers can tap into higher-value-added domestic agri-food markets. In the C system, much larger (often plantation-style) farms produce specialized products (often under production contracts) for high-value export markets and must therefore satisfy high international sanitary and phytosanitary standards. In developing countries, these systems typically operate in parallel, often with little interaction, further isolating the most vulnerable and least productive producers in the A system. These realities are key to understanding how value chains operate in Uganda and what upgrading options exist for farmers trapped in less productive systems.

Innovation constraints in African agri-food value chains

The agricultural sub-systems described above often function in parallel with few links other than relying occasionally on another sub-system to balance demand and supply gaps. The existence of these heterogeneous sub-systems, which are only weakly connected, poses unique challenges for supporting innovation and upgradation of these value chains.[5]

In many African countries, producers are saddled with poor infrastructure, weak institutions, barriers to entry, coordination failures, and unfavourable social and political conditions.[6] Although these hurdles may be surmounted individually in some cases, they can be pervasive and subject to substantial collective action problems, with the end result that they complicate the entire culture in which business activities take place.

Barriers to entry are a disadvantage to small-scale producers that have little capital to invest, use traditional techniques, and depend on family labour.[7] Such an environment causes difficulties in meeting product standards and makes it difficult to compete with larger-scale, more efficient, and more technologically sophisticated multinational corporations. Without market knowledge or competitive products, many small-scale producers fail to take advantage of larger markets or the techniques that could help them do so.

Furthermore, coordination failures are typically the result of a trust deficit or asymmetric relationships. Because of poor past performance, many value chains do not engender trusting relationships. This can lead to excessive risk mitigation, causing inefficiencies and reduced value addition.[8]

For commodities with low value added, such as raw agriculture staples, the terms of trade with Western countries are typically asymmetric. In such circumstances, Western partners capture only the high-value portion of the chain, thereby excluding small-scale farmers from participating in larger markets.[9]

These obstacles constrain the ability of system A and B value chain actors from innovating in a way that not only increases their agricultural productivity but also upgrades their systems.

Innovation constraints in the Ugandan agri-food sector

Ugandan farms are typically small: Roughly half of Ugandan farmers own less than three acres of land, a quarter own three to five acres, and a quarter own more than five acres.[10] The total area of arable land planted with either seasonal or permanent tree crops has increased at an annual rate of over 2% over the past 20 years.[11] This increase in crop area, however, was outpaced by population growth, and crop area per capita declined nearly 25% during this period as a result.[12] These trends have contributed to an annual decline in both food and agricultural production per capita of about 2% since 2002.[13] Thus at both the national and household levels there is a pressing need to increase agricultural productivity in Uganda.

Mirroring the above challenges, Ugandan farmers face a host of constraints that limit their ability and incentives to invest in their productivity. Among these constraints are unreliable growing conditions; natural disasters; liquidity constraints; high market risk and uninsured production; lack of access to high-quality agricultural inputs (only poor quality of agricultural inputs are available); lack of training, information, and awareness; limited output market opportunities; and few spillovers from public agricultural research and development (R&D). To the extent that farm-level constraints discourage farmers from adopting new technology, they also discourage private-sector investments in the development, distribution, and marketing of improved agricultural inputs and other technologies. Downstream markets for agricultural outputs are similarly suppressed by low on-farm productivity and concerns about the stability and quality of outputs. As a result, only one-third of agricultural production reaches market.[14] Key Ugandan agriculture innovation constraints at the value chain level are discussed in the next section.

