ICTs in Agricultural Production and Potential Deployment in Operationalising Geographical Indications in Uganda

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Abstract

The purpose of this study was to explore the role that agricultural information and communication technologies (ICTs) might play in scaling up traditional knowledge (TK)-based agricultural production, and to investigate the ways in which local communities have used ICTs to scale up TK in agricultural production. The study also aimed to explore the degree to which agricultural ICTs can be used in Uganda in the deployment of a category of intellectual property rights (IPRs) known as geographical indications (GIs).

GIs are a form of IP that have a potentially unique relevance for agricultural production. African countries have only recently paid attention to GIs as potential tools to protect their agricultural production. Uganda has enacted a GI law that is expected to play a role in the country's agricultural production.

In most developing countries, including Uganda, small-scale producers' access to markets and to agricultural information is constrained by a number of limitations. Producers in developing countries often depend on traditional means of communication, and sell their products at the farm gate, while intermediaries and other stakeholders in the product chain take a large share of the value generated by the products. Improving producers' access to markets and to agricultural information has long been identified as a key issue in improving small-scale agriculture in developing countries. The use of ICTs is one approach to linking small-scale producers to markets that can enable producers to make better-informed decisions during selling and when farming. Thus, ICTs and GIs can both potentially help link producers to markets in ways that that can affect their decisions, at both production and marketing levels. Considering the knowledge-based methods of production in tradition-based agriculture, GIs systems and ICTs foster collective action and collaboration among local stakeholders, thereby supporting innovation through collaboration. In this way, the simultaneous deployment of GIs and ICTs can be an effective strategy for Indigenous entrepreneurs to pursue in order to scale up collaborative innovation in agricultural production.

The study looked at the agricultural support ICT initiatives of the Grameen Foundation, the Busoga Rural Open Source and Development Initiative (BROSDI), and the Women of Uganda Network (WOUGNET). The study evaluated the potential relations between these agricultural ICT initiatives and their potential for use in the implementation of GIs in the production and marketing of agricultural products in Uganda. It is concluded that the deployment of such ICTs provides an appropriate forum for scaling up Indigenous entrepreneurship in agriculture through a framework of GI implementation.

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Keywords

information and communication technologies (ICTs), geographical indications (GIs); agricultural products; traditional knowledge (TK), traditional agricultural knowledge, TK-based agricultural production, specialty agricultural products, Uganda

I. Introduction

Uganda is a largely agricultural country, with agriculture contributing approximately 37% of the gross domestic product (GDP) (PwC Uganda, 2016). The agricultural sector is the largest employer of labour, constituting 73.3% of the total (UBOS, 2009). Smallholder farmers operating on less than two hectares dominate the agricultural production of Uganda (Petkoski, 2015).

Uganda is among a number of African countries that see considerable promise in adopting and protecting strong geographical indications (GIs) systems for encouraging higher value production in agriculture. Uganda was chosen as a basis for the case study because it has taken active interest in GIs as a means of protecting its diverse agricultural production. Uganda enacted the Geographical Indications Act of 2013, and implementation of the Act has been recommended to be fast-tracked in order to prevent other countries from trademarking unique agricultural goods from Uganda (URSB, ARIPO, & EU, 2013). In a workshop hosted by the Uganda Registration Services Bureau (URSB) in 2013, the importance of GIs to add value to, and realise market potential for, Ugandan products was underlined (URSB et al., 2013). In spite of such interest towards utilising GIs, however, Uganda has not yet implemented the law, largely because of the lack of a requisite implementation strategy that: facilitates coordination with the producers, exporters, and other value-chain actors of agricultural production; and develops the awareness and capacity of public regulators.

The principal function of GIs is spreading information for origin-based products about the specific factors of typicality that must be defined, verified, and defended in order to ensure positive economic returns to small-scale producers. GIs give producers the power to determine the way a product is produced, thereby taking back this decision from the hands of downstream processers, blenders, and retailers (AU & EU, 2011, p. 4). Thus, GIs help small-scale agricultural producers acquire better access to the market by shortening the value chain of agricultural market.

In most developing countries, small-scale producers' access to markets is constrained by a number of limitations. Producers in developing countries often depend on traditional means of communication, and sell their products at the farm gate, while traders, intermediaries and other stakeholders in the product chain take a large share of their value generated. Improving producers' access to markets has long been identified as key issue in developing small-scale agriculture in Uganda (Okello & Asingwire, 2011, p. 143).

The use of information and communication technologies (ICTs) is one approach to linking small-scale producers to markets, by enabling producers to perform informed decision-making during selling and when farming (Magesa, 2015, p. iv). ICTs also have a role to play in GI implementation, by supporting open sharing of information about production, and by ensuring the flow of market information. Thus ICTs and GIs share attributes in linking producers to markets and affecting their decisions at both production and marketing levels.

The research on which this Working Paper is based examined how ICTs can be deployed for use in the implementation of GIs in Uganda. First, we outline the methodology and research design of the study. The section that follows (section 3) draws the analytical framework for the interaction between traditional agricultural knowledge, ICTs and scaling up. Section 4 provides an overview of Ugandan ICT policy. Section 5 explores major ICT initiatives that have been adopted in the Ugandan agricultural sector: the Grameen Foundation's Community Knowledge Worker (CKW) programme, the Busoga Rural Open Source and Development Initiative's (BROSDI's) Collecting and Exchange of Local Agricultural Content (CELAC) programme; and the Women of Uganda Network's (WOUGNET's) ICT initiatives. In section 6, the paper discusses the legal framework for the protection of GIs in Uganda. It also examines the practical aspects of GI implementation, based on a case study of

Mukono vanilla production, and analyses the role of ICT initiatives in the operationalising of GIs at the production and marketing stages of agricultural production. Section 7 concludes the paper with a summary and suggests future directions in utilising ICTs and GIs in agricultural production in Uganda.

II. Research Design and Methodology

The overarching question for this case study was: What is the role of agricultural ICTs in scaling up traditional knowledge (TK)-based agricultural production, and what is the potential of GIs in this process?

The study was primarily aimed at understanding:

- the various agricultural ICT initiatives in place in rural Uganda;
- the role of such initiatives in supporting the exchange and dissemination of traditional agricultural knowledge;
- the Ugandan legal framework in place for the protection of GIs; and
- how agricultural ICT initiatives can be deployed as a means of supporting the operationalising of GIs at the production and marketing stages.

