DIGITAL for AGRICULTURE

Definitions	**ICT4Ag** or **e-agriculture** is the use of Information and Communication Technologies (ICTs) in the agricultural sector. It does encompass all ICTs that are/can be used in the field of agriculture, and which range from older technologies like video, radio and television to computing, internet, remote sensing, mobile and digital broadcasting.
	mAgri: stands for 'mobile technologies in/for agriculture' and limits its scope to the mobile ICTs, e.g. mobile networks, (smart)phones, tablets etc.
	Mobile financial services: the use of a mobile phone to access financial services and execute financial transactions. This includes both transactional and non-transactional services, such as viewing financial information on a user's mobile phone.

Strategic Objectives	The strategic priorities of the Belgian Development Cooperation, as noted in the strategic policy: 'Digital for Development' (D4D), are
	- **Better use of data and information**: The Belgian Development Cooperation will invest in the tools and policies needed to use (real-time) data to produce actionable insights for development actors, and thus to increase their impact. Equal attention will be given to 'open data'.
	- **Digital for inclusive societies**: The Belgian Development Cooperation will use the potential of digitization to optimize democratic rights and equal access to basic services as health and education.
	- **Digital for inclusive and sustainable economic growth: I**n line with its policy priority to promote sustainable inclusive economic growth, the Belgian Development Cooperation will deliberately support interventions that turn digitization into more employment and better social protection.

Key message	Enhancing the ability of smallholders to connect with the knowledge, networks, markets and institutions necessary to improve their productivity, food security, income and employment opportunities is a fundamental development challenge. The development of ICTs and the spread of mobile telephony and internet in rural areas allow farmers and entrepreneurs to gain access to information, services and markets they could previously not benefit from, and represent a transformational opportunity for rural populations, both as producers and consumers.
	Through its interventions, BTC supports the development of services responding to the needs of small-scale farmers and operators within agricultural value chains, thus fulfilling the potential of new technologies. BTC pays special attention to the strengthening of the partners´ abilities by taking into account the potential of ICTs and choosing the tools and technologies that best fit both the needs and situation of rural populations.

Context	In its latest report "Digital Dividends", the world Bank states: "Digital technologies – the internet, mobile phones, and all the other tools to collect, store, analyse and share information digitally – have spread quickly. More households in developing countries own a mobile phone than have access to electricity or clean water."
	Agriculture is identified as one of the sectors where ICT can have a huge impact potential. Mobile phones are used daily to transfer money, buy and sell goods, and communicate information including test results, stock levels and prices of commodities. Mobile technology is used as a substitute for weak telecommunications and transport infrastructures as well as underdeveloped financial and banking systems. The numbers of people using social media are growing rapidly in developing countries as well.

But the report also points out that the digital revolution does not equally benefit all countries and all people, and that its dividends in many cases still are not delivered.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)[1] identifies some specific factors in agriculture that influence the use of ICT-innovations:

- Age, literacy and education of the target group, as well as other characteristics (farm size, gender, motivation etc.) influence the use of the mobile phone and the confidence in the information.

- Economic attractiveness for services providers: there is a great heterogeneity between the farmers in developing countries, in terms of type of agricultural production, geographic circumstances, climatic conditions, time zone, language, culture, etc., which can impact negatively on the economic attractiveness of providing services, or on the real value of the provided services for sub-groups of farmers. As agriculture is inherently seasonal, with several dormant months a year, the question of sustainability of short-term productivity ICT services arises.

- Geographical spread of the target group can affect the cost of awareness raising, training and mobilizing large groups of farmers. Geographical remoteness can impact availability and accessibility of high-end infrastructure.

- Sustainability: most initiatives spreading the use of ICTs are subsidized by governments or donors. Farmers are highly price-sensitive and there is still the question of whether end beneficiaries will pay for such services.

Moreover, agriculture is becoming knowledge-intensive and high tech: Some of the world's newest industries have started to put money and tech talent into farming. Digital soil maps, remote sensing, and global positioning system (GPS) guidance are critical tools for modern farmers. "Big data" for precision agriculture increases yields and efficiency. These high-tech tools mostly benefit big farms that can make large investments in technology.