The low quality of agricultural inputs

The low quality of agricultural inputs in Uganda has been documented in several recent studies.[15] Thirteen percent (nine out of the 67 fertilizer retailers surveyed) reported receiving low-quality supplies from wholesalers.[16] In practice, the poor quality appears to be a result of counterfeited or adulterated or generic versions of the supplies. The ubiquity of low-quality inputs seems to be more a result of weak enforcement of guidelines and regulations on input producers and dealers than the lack of technology to produce high-quality supplies. Better enforcement and the adherence to higher standards would help overcome this bottleneck. Additionally, institutional changes aimed at improving the quality of agricultural inputs, markets, and supply chains are central to the innovation process. Importantly, such institutional changes make input suppliers more responsive to the needs of farmers because they increase competition in the market. In many cases, upstream innovation in inputs (e.g., improved germplasm) involves significant public-sector support, but the ultimate return on this public R&D investment is dependent on the efficiency and resilience of the input supply chains that deliver appropriate improved inputs to producers.

Constraints to public and private innovation in the agricultural input supply chain—in particular in the area of seeds, crops, and fertilizers—remains a bottleneck to improving the output of Ugandan agriculture. On the one hand, access to inferior inputs (e.g., counterfeit or ineffective fertilizer) remains a significant challenge where issues of quality and suitability prevail. On the other hand, the rise of new, sometimes domestic, hybrid seed varieties along with organizational innovations and improved distribution of agricultural inputs might offer novel possibilities.

Imperfect financial markets

In Uganda, the majority of rural households do not have access to credit. At the time of the 2005/06 Uganda National Household Survey, 24% of rural households had applied for credit from informal sources compared with 4.4% and 1.8% that had applied to micro-finance institutions and banks, respectively; only 15% and 12% of household heads have the capacity to borrow from micro-finance institutions and banks, respectively.[17] Following the conceptual framework of Boucher et al. (2009), of the non-borrowers in the 2008/09 Uganda Census of Agriculture, about half were credit

unconstrained, meaning that—given their production opportunities—they did not need a loan, did not borrow because of high interest rates, or could not profitability pay back the loan.[18] The other half of non-borrowers were credit constrained as a result of lack of collateral, lack of information about credit sources, negative past experiences with receiving credit, or unavailability of lending facilities.[19] Thus financial markets in rural Uganda should not only be equipped to provide finance to individual households in a community experiencing hardship but should also look critically at the demand for start-up capital or insurance against risk that is common across households in a community. Prices and market uncertainties contribute to low investment by making borrowing more uncertain and therefore less attractive. This environment of uncertainty inevitably affects household liquidity. Hybrid seeds and inorganic fertilizers that must be purchased each season are two technologies that are most likely to be affected by liquidity constraints at the household level. Furthermore, imperfect financial markets also impact the way labour is allocated across crops. The poorest households, which are less able to insure themselves against price risk, would tend to allocate less labour to high-return cash crop production, such as coffee production.[20]

Information constraints and a weak knowledge base

Information constraints and also, sometimes, a weak knowledge base among farmers are further bottlenecks.

Information constraints reduce productive investments by farmers by imposing constraints on (1) information about inputs/products and (2) information about practices/processes. Addressing this lack is the focus of public- and private-sector initiatives as well as research and policy recommendations.[21]

Limited information on inputs and products, in turn, negatively affects decisions about what practices and processes to adopt. For example, researchers found that only 2% of farmers in their sample correctly identified the variety of maize that they were growing.[22] If farmers believe they are growing a different variety than the one they are actually planting, they may apply practices and technology appropriate to the wrong variety; this can affect their productivity, as has been shown among cowpea producers in Tanzania.[23]

Often farmers also lack the capabilities to assess the potential and practical use of new technology or innovation, leading to underinvestment and limited adoption of new technologies.

Output markets, processing, and marketing

Agricultural output markets (e.g., markets for coffee, maize, or mangos) can play an important role in facilitating agricultural innovation. They are the first and the most important link through which the farmers can access domestic agro-processors, neighbouring countries, or global markets via processor-exporters. However, output sold by farmers is often purchased by middlemen in the village or at the farm gate shortly after harvest.[24]