The study, a qualitative case study, consisted of desk-based research, combined with semi-structured interviews and non-participant observation. The desk research involved an analysis of several reports and documentation from the organisations and groups targeted in the study. In this respect, the study looked at national, regional and international papers, articles and stakeholder reports on ICT initiatives in Uganda that are pertinent to agricultural production. The legal framework for GIs in Uganda, and policy documents on ICTs in agriculture, were also examined.

A qualitative case study research design was adopted because it is useful in interrogating observations that are not easily amenable to quantitative analysis. The interviews were conducted, in person and via telephone, with key stakeholders based on a semi-structured questionnaire composed of 18 questions in three parts: general information, use of technology in agricultural production, and implementation and enforcement of GIs. The target respondents for the questionnaires included vanilla producers, intermediaries, and qualified experts in the realm of ICT initiatives in agricultural production. The interviews were carried out in December 2016 and May 2017.

The interviews focused on various participants in the production and processing of Ugandan vanilla in Mukono District: in Mukono town and in the Kisoga and Koja areas. The producer interviewees were primarily drawn from the Mukono Vanilla, Spices and Horticulture Cooperative Society and Esco Uganda Ltd. The use of ICTs was examined through interviews with representatives of the aforementioned Grameen Foundation, BROSDI, and WOUGNET initiatives. The study also engaged in non-participatory observation of the daily operations of agricultural producers, with particular focus on vanilla producers in the Mukono District.

III. Analytical Framework: Traditional Agricultural Knowledge, ICTs, and Scaling Up

The term "traditional agricultural knowledge" refers to the category of knowledge that plays important roles in resource management and environmental decision-making by Indigenous peoples and communities in the context of agriculture. Traditional agricultural knowledge plays a key role in the day-to-day activities of farming communities around the globe. Compared to other forms of agricultural practices,[1] traditional agricultural practices appear to have more positive effects, as these practices help to conserve, foster, and even create biodiversity (Oviedo, 2000, p. 6). The role of traditional agriculture in sustaining biodiversity and ecosystems is best illustrated by the special relationship that cultural distinctness has with biological diversity in a particular region.

Given the positive relationship between traditional agricultural practices, biodiversity and ecosystems, rural strategies to scale up agricultural production should recognise the interaction between "environment, genetic resources and the management systems and practices used by culturally diverse peoples" (FAO, 1999). The collective traditions and collective decision-making processes underlying GI law ensure that the deployment of ICTs to support traditional agricultural practices can be a useful strategy in scaling up agricultural economies, while paying attention to environmentally sustainable practices. Agricultural technologies play a significant role in facilitating the sharing of sustainable production practices, and in creating a link between agricultural economies and the market.

It is important to understand the intersection of technology and traditional agricultural knowledge in analysing the role of ICTs in the implementation of GIs. In broad terms, technology is understood as "the knowledge/information that permits some tasks to be accomplished more easily, some service to be rendered or the manufacture of a product" (Mwangi & Kariuki, 2015, p. 209). According to the UN Development Programme (UNDP), ICT "is a pervasive input to almost all human activities: it has possibilities for use in an almost endless range of locations and purposes" (2001, p. 35). In this respect, agricultural technologies are "discrete biological/physical structures […] and management practices that farmers employ in production and post-harvest handling together with land, labor and capital" (Bolwig, 2006, p. 4).

This study was primarily interested in investigating technologies aimed at improving the flow of information between value-chain actors in agricultural production. It focused on a subset of technologies, ICTs, defined as "communication devices or applications encompassing radio, televisions, cell phones, computer networks [...] as well as the devices and applications associated with these" (Gascó-Hernandez, Equiza-Lopez, & Acevedo-Ruiz, 2006, p. 118). These include: hardware; software; media for collection, storage, processing, transmission and presentation of information in any format (i.e., voice, data, text and image); computers, the internet, CD-ROMs,

[1] Modern forms of agriculture are antithetic to the conservation and preservation of biodiversity, as they sometimes contribute to its reduction "by the reclamation of natural ecosystems and by leveling out natural variety in abiotic conditions through drainage, fertilizing, and pesticide use" (Council of Europe, 2002, p. 39).

email, telephone, radio, television, video, and digital cameras (Asenso-Okyere & Mekonnen, 2012, p. 1).

ICTs have revolutionised every aspect of our lives, and have made it easier to overcome time and distance impediments in the dissemination of agricultural information. Like the rest of the world, Uganda has experienced rapid changes in its ICT sector in recent times. ICTs are critical in agricultural development because they are tools for communication between stakeholders, and they serve as channels for assessing trends and shaping decisions. Agricultural ICTs improve the ability of rural farmers to "obtain information for sound decision-making", and assist "farmers in identifying potential buyers and purchase of inputs in rural markets" (Auma, Wangia, Magomere, Ligare, & K'obill, 2017, p. 55).

The hypothesis of our study was that ICTs have the potential to help the implementation of GIs by improving the communication of knowledge and information, by building capacity, and by fostering market access, for rural agricultural communities at the production level. ICTs can be deployed in the agricultural sector both as strategies to improve production quality and as marketing tools to obtain direct access to global markets (OTF Group, 2007, pp. 48–51). The impact of ICTs in the agricultural sector can be significant in improving productivity and "scaling up inter-linkages of development interventions" (Munyua, Adera, & Jensen, 2009, p. 1). As a previous Open AIR study demonstrated, GIs play a significant role in networked, collaborative traditions of knowledge generation among local communities and diverse stakeholders involved in specialty agricultural production (Oguamanam & Dagne, 2014). As such, GIs provide a useful policy framework to facilitate and support the scaling up of collaborative innovation in traditional knowledge (TK)-based agriculture. Given TK's prominent value in urban and rural applications in Africa (Elahi & De Beer, 2013), the effective deployment of ICTs as a means of operationalising GIs facilitates and supports TK-based Indigenous entrepreneurship. The study on which this Working Paper is based analysed the role of ICTs in instrumentalising GIs as a means of scaling up collaborative knowledge-based production and innovation in the agricultural sector in Uganda.

IV. Uganda ICT Policy

The government of Uganda has recognised that ICTs have become a key enabler of economic and social transformation, as clearly articulated in the National Development Plan 2010/2015 where the ICT sector is identified as one of the primary growth sectors (Republic of Uganda, 2015). The government has also long recognised the importance of addressing new trends occasioned by the rapid changes in technology and characterised by the advent of the internet—as evidenced by the approval by Cabinet of a National Information Communication Technology Policy Framework in 2003 to guide the development of the ICT sector (Government of Uganda, n.d.). In 2006, the Ugandan government created a fully-fledged Ministry of Information and Communications Technology, with the aim of bringing together different aspects of ICT that were scattered in different government ministries. The Ministry created the National Information Technology Authority-Uganda (NITA-U), whose mandate is to coordinate, promote and monitor ICT development within the context of national social and economic development (UNCSTD, 2010). The NITA-U is currently undertaking a

number of initiatives, such as the District Business Information Centres, which are aimed at promoting affordable and timely access to ICTs in rural Uganda (UNCSTD, 2010, p. 3).