@BTC: For some years now, the use of ICTs has considerably increased in the agriculture and rural development projects implemented by BTC, particularly in relation to the collection and the treatment of data and the use of Geographical Information Systems. Market Information Systems are also commonly used in projects that focus on the promotion of Value Chains. There are however a lot of domains where a more systematic use of new technologies could improve the efficiency and the outputs of the interventions.

1. ICT and normative frameworks in developing countries	**Normative framework**s are often absent, **regulations** on the use of digital technologies are most of the time unavailable; **protection of privacy** and individual data undeveloped. Setting in place national and local e-agriculture strategies is an essential first step in our partner countries. While the need for e-agriculture strategies is acknowledged by many stakeholders, most countries have yet to adopt a strategic approach in making the best use of ICT developments in agriculture. E-agriculture strategies will help to rationalize both financial and human resources, and address holistically the ICT opportunities and challenges of the agricultural sector while generating new revenues and improving the lives of people in rural communities.
2. ICT for Extension Services, Productivity Learning, Capacity Development	Information services are one of the most common ICT-related categories for agriculture. They provide data and information that are tied to helping farmers improve their productivity, yields and profitability during the course of their normal business of growing agricultural produce. We need to distinguish different objectives and then define the most suitable tools. - Increase short-term productivity and crisis management through information on weather patterns or the dissemination of plant or animal diseases. In some cases, the information is simply pushed out to the consumer with little customization (SMS). In other cases, there is more interaction (Voice calls). In Mali for example, Orange offers the service Sénéléka, which offers the opportunity to discuss with advisers. - Increase long-term productivity and field-based risk management: Long-term productivity

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[1] GIZ - Use of ICT for agriculture in GIZ projects – status quo, opportunities and challenges

		enhancements and risk management ICT services can have a significant impact on customers' livelihoods. Long-term productivity information services cover topics that take longer to learn and are often offered with other technologies and channels, such as face-to-face training or extension agent support. Many such services are delivered in conjunction with personal and continuing training, extension services, demonstrations and field visits.
3. ICT in livestock family farming		In the South, hundreds of millions of people depend on their animals to assure their livelihoods. Livestock families are increasingly relying on modern technology to optimize their production, improve market access, receive information on weather conditions, etc. Using these "modern" tools results into clear gains in terms of time and money. They often provide benefits in terms of socio-economic development and to some extent, seem to be already integrated in most livestock keepers' lives through for instance the usage of mobile phones. In the Sahel, each pastoralist family has at least a mobile phone. The pastoralists can be informed through an online application on their cell-phone where they can access pasture. This results in positive effects on the productivity of their herds and makes them more resilient to shocks and stress. Likewise, market information and information on upcoming droughts and floods – e.g., early warning systems – can be better shared through the multiple usages of mobile technology. Usage of modern technology in livestock family farming systems is also important for the dissemination of knowledge and assuring quality animal health services.

@ BTC: In the livestock development programs in Niger and Mali, in collaboration with different partners (Vets without Boundaries, notably), BTC promotes the usage of ICT for information services for the livestock keepers through mobile phones, such as information on where they can access pastures, on market prices, and on weather conditions. The animal health and production services will be strengthened to collect data through mobile devices to improve for example epidemiological monitoring, but also to improve the monitoring of productivity.

We make use of new technologies to map the transhumance corridors, the pastoral areas, the watering places, the food banks for the herds, the market places… Local authorities use these tools to choose public investments for livestock or to manage conflict between pastoralists and farmers. |
| **4. ICT use to inclusive Value Chain and market access** | | ICTs have a great potential to make Value Chains more inclusive and more competitive. They can help to reduce transaction and information costs, foster entrepreneurship and create new business models.

Promoting **market access ICT services** comprise any service that provides beneficiaries, especially farmers, with access to information on pricing of agricultural products (inputs and outputs) and on finding and connecting to suppliers, buyers or logistics providers, such as storage facilities and transport companies. |
| | | Such services include simple pricing services, virtual trading floors (matching services or full commodity exchanges) and holistic trading services. Market access services also cover ICT solutions that help the typically larger upstream and downstream firms, such as processors or exporters, to manage their operations and the quality of their produce better.