The interdependence between actors along this chain implies that downstream costs of market imperfections may be transferred upstream to farmers themselves. Because farmers make input investment decisions with an eye on the ultimate output markets, reforming agricultural output markets is an important way to increase farmers' use of improved inputs such as fertilizer.[25] The nascent rice value chain in Uganda provides a concrete example of this dynamic. Since upland rice has only recently been introduced in the country, there are few rice mills and only one industrial agro-processor of rice in Uganda.[26] The costs of transporting rice between farms and these mills was one of the main factors driving over half of the farmers who had initially adopted this crop two years earlier to abandon growing NERICA rice.[27]

Relatedly, low levels of investment in Uganda's agriculture sector are in part due to coordination problems between producers and purchasers of agriculture products. Smallholder farmers face uncertain demand for output, which reduces their incentives and ability to invest in agricultural production. Agro-processors face uncertain quantity and quality of supply, which is exacerbated by potential suppliers' side-selling opportunities on agricultural spot markets.[28] In this way, uncertainty about demand and supply of commodities facing farmers and agro-processors, respectively, reduces their investment incentives. This agricultural investment trap results in only one-third of agricultural production reaching domestic and export markets.[29]

Lacking spillovers from public agricultural R&D

The public sector conducts the vast majority of agricultural R&D in Uganda, as in many least-developed and low-income countries. These investments focus primarily on technologies to improve agricultural productivity and sustainability. Yet a number of factors, including the lack of complementary investments and capacity, hamper spillovers from public research to private enterprises. These spillovers and the interactions and processes that generate them are complex and dynamic. It is critical

that researchers and policy makers better understand the drivers and challenges inherent in generating R&D spillovers, as well as the levels and direction of agricultural R&D.

Creating an enabling environment for agri-food innovation in Uganda

Uganda's performance in previous editions of the GII attests to its growing focus on innovation as a driver of development in some of its key sectors. Within the agriculture sector, Uganda is prioritizing investments in modern biosciences, with a particular focus on disease diagnostics, vaccine development, crop productivity improvement, and value addition.[30] The government is also taking steps (though small) to improve institutional capacity, as evidenced by the growing importance of work of R&D institutions such as the National Coffee Research Institute (NaCORI) and others within the National Agricultural Research Organisation (NARO).

The growing focus and recent measures taken by the government for promoting innovations and value addition in agro-based industries is definitely a step in the right direction. However, to truly stimulate growth, the government needs to create an enabling environment for agri-food innovations by addressing obstacles that impede value addition and innovation in agri-food systems.

Among policy measures to encourage innovation, governments can establish intellectual property rights (IPR) and maintain the institutions that enable these rights to be used and enforced. An IPR regime encourages innovation by allowing inventors to recoup their investments through monopoly rents. The agricultural industry typically relies on patent protection, plant variety protection, and trademarks.

In the past decade, Uganda has taken some major strides towards establishing a well-functioning IPR regime in agriculture. The country recently introduced its Plant Variety Protection Act 2014 and became a signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture, to which it acceded in 2003. It also enacted its Geographical Indications Act 2013, which provides protection and promotes the value of its indigenous and traditional agricultural produce. Enhancing the instruments available to both private and public players in the agri-food sector to create viable business opportunities based on innovation could be a policy priority. At the most basic level, firms will invest in innovation only if they have a defensible strategy for building and maintaining a reputation that attracts customers and differentiates high-quality products and services. The effective use of trademarks may therefore play a role in improved branding and longer-term investments in innovation. Uganda also enacted its Trademark Protection Act in 2010. Since then, compared with other forms of intellectual property (IP) protection—such as patents—the use of trademarks has increased rapidly. Furthermore, trademarks are emerging as the preferred form of protection in the agricultural and food and beverage sectors because the majority of trademark filings occur within these sectors.[31]

In order to provide institutional support for IP protection, Uganda has mandated by law two institutions for the formulation, administration, and enforcement of IPR. The Uganda Registration Services Bureau is mandated with the registration of IP instruments, and the Uganda National Council for Science and Technology is concerned with formulating the national science and technology policy and protection of IPR. This demonstrates that Uganda has the basic framework it needs to promote formal agricultural investment in innovation.