The Uganda Communications Commission (UCC) is another key player in the ICT sector with a principal goal of developing a modern communications sub-sector and infrastructure in Uganda (UNCSTD, 2010. p.3). The UCC conducts the Rural Communications Development Fund (RCDF) initiative whose main objectives are: to provide access to basic communications services such as telephones, computers and internet within a reasonable distance to all the people in Uganda; to leverage investment into rural communications development; and to promote ICT usage in Uganda (UNCSTD, 2010, p. 3). The implementation focus areas for the RCDF are those areas considered financially unviable by commercial telecommunication operators (Etta & Elder, 2005, p. 224). The government has also removed taxes on all imported ICT equipment—a step considered to have gradually reduced the costs of providing ICT services (Etta & Elder, 2005, p. 224).

In 2014, the government introduced the National Information and Communications Technology Policy for Uganda, which builds on the 2003 National ICT Policy Framework and incorporates new policy directions in line with technological advancements (MICT, 2014). The policy document details the government's objectives for ICTs, and sets out a strategic framework for meeting those objectives. It identifies the use of ICTs in education, health, agriculture, commerce, and a number of other sectors as emerging policy areas that require government's policy input (MICT, 2014, p. 7). Most importantly in the field of agriculture, the policy identifies the need to ensure "the systematic sharing and dissemination of information on agriculture, animal husbandry, fisheries, forestry and food security" through the use of ICTs (MICT, 2014, p. 42).

Particularly pertinent to the scope of this study is the 2014 Policy's recognition of the roles of the private sector and non-governmental organisations (NGOs) in facilitating access to ICT in rural parts of Uganda (MICT, 2014, p. 44). Various actors from the private and NGO sectors have spearheaded efforts to expand ICT adoption in rural areas and to increase and expand ICT infrastructure coverage. In the next section, we outline the ICT initiatives that use ICT as a tool of agricultural knowledge exchange and dissemination—and which we focused on in our research.

V. Agricultural ICTs in Uganda

There are a number of ICT initiatives in the agricultural field that are aimed at communicating knowledge and information to rural agricultural communities in developing world, providing capacity-building, access to markets and credit, and restructuring of extension services (Qiang, Kuek, Dymond, & Esselaar, 2012). While many of these ICT initiatives focus on the various intersections of ICT and agriculture—such as the provision of nutrition and health services, banking and financial services, employment and livelihood opportunities—some focus on the provision of knowledge and information in agricultural production and marketing.

Our study focused on categories of ICT initiatives that play a significant role in delivering agricultural production and marketing information to smallholder farmers in rural parts of Uganda. These

initiatives serve as vehicles for the exchange and dissemination of traditional agricultural knowledge on agricultural practices and inputs, as well as for the delivery of information on prices, weather forecasts, and/or buyer and seller information. As such, they have particular relevance to our focus on the operationalisation of GIs as tools of agricultural production and marketing. The most significant ICT initiatives we identified that have relevance to agricultural production in rural Uganda are those, as mentioned above, run by the Grameen Foundation, the Busoga Rural Open Source and Development Initiative (BROSDI), and the Women of Uganda Network (WOUGNET). The following sections explore the activities and mechanisms of the ICT-based programmes run by these three entities.

A. Grameen Foundation Community Knowledge Worker (CKW) Programme

The Grameen Foundation ("Grameen") was created in 1997 to "enable the poor, especially the poorest, to create a world without poverty" (McCole, Culbertson, Suvedi, & McNamara, 2014, p. 9). It owes its origin to the Grameen Bank (GB), which first entered the rural telecom sector in Bangladesh, based on the premises that: asymmetry in possession of technology is a driver of inequality and poverty; that telephonic services can positively impact economic decisions confronting rural households; and that the question of "who controls the technology" must be addressed (McCole et al., 2014, p. 9). Grameen's work in Uganda began in 2002, when the foundation partnered with telecommunications operators and microfinance institutions, creating the first Village Pay Phone Programme outside of Bangladesh (Grameen, n.d.).

i. Programme Structure: The CKW Model

Grameen created the Community Knowledge Worker (CKW) programme, a form of agricultural extension and advisory service, in Uganda in order to facilitate the dissemination of agricultural information to rural farmers (Grameen, n.d., p. 9). The programme uses mobile-enabled advisory services with networks of trusted community members to complement traditional agricultural extension systems (Gantt, 2016, p. 31). The programme has built a network of peer-nominated farmer leaders, the CKWs, across Uganda who use mobile phones to share agricultural information with smallholder farmers. The CKWs also use mobile phone-based surveys to gather information from farmers for agricultural extension organisations (Gantt, 2016, p. 31). The programme facilitates bi-directional communication between farming communities, research organisations, government extension agencies, buyers, NGOs, and other groups working with farmers. The two-way communication between farmers and organisations allows sector-wide learning, as it allows farmers not only to access up-to-date information but also to articulate their own challenges and priorities (Gantt, 2016, pp. 31–32).

Grameen, in concert with their partner organisations, selects which areas are to receive the CKW programme, only expanding to an area where it has found a partner to share the expansion costs (McCole et al., 2014, p. 11). Because of this, the communities that receive the programme reflect the interests of the partner organisation as well, not just Grameen (McCole et al., 2014, p. 11). Private-sector partners provide technological support for the CKW programme. In Uganda, Grameen has partnered with MTN Uganda, the nation's leading mobile network operator, to provide the infrastructure necessary to connect farmers with information (McCole et al., 2014, p. 10). Google has donated Android phones and a 1,000 solar phone chargers, while Salesforce.com has donated

licences for its software, which is used as the interface for the programme's administrative and survey database. Atlassian provides the software that allows Grameen to streamline operations (McCole et al., 2014, p. 10).

ii. Selection Process

The CKW programme first engages communities to select a farmer who will serve as the local community knowledge worker—the agent at the centre of the model (Gantt, 2016, p. 33). The first step of the selection process is to obtain a list of eligible candidates, which is provided by Grameen's partners (Gantt, 2016, p. 31). Once a list is obtained, the Grameen team then goes from village to village promoting the selection process through broadcasts on public radio and in mosques and churches (Gantt, 2016, p. 46). There is then a selection meeting where Grameen presents the list of candidates, and describes what an effective CKW does (Gantt, 2016, p. 46). Grameen requires that a CKW be a permanent resident of the area, a farmer, literate in English, fluent in the local language, and able to visit other farmers (Gantt, 2016, p. 31).