FAO[2] identifies the most common types of ICT services to enhance the access to market for farmers as follows:

- **Pricing**: The most common ICT intervention is a pricing service in which commodity price information is pushed out to customers on a regular basis. These data are often national or regional in scope, and so may not be entirely relevant for the farmer in the field, depending on his/her proximity to markets. Users (mainly farmers) generally have little interaction with providers, and must digest the information to find and negotiate with buyers. The most common advantages to such services are price transparency and improved negotiating leverage for the often disempowered seller (farmer). The service N'kalo provides for example market information over five Value Chains in West-Africa.

- **Virtual trading floors**: Virtual trading floors (VTFs) are digital market places where buyers and sellers connect through a digital network (as opposed to pricing services, which mostly only provide static information). The important difference between VTFs and more traditional |

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[2] ICT uses for inclusive value chains – FAO, Rome 2013

trading floors is that the buyers and sellers on a VTF do not have to be physically in the same location to make an exchange.

- **Holistic trading services**: Holistic trading services essentially provide the same services as pricing information services and VTFs, with additional assistance beyond the simple transactions of purchasing and buying agricultural products. Such assistance can include weather information, technical information on agricultural practices, and long-term education. These holistic service packages can not only link suppliers and buyers but can also connect parties for logistics, transportation, processing and storage needs. Often, holistic trading providers also offer access to financial services (payments, credit, etc.).

But even when farmers are seemingly better informed, they may not necessarily be able to act on that information because of the inaccessibility of alternative markets and the complex interlinked relationships between buyers and sellers in low-income developing economies. Rather than assuming that an information and communication technology (ICT) approach will always be cost-effective and yield a better outcome, a more nuanced understanding of the underlying institutional environment and constraints is warranted.