However, to foster innovation in agriculture, Uganda needs to define its key innovation policy commitments in this sector and involve a larger actor base in the management and promotion of IPR. An ongoing World Intellectual Property Organization (WIPO) study will shed further light on the policy options available to Uganda for enhancing its IP regime and making it more inclusive for the agriculture sector (see Box 1).

Policies for supporting innovation include fostering an enabling environment and collective action. The former typically relates to the provision of public goods to address market failures in transportation, communication, and processing. However, policies can also focus on the small producers by aiming to integrate them into the market economy. Indeed, a strong agro-processing sector, which is linked to farmers, is an incentive for small producers to invest more to increase the productivity of their farms. These links with agro-processing rely on a combination of service provision, as mentioned above; facilitation of the private sector through financial services and fiscal policy; and an appropriate regulatory environment achieved through standards, regulations, and enforcement. Collective action offers the possibility of lower costs, a more reliable network, and potentially higher profits.[32] Umbrella organizations play a major role in marketing agricultural produce, providing access to training, and service delivery from external organizations.[33] They also provide an ideal environment for knowledge transfer and innovation as they link farmers

Box 1: Innovation in the Agro-Based Industry in Uganda: Insights from coffee seed supply chains and tropical fruit processing

The Ugandan government has requested the Economics and Statistics Division (ESD) of the World Intellectual Property Organization (WIPO) to conduct a study on innovation in the agro-based industry in Uganda. Two value chains have emerged as promising and two focal links in these value chains have emerged as particularly relevant for this study:

1. **The seed/seedling supply chain in the coffee value chain.** Coffee has always been an important cash crop in the Ugandan agri-food sector. It has endured the booms and busts of the global coffee market as well as devastating diseases. Still, coffee yields continue to be low by international standards (e.g., Robusta coffee yields in Viet Nam are, on average, three to four times larger than yields of the same coffee in Uganda). Although there are several reasons for this, the quality and suitability to local agro-climatic conditions of the coffee varieties and the level of input usage play a central role. Getting high-quality and suitable seedlings to farmers may catalyse other investments. For example, investment in several inputs (i.e., fertilizer, pesticides, and agronomic practices such as planting, spacing, and intercropping) is likely to be higher when a grower has planted the varieties best suited to his growing conditions (such as farm size, soil type, and climate). Thus providing better traceability and information along the seed supply chain could create more favourable incentives and induce more on-farm investment. This focus aligns well with the current agricultural agenda of the Ugandan government, which has set extremely ambitious coffee production goals for the next several years.
2. **Primary post-harvest processing—especially drying and juicing—in the tropical fruits value chain.** Nearly every Ugandan farmer grows tropical fruits of some kind. Although fruits such as mangos, pineapples, and bananas can be highly profitable, they are also perishable and costly to transport. Moreover, markets for unprocessed fruit are typically poorly integrated spatially and prices often fluctuate wildly. Immediately after harvest prices can collapse locally, with a glut of perishable fruit in markets and roadside stalls. In this context, even rudimentary post-harvest processing technologies can add significant value; this has motivated innovative activities in the public and private sector among both formal and informal players. For example, the Food Technology Incubator at Makerere University has played an active role in developing and diffusing these technologies and in providing the marketing and distributional expertise required to form profitable small and medium-sized enterprises in this value chain.

Source

WIPO-Uganda study 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country'.

with similar interests. Finally, governments can also engage in the direct funding of agricultural R&D. Public-private partnerships also support R&D, education, technology transfer, and incremental problem solving.[34]

The ongoing WIPO-Uganda study titled 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country' (see Box 1) pays particular attention to the policy options that enhance spillovers from public R&D to private enterprise and to innovation and the productivity of the agri-food sector more broadly.[35] In particular, the study aims to understand how firm innovation processes could help translate public R&D into improved firm or household productivity and social returns. On this basis, the study will apply existing findings to the case of Uganda, and then analyse how innovation and (formal and informal) IP, and related policies, affect returns on R&D investment.