Communities are then encouraged to debate which candidate best fits the position of CKW (Gantt, 2016, p. 31). Gathering community input is expensive, but experience shows that participatory selection is important in validating the CKW position. A community's trust in a CKW and its long-term participation in the feedback process depends on the community's meaningful involvement in the selection process (Gantt, 2016, p. 47). Communities are encouraged to select someone who has a deep commitment to community service and is trusted by the community. During CKW selection and training, so as to prevent the further marginalisation of already marginalised groups, Grameen representatives monitor the poor and poorest people who access the services, set targets for the participation of women—aiming for half of all CKWs to be women (McCole et al., 2014, p. 11)—and speak about the importance of services for community benefit (Gantt, 2016, p. 47).

iii. Training

After CKWs have been selected, they must be trained. CKWs are usually trained at a specific location, in two classes of approximately 25 each. They are provided with housing, and also receive a travel allowance (McCole et al., 2014, p. 11). CKWs then receive four 10- to 12-hour days of instruction, in English. The programme starts with the philosophy and background of the initiative, a programme value proposition, and the expectations of the programme (McCole et al., 2014, p. 11). The second part of the training is skills-based. The CKWs are shown how to use a smartphone, how to use the CKW platform (e.g., searching, registering farmers), and how to use support functions. They also engage in role-playing to help them learn how to identify keywords from narratives that farmers convey to them (McCole et al., 2014, p. 11).

CKW candidates can drop out at any time during the training, but the attrition rate is only about 4% (McCole et al., 2014, p. 12). After their training, candidates sign a commitment to participate. Refresher courses are offered periodically after the initial training. During these courses, CKWs refresh their data collection and enumeration skills, learn survey ethics, and/or do preparation for new surveys (McCole et al., 2014, p. 11). After the initial training, CKWs must make a deposit of UGX10, 000 (about USD4) for their communication package (McCole et al., 2014, p. 11). This package

includes a phone, a solar-powered battery charger, a weighing scale, and a measuring band to record the girths of livestock for nutritional content and pharmaceutical dosing (McCole et al., 2014, p. 12).

The programme aims to select individuals who are personally motivated to serve their communities; many CKWs will in fact support other local farmers even without any formal incentive (Grameen, 2014, p. 6). Although CKWs are recruited as volunteers, Grameen provides monthly, performance-based financial incentives, with the intention of offsetting the opportunity costs that come with a sacrifice of time on CKWs' own farms (Grameen, 2014, p. 6). Each month, CKWs are expected to register 15 new farmers and complete 48 agricultural database searches for farmers (Grameen, 2014, p. 11). Additionally, they agree to have UGX20,000 withheld from their pay each month for the next two years as part of a rent-to-own scheme for their mobile phones (Grameen, 2014, p. 12). The CKW platform automatically records database searches and the GPS coordinates of where a search, a survey, or a farmer registration occurs (McCole et al., 2014, p. 11). These records are used to pro-rate the performance-based incentives (McCole et al., 2014, p. 11). CKWs are also encouraged to charge neighbours' mobile phones with the CKW-programme-issued solar-powered battery chargers (McCole et al., 2014, p. 11).

The benefits of being a CKW include access to mobile phones and charging stations for the CKW's personal use. From these charging stations, many CKWs power small electrical devices for their houses such as lights and radios. They also receive a benefit through improving their own farming practices based on information in the agricultural database. There are also intangible benefits, such as the intrinsic reward of knowing they are helping to improve the lives of their fellow community members, the increased knowledge they obtain, and their enhanced status in the community (McCole et al., 2014, p. 12).[2]

iv. Operation in the Field

After their training, CKWs are sent into the field with their smartphones, and the preloaded CKW App Suite, to obtain answers to farmers' agricultural, meteorological, and economic enquiries (Van Campenhout, 2013). The Search application was developed in Grameen's Applab, and allows a large amount of information to be accessed. The app can provide information on farmer best practices, and allow for access to three-day and long-range weather forecasts. It can provide up-to-date crop prices for the farmer's region and elsewhere. Also, because of information uploaded by the Uganda National Agro-Inputs Dealers Association, farmers are able to access supplies across the country, and are provided with supplier locations and contact information (Van Campenhout, 2013).

One of the unique features of the CKW Search app is that the agricultural database is programmed into the phone, allowing for access in areas without a network connection. When searches and surveys are done offline, the data are cached and once the CWK returns to an area with cell service, the CKW is able to update the database and submit the data to the central server (McCole et al., 2014, p. 11). Through an analytical dashboard, Grameen can track CKW performance, the locations of CKW workers, the number of farmers registered, and the impact of the information provided

[2] For example, CKWs reported their neighbours giving them titles of respect, such as "Doctor".

(Wanume & Birungi, n.d.). By tracking and categorising questions and responses, warning signs of potential disease outbreaks can be detected and thus mitigated (Wanume & Birungi, n.d.).

The CKW collects baseline data to understand the farmers, including their degree of adoption of sound agricultural practices (Wanume & Birungi, n.d.). These data are used to determine how information services are developed and targeted to farmers. Monitoring and evaluation efforts are ongoing and used to track farmers' feedback on service value, and to monitor how farmer behaviour changes (Wanume & Birungi, n.d.). Subsequently, the farmers' feedback is analysed to design and deliver new and improved services (Wardle & Grameen, n.d.).

As an initiative that utilises ICT, the CKW programme has great potential significance in the operationalisation of GIs in agricultural production.

B. Busoga Rural Open Source and Development Initiative (BROSDI)

BROSD is a non-profit, donor-funded NGO that began in the Busoga region of Uganda (Mandler, 2008, p. 30). BROSDI's objective is to promote agricultural productivity by training farmers in modern agricultural techniques, and increasing access to market information through the use of ICTs (Mandler, 2008, p. 30).

Originated from a brainstorming session, in 2004 BROSDI developed an information dissemination and collection project known as Collecting and Exchange of Local Agricultural Content (CELAC) (Akiiki, 2006). This project is a partnership between civil society and government, which aims to improve the livelihoods of rural farmers, and their food security, by sharing information through ICTs (Randle, 2008, p. 26). CELAC focuses on local agricultural content with the aim of reintroducing local farming practices, because the "chemical-based farming practices" introduced by the West have had negative impacts on "resultant harvests, the air we breathe, our environment, the soil fertility and on human life" (Randle, 2008, p. 26). The CELAC website has a large array of materials, which include online and offline newsletters—written in English and the local Luganda language—SMS text-messaging, radio call-in programmes, and music, dance, and drama recorded onto DVDs for use by local non-governmental organisations (Randle, 2008, p. 26). The project enables farmers to voice-record information and share it on FM radio and CDs in local languages (CELAC, n.d.). CELAC provides a weekly text message,[3] annual knowledge fairs, radio broadcasts, and the aforementioned items on its website (Munyua et al., 2009). The initiative also has resource centres with ICT facilities where farmers can ask agriculture-related questions via Yahoo and Skype conferencing (Munyua et al., 2009).