@ BTC: In Benin, BTC supports rice and vegetable value chains. Farmers needed an information system on prices and amounts of commodities on the markets. With the collaboration of ESOKO, the NGO Partner For Development, a system has be designed and implemented, as shown in the following figure:
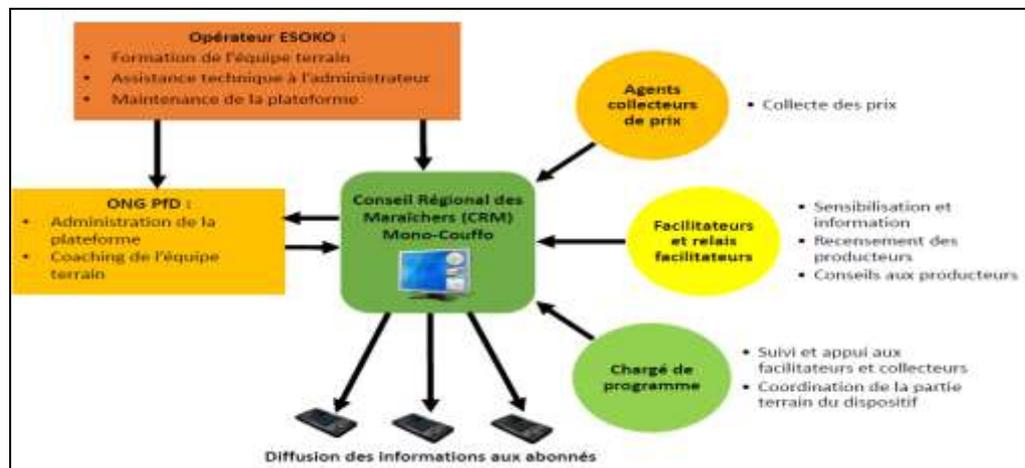
5. ICT for financial inclusion	In most developing countries, the majority of the population is unbanked. It gets worse in rural areas because of the cost of formal services and the distance from urban centers. As a result, most smallholders lack sufficient financial services to invest in their farms or business, improve productivity, manage risks/ respond to shocks (e.g. unexpected medical expenses) and to get connected to markets.
	Digital payments enhance transparency and security, as they are easier to follow and keep track of. This helps reduce the risk of corruption and cash payments related crimes. Financial inclusion also helps facilitate resource mobilization. Mobile finance offers greats opportunity to farmers to access the financial services they need.
	FAO[3] proposes four ways to enhance access to financial services :
	- **Transfers and payments**: money transfers through ICT solutions, notably through mobile phones, have become a much-discussed solution. This service is typically called a direct person-to-person (P2P) service. Mobile network operators rather than banks often offer these types of solution, as they provide simple cash transfer service. In recent years, governments have also begun to make transfer payments (government-to-person [G2P] payments) – such as welfare, social security and pensions – to rural beneficiaries through these same electronic platforms. This new way of transferring money reduces costs, improves efficiency and, most important, reduces graft and waste. Payments for products and services may be a more compelling way of helping to develop agricultural value chains. These options entail payments from businesses to people/farmers (B2P) or the reverse – people/farmers to businesses (P2B). B2P ICT payment services typically entail a buyer of agricultural products paying a farmer or group of farmers for her/his/their agricultural products.
	- **Credit:** Large credit programs through governments have often failed, but in recent decades there has been a significant increase in access to private credit providers, such as input suppliers, lead buyer firms, specialist lenders, microfinance institutions and banks, which all require at least sustainability if not profitability. This trend has encouraged a search for higher efficiency, improved (credit) risk monitoring, and better delivery to farmer and institutional customers – ICT has played a significant part in achieving all three of these aims.
	- **Savings:** More compelling solutions may be found in other financial services, such as savings and insurance, both of which are often ignored in the preference for credit. The rural poor need financial services that are convenient, flexible and secure, especially for their own money, i.e., savings. The most common ways for rural farmers to save are informal, such as in kind and through savings groups, and generally meet the first two criteria – convenience and flexibility – very well. However, the third point, security, is a major constraint of informal mechanisms: money guards may run away with the money; in-kind savings such as stored rice may spoil or diminish in value; and money left under the mattress may be lost in a house fire. By either making informal methods more secure or improving formal financial institutions' convenience and flexibility, ICT can help solve the savings puzzle for rural farmers.
	- **Insurance:** ICT can be a significant contributor to improvements in the adoption and administration of insurance, as policy renewals are historically very poor (potential solution: short message service [SMS] reminders), trust between customers and insurance companies is generally low (potential solution: improved claim processing times), and the level of data for appropriate pricing of policies and monitoring of potential risk events is inadequate (potential solution: put in place remote rainfall sensors connected to a database via a satellite connection).
	@ BTC: BTC has started using digital payments in Tanzania. Using ICTs to improve access to financial services will be a point of attention in the new interventions, particularly in those aiming to promote Value Chains.

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[3] ICT uses for inclusive value chains – FAO , Rome 2013

6. **ICT for Data Collection, GIS, Field Survey, M&E**	Remote populations, lack of infrastructure, paucity of landlines and insecurity add up to challenging environment for traditional information gathering. Data collection and monitoring and evaluation (M&E) efforts take a great deal of time and methodical planning and implementation. ICTs tools, including hardware like mobile phones and tablets, applications with the capacity to create digital surveys, and software that allows users to upload data to storage facilities in real-time, have reduced the conventional challenges associated with remote data collection and M&E.

The availability of timely, relevant, and reliable data on the agriculture sector is necessary for effective planning, monitoring, and evaluation of agricultural and rural development policies and field interventions. Recent approaches focusing on climate impacts and land use pressures (climate-smart agriculture and landscape approach) add to the complexity and require efficient data collection and analysis methods.

@ BTC: In many partner countries (e.g. Burundi, Benin, Mali, and Niger), BTC supports Agriculture and Livestock Ministries and/or local authorities to adapt and to use the new technologies. The Geographic Information Systems permit visualization of the data and have become important in decision-making.

Most of BTC projects use now Akvo Flow or OpenDataKit (ODK) to collect data for the monitoring of the activities, and a large range of applications for the treatment and the visualization of the data. The following figure show the system used in a multi-actor food security program in Tanzania.