The possibility of domestic spillovers to other sectors of the Ugandan economy is particularly important in this regard because these spillovers are central to the economic development and poverty alleviation process that can be unleashed by investment and innovation in the agri-food sector. For this reason, the WIPO-Uganda study will focus on domestic innovation relevant to domestic and regional agricultural varieties and market opportunities. A variety of specific policy solutions to questions that will likely emerge throughout the course of the study include (1) ways to stimulate or import African domestic research and technology to solve local problems; (2) ways to use local brands, local techniques, local tools, local seeds, and local IP to improve the efficiency and dynamism of the agri-food sector; and (3) ways to transfer promising research, innovation, products, and even services that emerge from the Ugandan agri-food sector to neighbouring markets in the surrounding region.

Conclusions

Uganda has been taking several measures designed to improve its performance in the innovation rankings. The GII rankings for the period 2013 through 2016 show Uganda to be a consistent innovation outperformer in comparison to other economies

at the same level of development. However, for Uganda to translate this success to economy-wide gains, it needs to address constraints hampering innovation and productivity improvements in its agriculture sector. This chapter has outlined several factors that impede value addition and upgradation of its agriculture value chains. It has also highlighted some possibilities that could improve the country's agri-food innovation. The policy measures required for Uganda to improve its current innovation standing focus on enhancing its institutions to promote and protect IPR, foster innovation, and provide an enabling environment to cultivate collective action. The ongoing WIPO-Uganda study seeks to improve the understanding of the role of innovation and IPR in the Ugandan agriculture sector and will identify key policy responses that have the potential to enhance the impact of agricultural R&D for innovation and technology diffusion. It will offer policy recommendations and describe possible interventions for enhancing innovation and agribusiness in Uganda by providing empirical evidence from an analysis of innovation in the value chain of its key cash crop, coffee.

Notes

1 'Innovation achievers' are countries for which GII scores are higher than expected, based on their level of economic development as measured by GDP per capita. 'Pillar outperformers' are countries that outperform their income group peers in four or more GII pillars.

2 Ecuru and Kawooya, 2015.

3 World Bank, 2016.

4 World Bank, 2016; Uganda Ministry of Agriculture, Animal Industry & Fisheries, 2010.

5 Trienekens, 2011.

6 Trienekens, 2011; Poulton and Macartney, 2012.

7 De Janvry and Sadoulet, 2005; Daviron and Gibbon, 2002.

8 Webber and Labaste, 2010.

9 Kaplinsky et al., 2002.

10 LSMS-ISA, 2012.

11 FAOSTAT, 2014b.

12 FAOSTAT, 2014a.

13 FAOSTAT, 2015.

14 World Bank, 2011.

15 Ashour et al. 2016; Benson et al. 2012; Bold et al. 2015.

16 Benson et al., 2012.

17 Kasirye, 2007.

18 Munyambonera et al., 2014

19 Munyambonera et al., 2014.

20 Vargas Hill, 2009.

21 Benson et al., 2012; Jansen et al., 2013.

22 Stevenson et al., 2016.

23 Bulte et al., 2014.

24 World Bank, 2015.

25 Benson et al., 2012.

26 World Bank, 2015.

27 New Rice for Africa ('NERICA') is a cultivar group of interspecific hybrid rice developed by the Africa Rice Center (AfricaRice) to improve the yield of African rice cultivars. Kijima et al., 2011.

28 Like financial spot markets, in agriculture spot markets agricultural commodities are traded for immediate delivery.

29 World Bank, 2011.

30 Ecuru and Kawooya, 2015.

31 WIPO, 2017.

32 Dorward et al., 2008.

33 Larsen et al., 2009.

34 Hall, 2006.

35 CDIP/14/7 Project on Intellectual Property and Socio-Economic Development (Phase 2): WIPO-Uganda study 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country'. Kampala and Geneva: Uganda National Council for Science and Technology, Uganda National Council for Science and Technology and, WIPO Economics and Statistics Division.

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