In order to collect and disseminate information through CELAC, the BROSDI field staff recruit and organise smallholder farmers who are interested in using ICTs to improve their lives as farmers. One member of the group (usually the most literate) is then designated the "community knowledge broker". The field staff seek out candidates who, in addition to being literate, are sociable, are willing

[3] The programme has a database of phone numbers to whom local agro-related information is sent every Monday (Qiang et. al., 2012, p. 29).

to share the knowledge communicated to them, are living in a rural area, are farmers, and, preferably, are women (Mandler, 2008, p. 30).

The broker is then given a mobile telephone handset to communicate with BROSDI members and agricultural markets. With this phone, the broker can communicate information from BROSDI, usually in SMS form, and disseminate it to fellow farmers (Mandler, 2008, p. 30). The interactions between the knowledge broker and the CELAC website, or the knowledge broker and field staff, is processed by BROSDI, and uploaded to a database—information that can then be accessed by others who are using the CELAC service (Cranston, 2009).

BROSDI uses a wide breadth of electronic formats to spread information on agriculture, health, and education. It disseminates information through blogs, wikis, podcasts, and RSS feeds (Mandler, 2008, p. 76). BROSDI has opted to promote the use of internet-based formats rather than SMS formatting to allow its users to avoid SMS charges from mobile operators (Cranston, 2009, p. 6).

BROSDI also encourages user-generated content. Through their podcasting network, the farmers' experiences are recorded: experiences such as "the difficulties they face, successes they have achieved and advice they would want to give others engaged in similar practices" (Jorgensen, 2010, p. 40). Interviews, done in local languages and translated into other languages, are converted to MP3 and uploaded to the podcasting network (Jorgensen, 2010, p. 40). By using this format, local farmers contribute to the canon of agricultural knowledge. Podcasts also allow for those of older generations, who may not be literate, or may not see electronic screens well, to expand their knowledge. If there is no internet access in the area, BROSDI will send CDs so that materials can be accessed on an offline computer (Jorgensen, 2010, p. 40).

BROSDI has also engaged in a citizen journalist project, which records stories and advocates for local development using ICTs (Jorgensen, 2010, p. 40). This particular initiative started with a survey that asked farmers about the challenges they faced with regard to agricultural information. The results of the survey indicated that markets were diminishing, and that there was a need to collect agricultural expertise and the agricultural experiences of past generations (Jorgensen, 2010, p. 40). The information from the survey was translated and distributed through blogs, Google Maps, wikis, databases, and chat rooms. Furthermore, the project allowed farmers to write blocks of text in their local languages, which were then translated into English to reach an even wider audience (Jorgensen, 2010, p. 41).

The primary users of CELAC's services are farmers, community development workers, and agricultural extension workers (Qiang et al., 2012, p. 32). CELAC also caters to farmers' organisations and NGOs by providing its DVDs containing information on farming practices—portrayed through dance and music to enhance learning through increased accessibility (Qiang et al., 2012, p. 32). These activities have significance relevance to improved production methods, to marketing of agricultural products, and to potential implementation of GIs.

C. Women of Uganda Network (WOUGNET)

WOUGNET is an NGO initiated in May 2000 by several Ugandan women's organisations (WOUGNET, 2017). These organisations came together to "promote and support the use of ICTs as tools to share information and address issues of sustainable national development collectively" (Owiny & Apio, 2017, p. 2). WOUGNET's mission is to promote and support the use of ICTs by women and women's organisations in Uganda, so that they can take advantage of the opportunities presented by ICTs to effectively address national and local problems of sustainable development (WOUGNET, 2017). Three specific objectives are described as guiding WOUGNET's programme activities: information- sharing and networking; technical support; and gender and ICT policy advocacy (WOUGNET, 2017).

The first objective aims to provide "relevant information to urban and rural women and sharing of experiences for purposes of improving quality of lives" (WOUGNET, 2017). This is done through online and offline channels. The online channels include electronic mailing lists, an e-newsletter about the happenings at WOUGNET and at its members, the WOUGNET website itself, and social media. The offline channels include community radio, a resource centre, and rural information centres. WOUGNET also helps to implement a program in which women in rural areas are provided information (WOUGNET, 2017).

The second objective is to provide technical support. The ICT field is fast-changing, and in order to adapt to these changes, WOUGNET puts some of its resources into researching and piloting new software and hardware technologies with their members (WOUGNET, 2017).

The third objective is that of gender and ICT policy advocacy. This branch of WOUGNET has the aim of "effectively influencing the formulation and implementation of gender sensitive ICT policies and programs" by collaborating with its members (WOUGNET, 2017). WOUGNET serves as the secretariat for the Uganda Women's Caucus on ICT (UWCI), an organisation that aims to address gender concerns in ICT initiatives. WOUGNET also researches and analyses issues of internet access and e-governance, and seeks to ascertain which ICT policies are most effective. It then communicates the findings to policymakers and decision-makers (WOUGNET, 2017). In the field, WOUGNET helps to implement projects that promote gender equality, such as promoting the economic empowerment of women entrepreneurs (WOUGNET, 2017).

Through the programme activities guided by the three objectives, WOUGNET anticipates making a significant contribution to the use of ICTs in Uganda, one that is in line with the national vision of "a knowledge-based Uganda where national development and good governance are sustainably enhanced and accelerated by timely and secure access to information and the efficient application of ICT" (WOUGNET, 2017, p. 101).

WOUGNET has several projects and partnerships, but the Kubere Information Centre (KIC), located in Apac District, is considered the "heartbeat" of WOUGNET's information-sharing programme (Maree, Piontak, Omwansa, Shinyekwa, & Njenga, 2013, p. 22). Through this initiative, WOUGNET has worked with women farmers in Northern Uganda by integrating ICTs such as mobile phones, radio, internet, computers and information centres, to send and receive messages relating to crops

and disseminate agricultural information. The KIC was originally established in 2005, under the programme Enhancing Access to Agricultural Information using ICTs (EAAI) (Maree et al., 2013, p. 21). It is a multidimensional information centre created for local women farmers to answer their agricultural enquiries, specifically offering development-oriented information with an emphasis on agriculture and rural development (WOUGNET, 2017). KIC allows women farmers to find answers to agricultural questions. It disseminates most of its information through Radio Apac, in a programme that runs on a weekly basis (WOUGNET, 2017). In the centre itself, there are computers are connected to the internet, and equipment that allows for teleconferencing (Okello & Asingwire, 2011, p. 104).