Figure 1: M&E system in the multi-actor programme in Tanzania |
| 7. **ICT to strengthen farmer organisations and public institutions in the agricultural sector** | Farmer organizations can function more efficiently by using ICTs to attract and retain a wider membership, generate more funds, and provide better services to their members. Documented benefits of ICTs include improved connections to members, better accounting and administration, and stronger collective voice. Through for example online platforms and social media, ICTs can contribute towards the emergence/strengthening of an advocacy movement that is proactively engaged in policy processes, which will ultimately lead to a more sustainable and equitable agriculture.

Public institutions are also lacking the resources needed to fulfill their missions and mandates in the agricultural sector. New technologies can improve significantly the quality of their services to farmers and farmers associations.

@ BTC: BTC supports farmer organizations and public institutions in nearly all the agricultural projects. The support can include IT equipment, IT networks, web and database design, digitization of archival and library papers, and, of course, the training of the users. Sustainability remains a challenge, given the maintenance and operating costs are often too high to be paid from their own resources. |

General recommendations and lessons	Important lessons from the previous ICT4D experiences have been bundled in the so-called "Principles for Digital Development" which are endorsed by major development actors. The principles find their roots in the effort to institutionalize lessons learned in the use of ICTs in development projects, and are synthesized in 9 key principles:
	- Design with the user
	- Understand the Ecosystem
	- Design for scale
	- Build for sustainability
	- Be data driven
	- Use open data, open standards, open source, open innovation
	- Reuse and improve
	- Address privacy and security
	- Be collaborative

Points of attention for formulation & implementation	We have pointed out earlier in the document some specific factors of the agriculture sector that must be considered in the formulation and the implementation of ICT4Agri strategies. The following 10 key issues fundamental for ICT4Ag implementation in development projects were put forward by the participants of the international ICT4Ag conference in Kigali 2013:
	1. Developing partnerships to ensure positive impacts of ICT4Ag initiatives: All too often, ICTs for agriculture initiatives are developed in isolation, with companies and individuals producing comparable applications (apps) for similar purposes in different countries. Those involved in ICT development should build partnerships and communities of practice that encourage greater collaboration. They should also build on existing models and approaches to develop solutions that have a real impact.
	2. Supporting ICTs for extension and advisory services: ICTs have a vital role to play in getting information to farmers and vice versa. Extension and advisory services should take full advantage of the potential of new technologies. They need to focus on proven and innovative ICT tools which recognize the importance of two-way communication. ICTs should be used more innovatively to achieve the goals of extension, and efforts should be made to attract women and young people to work in extension and advisory services.
	3. Supporting open and big data for smallholder farmers: Smallholder farmers need to benefit more from 'big data' – datasets which are large, complex and difficult to handle – and information derived from such data should be made available in a format they can readily use. The conference stressed the importance of good data visualization, and the importance of providing real-time data via multiple channels to smallholders and others involved in value chains. There is an urgent need to create a public information platform to reduce data duplication.
	4. Ensuring the reliability and availability of high-quality information: Developing farmers' trust in ICT services and the content they provide is important. They should never be bombarded with information that is unreliable, of poor quality or difficult to use. Indeed, the content – rather than the mode of delivery – should always be the first consideration for those involved in disseminating information to farmers. The conference affirmed that what goes into the content box is more important than the technology; this is a signal for better linkage between research and extension.
	5. Ensuring grassroots access to ICT solutions: Many rural communities still have little or no access to ICTs. We need to ensure that they can take advantage of these technologies, in terms of cost, availability and usability. Providers should focus on the household level and adapt information to the local context. They should also recognize the multidimensional needs of farmers and their families, and encourage grassroots community engagement in policy processes related to ICTs.

	6. Strengthening the involvement of young people and women in ICT4Ag initiatives: All too often, women and young people are disadvantaged, in a variety of ways, in rural areas. ICTs have an important role to play in empowering young people and women. Women are the pillar of the family in terms of smallholder agriculture and they should be provided with the resources and information they need to improve their productivity and gain access to markets. ICTs should also be used to attract young people to agriculture and ensure that they can develop their potential.

7. Supporting ICT4Ag entrepreneurship and promising business models: Policy makers and others working in the field of agriculture need to encourage smart entrepreneurship and ensure that those developing ICT applications develop sound business models. If they fail to do so, then their apps are unlikely to survive or be scaled up for wider use. Apps should be designed to help not just farmers, but all those involved in value chains, from field to fork.