The KIC focuses mostly on female smallholder farmers in Apac District. The Centre works with 12 groups, each of which is comprised of 30 female farmers (Okello & Asingwire, 2011, p. 104) with a chairperson designated in each group. This person becomes the conduit between the farmers and the WOUGNET staff at the KIC, assuming the responsibility of receiving information on behalf of the group and of safekeeping the ICT equipment that is provided to the group by WOUGNET: a CD/radio player and a mobile phone (Okello & Asingwire, 2011, p. 104). It is through these lines of communication that the women receive agricultural knowledge and information about the markets where they sell their produce (Okello & Asingwire, 2011, p. 104). While the KIC was initially primarily targeted at the Apac District, it is now the base for WOUGNET project activities in the districts of Amuru, Gulu, Kole, Lira and Oyam as well (WOUGNET, 2017).

We see, in the participation of agricultural producers in the WOUGNET ICT initiatives, as with the Grameen and BROSDI programmes, manifestations of agricultural producers' commitment to collective traditional production methods and the sharing of agricultural information. By facilitating the provision of knowledge and information for agricultural production and marketing, each of these initiatives has the potential to provide the basis required for implementation of GIs. In the instrumentalisation of GIs as tools for agricultural development, these ICT initiatives can play a role by supporting the open sharing of information about production, and by ensuring the flow of market information. The combination of GIs with ICT initiatives provides an alternative model of agricultural development that is built on collective sharing of agricultural knowledge and practice. But before analysing of the potential role of these ICT initiatives in the implementation of GIs, we must the briefly explore the existing legal framework for GIs in Uganda.

VI. Legal Framework for Protection of GIs

The first step towards a GI protection system is to develop a legal framework. Most African countries do not have well-developed system of intellectual property rights (IPRs), including those pertaining to GIs. In light of this, introducing a functional system of GIs requires the establishment of institutional, legislative and organisational frameworks. Uganda's Geographical Indications Act of 2013 defines, recognises, and specifies various GI rights that apply to diverse agricultural products, thereby establishing a specific legal and institutional framework for GIs.

But beyond simply enacting a legal framework, the implementation of GIs requires the establishment of institutional and administrative mechanisms for the identification and registration of products eligible for GI protection. There is also a need to build the institutional infrastructure and expertise required to establish, monitor and control production methods that contribute to the "quality, reputation or other characteristics" of the product, which is a basis for GIs protection of a particular product (Republic of Uganda, 2013, section 8(3)). In this respect, the Uganda GIs Act provides for the creation of an office of the Registrar of Geographical Indications, which is to manage the registration of GIs (sect. 6(1)). The Act also mandates the appointment of as many officers as may be necessary for the efficient discharge of the duties and functions of the Registrar of GIs (sect. 6(2)). Moreover, the Registrar is required to "establish and maintain a register of [GIs]" and to receive applications for registration (sect. 7(1)). The Act also stipulates conditions under which a product may be entered in the register as a GI (sect. 7(2)).[4]

The right to register a GI in the country is vested in one of three categories: a legal entity carrying on an activity—such as producers, farmers, artisans—relating to the product to which the GI is applied (in the area specified); a group of representative producers; or, in respect of an indication with national character, "any competent authority" (sect. 8(3)). The procedure for GI registration involves the following stages: lodgement of application, examination and correction of errors/amendments, publication, notice of opposition, counter-statements, acceptance or rejection—and, in the case of rejection, a right to reapply or appeal to court—and final registration (sect. 9–10).

A. Implementation of GIs at Level of Production: Example of Mukono Vanilla

As mentioned above, the key tasks required for implementation of GIs are the setting up legislative and institutional systems of registration and enforcement of GIs (see, for example, Barclay, 2010). The Ugandan GIs Act requires an implementing regulation to provide for such a system. The Uganda Registration Services Bureau was, at the time of our research, preparing such implementing regulations.[5] In the implementation of GIs, such a regulation is expected to stipulate the processes of registration, certification, and protection, of GIs. In this respect, the first step is the identification of the community in charge of the rights and duties associated with the use of a GI. The primary stakeholders for GI registration are producer collectives organised in the form of cooperative unions or other forms of organisations that have legal standing.

The major Ugandan vanilla producer region is the Mukono region in central Uganda. Mukono vanilla is known for having the highest vanillin content in the world (Mpeirwe, 2013). Vanillin, an aromatic compound that is attached to vanilla sticks in the form of fine crystal needles, determines the strong odour and taste of vanilla. Producing vanilla is extremely labour-intensive. Every vanilla flower has to be hand-pollinated. It takes about six months before the long, odourless, yellow-green fruits—which look like pods, but are actually berries—are ripe. After the berries are collected, they are cured in a

[4] These include (a) that the indication identifies the goods to which the indication pertains and identifies the goods as originating in a particular country, region or locality; (b) a given quality, reputation or other characteristic of the goods is essentially attributable to its geographic origin; (c) as applied to the goods identified in the application, the indication does not contravene the provisions of this section; and (d) an application for registration is filed with the registrar on the prescribed form (Geographical Indications Act, 2013, sect. 7(2)).

[5] Interview with Fiona Bayiga, Director of Intellectual Property, Uganda Registration Services Bureau, 14 December 2016.

fermentation process that takes some months and requires a great deal of expert knowledge.[6] Good vanilla production practices, namely planting shade trees, minimal weeding, and non-use of chemicals, engender a more sustainable environment than that which is possible for many other crops (Wals, 2009). The labour-intensive nature of vanilla production has made it the world's second-most expensive spice, after saffron (Fierberg, 2018).

Given the introduction of a legislative framework for GIs, the first step that producers of vanilla have to contend with is the process of registration, certification, and accessing protection of GIs. This requires the existence of entities who will be the bearers of GI rights. Our research identified four large producer associations in the Mukono region, but there are also many small-scale farmers who work independently or in smaller groups. Besides being a registrant of GIs rights, the organisational participation of producer groups is necessary to ensure that collective norms of production are adequately protected, regulated, and supported. The successful implementation of a GI system with respect to a particular product requires the presence of producers' organisations with a structure that allows collective participation in registering, maintaining, and protecting GIs rights (INRA, 2008, p. 3).