8. Supporting sound strategies and high-level political buy-ins for ICT4Ag: ICTs have a transformative influence on farming and food production in countries where governments and policy makers are committed to developing comprehensive e-agriculture strategies. In particular, the conference heard about the successes in Côte d'Ivoire and Rwanda. These two countries are pioneering the development of e-agriculture strategies to support the efficiency and effectiveness of ICTs for agriculture.

9. Promoting adequate infrastructure and energy for ICTs in rural areas: Most of the policy pointers above are concerned with the software of ICT development. But the hardware – broadband infrastructure, mobile phone masts, energy provision – is just as important. Governments should be encouraged to provide access to energy, devices and infrastructure, especially in remote areas. This often works best when they act in tandem with the private sector. Local entrepreneurs also have a key role to play in achieving connectivity, but if they are to do so, they need to develop sound business models.

10. Promoting sound knowledge management activities: In addition to the above nine conference recommendations, this tenth recommendation emerged from the follow-up survey that was conducted with the conference participants. Participants suggested the need to address issues arising from awareness-creation, information gathering and capacity-building on ICT4Ag. They identified the need for more inclusive learning models that promote the existence of knowledge providers at grassroots level using the value chain model. |

Partners	- **MRAC**: A framework agreement with the Royal Museum for Central Africa (Tervuren) on cartography and mapping. - **AKVO**: A framework contract on mobile data collection with AKVO (www.akvo.org)

Documents & tools	Study of GIZ: « *Use of ICT for Agriculture in GIZ projects-status quo, opportunities and challenges*". Annex 2 of the report provides **a list of existing ICT4Ag applications and services.** http://www2.giz.de/wbf/4tDx9kw63gma/GIZ-ICT-study-final-interactive-version.pdf
	ICT in Agriculture Sourcebook addresses mainstreaming ICT into 14 sub-sectors of agriculture (including rural finance, markets, value chains, extension, etc.). To disseminate this work and to get inputs from others in the field, the World Bank is organizing high-level/participative online forums on some of the modules in the sourcebook in partnership with FAO and the e-Agriculture Community. http://e-agriculture.org/ict-agriculture-sourcebook
	E-agriculture is a global community of practice that facilitates dialogue, information exchange and sharing of ideas related to the use of information and communication technologies (ICTs) for sustainable agriculture and rural development. http://www.e-agriculture.org/
	ICT uses for inclusive agricultural value chains - FAO: http://www.fao.org/docrep/017/aq078e/aq078e.pdf
	Data collection tools: Akvo: http://akvo.org/products/akvoflow/#overview ODK: https://opendatakit.org/
	Global Open data for Agriculture and Nutrition – GODAN supports the proactive sharing of open data to make information about agriculture and nutrition available, accessible and usable to deal with the urgent challenge of ensuring world food security. It is a rapidly growing group,

	currently with over 547 partners from national governments, non-governmental, international and private sector organisations that have committed to a joint Statement of Purpose. http://www.godan.info/
	World Development Report 2016: Digital Dividends - World Bank. www.worldbank.org/en/publication/wdr2016
	FAO has developed a guide to support the development of national e-agriculture strategies: http://www.fao.org/3/a-i5564e.pdf
BTC contact	Lawrence Ghesquière, Agriculture expert, lawrence.ghesquiere@btcctb.org
	Gijsbert Ooms, D4D expert, gijsbert.ooms@btcctb.org, T +32 2 5053700
Interesting literature	National ICT4Ag strategy of Rwanda: http://www.minagri.gov.rw/fileadmin/user_upload/documents/policies_and_strategy/ICT4RAg_STRATEGIC_PLAN_2016-2020_final__final__3_.pdf
	ICT Update is a bimonthly printed bulletin, a responsive web magazine and an accompanying e-mail newsletter. Each issue of ICT Update focuses on a specific theme relevant to ICTs for agricultural and rural development in ACP countries, and features a selection of commissioned articles. http://ictupdate.cta.int/
	Annual conference: http://ictforag.org

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