One of the producer groups that we found has vast experience in vanilla production and processing is the Mukono Vanilla, Spices and Horticulture Cooperative Society. At its peak, this Cooperative Society had 2,000 farmers as members. It is a producers' cooperative engaged in the production, collection, processing and exporting of quality vanilla. The cooperative, headed by John Nviiri, is also network for learning quality vanilla production and processing in Uganda. The cooperative works with local farmers to increase awareness and disseminate knowledge about vanilla production and processing. Given the highly technical nature of growing and processing vanilla, the cooperative ensures adherence to certain standards of production by its members. Until 2011, the cooperative exported vanilla products collected from its members, and dried and cured through a cooperative facility, to a Canadian vanilla processing company, Aust & Hachmann (Canada) Ltd.

The quality of the vanilla beans depends on the farmers' adherence to strict production methods and activities at the different stages of vanilla production. According to Nviiri, the Mukono Vanilla, Spices and Horticulture Cooperative Society lost its competitive advantage in the provision of vanilla due to loss in the quality of vanilla—primarily because of non-adherence to production methods by farmers.[7] The loss of quality of the vanilla produced in the region, coupled with fluctuating prices for vanilla in international markets meant that the cooperative closed its once-vibrant vanilla drying and curing facility and stopped selling vanilla directly to foreign importers. As a result, farmers now sell their products to local collectors who then sell them to local wholesalers, who process the vanilla in their facilities before exporting it to foreign importers. This means that there are additional value-chain actors between the vanilla growers and foreign importers, resulting in a diminished role for vanilla growers in the price determination for their product in the market. Thus the reduction in quality, and the decrease in control of agricultural production, have contributed to a loss of market power.

[6] Interview with John Nviiri, Mukono District, 15 December 2016.
[7] Interview with John Nviiri, Mukono District, 15 December 2016.

As tools of agricultural development, the implementation of GIs can be a useful strategy to empower agricultural producers by entrenching local agricultural knowledge as a basis of production. In this scenario, the ICT initiatives reviewed above have a potential role to play in the implementation of GIs, by facilitating the distribution of agricultural knowledge. The following section elaborates this in more detail.

B. Role of ICTs in Implementation of GIs at Level of Production

At the production level, agricultural ICTs help in the implementation of GIs by facilitating the exchange of information on appropriate agricultural practices, as well as through providing reliable and cost-efficient inputs such as extension advice, mechanisation services, seeds, and fertilisers.

Under Grameen's CKW programme, the smart phones deployed in the programme are loaded with the CKW App Suite, which includes a searchable library of agricultural information, a data-collection tool, and an application that enables real-time, two-way communication (Grameen, 2014, p. 5). The information disseminated to farmers in this way includes production tips, prescriptive advice for pest and disease control, and general information about crop and livestock varieties. In addition, three-day weather forecasts provided by Uganda's Department of Meteorology can be retrieved, along with seasonal forecasts. The CKWs also provide access to an extensive knowledge base on farmer best practices. In partnership with local organisations such as the National Agricultural Research Organisation (NARO), the National Agricultural Advisory Services (NAADS), and the International Institute of Tropical Agriculture (IITA), the CKW programme provides farmers with information that is tailored to address local needs, and is immediately usable. For example, Grameen worked with the IITA to develop and test a diagnostic survey that enables CKWs to help farmers identify which banana disease was present on their plantation and then use that diagnosis to teach farmers how to control the disease (Gantt, 2016, p. 36). Farmers found the diagnostic surveys and disease control information so useful that CKWs had to travel outside their sub-counties to meet farmer demand (Gantt, 2016, p. 36). It is clear from the available literature that CKW agricultural services effectively influence farmers' adoption of good agricultural practices. In an evaluation of the CKW services, the International Food Policy Research Institute found a 17% increase in farmer knowledge of best practices, and a 34% increase in access to extension services (Gantt, 2016, p. 37).

BROSDI provides a forum for agricultural producers to share and promote information and innovative techniques directly generated by the farmers themselves. The participatory model that BROSDI employs has addressed gender and cultural factors that have in the past limited accessibility of knowledge (Akiiki, 2006). Using BROSDI's information-sharing and knowledge-exchange platform, a number of farmers have found new markets and connected with other producers to engage in collective production and marketing techniques (Pedrick, 2015, p. 24).

In a programme similar to Grameen's CKW, WOUGNET provides women with relevant and simplified agricultural information, disseminates local agricultural content, and, through its training programmes, builds women's capacity to use ICT tools such as mobile phones and computers. The available literature suggests that farmers more easily adapt to better farming techniques, and thus

increase yields and production per unit area, when they have access, via ICTs, to timely weather forecasts; production tips; information about livestock and plant varieties; marketing opportunities; information on pest and disease control; post-harvest strategies; loss mitigation information; and market information (Maree et al., 2013, p. 22). Research has found that WOUGNET's efforts have increased the production of commodities within targeted farming communities by facilitating the adoption of better methods of production (Owiny, 2012).

In the implementation of GIs, there is a need to ensure collective methods of production that form the bases for maintaining the distinctiveness of the product. This requires active coordination and cooperation of national, regional and local administrative authorities with producer groups, to adopt and to administer compliance mechanisms for agricultural production (Rangnekar, 2007, p. 126). Such efforts ensure the distinctiveness of the product and prevent the GI from becoming generic through unregulated production processes.

The protection of GIs and their continued use depend on strict adherence to TK-based production methods, so the use of ICTs to disseminate and facilitate good agricultural practices is a significant factor in helping farmers to acquire GI rights and to maintain them. In a country such as Uganda, where local administrative authorities generally lack the ability to conduct the inspection and monitoring that is required to maintain GIs rights, the adoption of ICTs in the form of the CKW initiative would result in a voluntary compliance system, which would ensure that production standards are controlled and applied in a uniform manner. To conclude, ICT-based methods of information provision play a major role in communicating knowledge and information among farmers whose social customs of agricultural production—such as selecting, saving, swapping and replanting seeds—may be incorporated in GI regulations as recognised methods of production that ensure quality expectations are set.

C. Role of ICTs in Implementation of GIs in Agricultural Marketing

The operational use of GIs involves activities to capture the market value of products, and to maintain and expand the market share of the products. In this regard, the task of GI implementation covers activities that go beyond registration and complying with protection requirements. The operational use of GIs requires commitment to tasks that are necessary to enhance markets and to generate revenues from products that the GI law protects. In this respect, the role of ICTs in helping producers achieve marketing success is a significant factor in operationalising GIs in a country such as Uganda. This section evaluates the conditions under which ICTs may be used to assist in the operational use of GIs through marketing for speciality agricultural products.

Agricultural producers, such as the Mukono vanilla growers, lack access to markets and marketing information. Poor access to markets and marketing information has left rural farmers exploited by other players in the product's value chain. Farmers are at the mercy of local collectors in determining the price at which they can sell their products. They often do not know the prices their products realise at distant markets. And, due to poor road infrastructure and financial constraints, they often cannot transport their produce to distant markets themselves. Traders and middlemen visit the

farmers at their homes and local markets and make purchases there.[8] In most cases, the farmers' negotiations are based on the prices proposed by the traders or middlemen and, as a result, they acquire only a small share of their production. Traders and middlemen take advantage of farmers' lack of knowledge of market prices; pocketing a large share of the profits.

The use of ICTs serves to link smallholder farmers with the market, with a view to increasing farmer's income. Agricultural technologies help small-scale farmers perform informed decision-making—at both production and marketing stages of their agricultural production. Besides supporting agricultural production through the provision of agricultural information, ICTs are also deployed to link producers with markets. Based on information acquired through agricultural technologies, producers can now make informed decisions when selling, thus reducing information asymmetry and bypassing intermediaries (Magesa, 2015, p. iv). The acquisition of market information thus impacts the selling decisions of individuals, thereby improving their bargaining power and income. It helps farmers decide on where to sell, when to sell, who to sell to, and how to plan their production. Through the use of ICTs, farmers may also be aware of the types and quality of produce being sought by national, regional and international customers (Magesa, 2015, p. iv). In this respect, the study identifies Grameen Foundation's "Farmer's Friend" app as an important example of an ICT initiative that helps Ugandan farmers in their marketing.

Farmer's Friend is an app for rural agricultural advice that was built for Uganda through a 2009 collaboration between Google, MTN Uganda, and Grameen (World Bank, 2017, p. 271). The app was created because many Ugandans have mobile phones but no internet access. The app allows people to use databases and search engines via SMS (texting) by entering searches and receiving answers as text messages (World Bank, 2017, p. 271). The primary users and beneficiaries of Farmer's Friend are smallholder farmers and traders (Heim, 2009).

Farmer's Friend is part of a group of five apps (AppLab) that combine text messaging, search engines, and databases of locally relevant information to provide weather forecasts, agricultural advice, and health tips. Farmer's Friend is supported by the virtual marketplace Google Trader, a user-generated trading bulletin that provides farmers with the contact details of traders and vice versa, through SMS posting and notifications (Heim, 2009). Using Google Trader, farmers are able to post their produce for sale, and receive queries from interested traders (Wanume & Birungi, n.d.). The app supplies Ugandan farmers with agricultural advice and information, sometimes collected with the support of BROSDI via SMS (Heim, 2009). Through the application, current prices for various crops in different locations can be requested. This price information is provided by FIT Uganda, a business development consulting company that collects prices on 46 commodities in 20 markets across Uganda (Van Campenhout, 2013, p. 3). Research indicates that access to information on agriculture commodity marketing through a CKW induces farmers to adjust their crop portfolio, moving from low-risk low-return to higher return crops (Van Campenhout, 2013, p. 3).

[8] Focus group discussion with vanilla farmers, Mukono District, 15 December 2016.

VII. Conclusion and Recommendations

Access to modern ICTs, and their effective utilisation to improve and sustain agricultural production throughout the world, have become critical as the world advances towards a global knowledge economy. The ICT initiatives examined in this paper are aimed at improving agricultural productivity through improved exchange of TK and the dissemination of information.

The BROSDI's CELAC project promotes the exchange of local agricultural content in rural Uganda by working closely with the government and civil society to promote knowledge-sharing and information management related to local agricultural content, using various ICT methods. The initiative seeks to empower rural communities to exploit their environment, using ICTs as a means of knowledge-sharing.

Similarly, WOUGNET carries out various activities that offer agricultural and rural development information for women by incorporating ICTs within new and pre-existing women's farming groups. Through its flagship agricultural extension programmes at the KIC, WOUGNET has worked with women farmers in Northern Uganda by integrating ICTs such as mobile phones, radio, internet, computers and information centres to send and receive messages relating to crops and disseminate a variety of agricultural information.

Meanwhile, we found that Grameen's CKW initiative is by far the most extensive agricultural ICT initiative in Uganda. It has a significant impact among farmers, with a unique model that challenges the weaknesses of other agricultural extension and advisory service programmes. The CKW initiative gives farmers access to vital information and services, mediated through a trusted member of local society who provides hands-on assistance and interpretation of agricultural information.

The use of ICTs in the manner described above manifests two aspects of agricultural production. The first aspect involves facilitating the dissemination of knowledge and information in the practices of agricultural production. The second aspect involves the provision of market information in the determination of prices of products. It is our view that it is imperative to harness ICTs to disseminate all aspects of agricultural information. The three ICT initiatives discussed above all constitute scalable networks that help close the critical information gaps faced by smallholder farmers in agricultural extension and marketing information.

In the implementation of GIs as a tool for pursuing agricultural development, ICTs play a vital role in revolutionising the use of technology to maximise the returns to the agricultural economy. ICT initiatives such as the CELAC project can be deployed to ensure the continuation of the tradition of collective production and collective decision-making that is the basis for GI protection in agricultural production. The use of ICTs facilitates skills and spreads knowledge in the process of agricultural production—which can be essential in revitalising the economic well-being of agricultural producers who subscribe to quality-based methods of production.

Accordingly, we recommended systematic consideration, by Ugandan stakeholders, of the potential contribution to the socio-economic development of Ugandan agriculture that can be made by existing agricultural ICT platforms in concert with deployment of GI protection as provided for in Ugandan law. One aspect of the implementation of GIs is their role in enabling producers to acquire better bargaining power along the value chain. The use of ICTs ensures that farmers get current marketing information, thus reducing information asymmetry and bypassing costly intermediaries. Farmers who acquire price information are in a much better bargaining position vis-à-vis traders or middlemen. Equipped with accurate market information, small-scale farmers are better able, at the farm-gate, to negotiate with, or bypass, local collectors and middlemen who sell at a higher price in a distant market. ICTs can potentially complement the strategic use of GIs as a means of revitalising agricultural production and acquiring improved prices in agricultural markets. In this way, ICT initiatives in agricultural production can play the role of facilitating collaboration, and their broader adoption can scale up innovation in TK-based agricultural production. The deployment of GIs in such a setting provides a policy context that can best ensure that the benefits of collaborative innovation in agriculture are collectively shared.

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