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Data-driven opportunities for farmer organisations

Chris Addison, Caroline Figuères, Hamlus Owesiga, David Muwonge, Elizabeth Nsimidala, Annick Sezibera, Stephan Boyera, Hugo Besemer, Valeria Pesce, Athanase Birba and Didier Muyiramye

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About CTA

The Technical Centre for Agricultural and Rural Cooperation (CTA) is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and the European Union (EU). CTA operates under the framework of the Cotonou Agreement and is funded by the EU. For more information on CTA, visit www.cta.int.

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Please address comments on this Working Paper to Chris Addison (addison@cta.int).

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Foreword

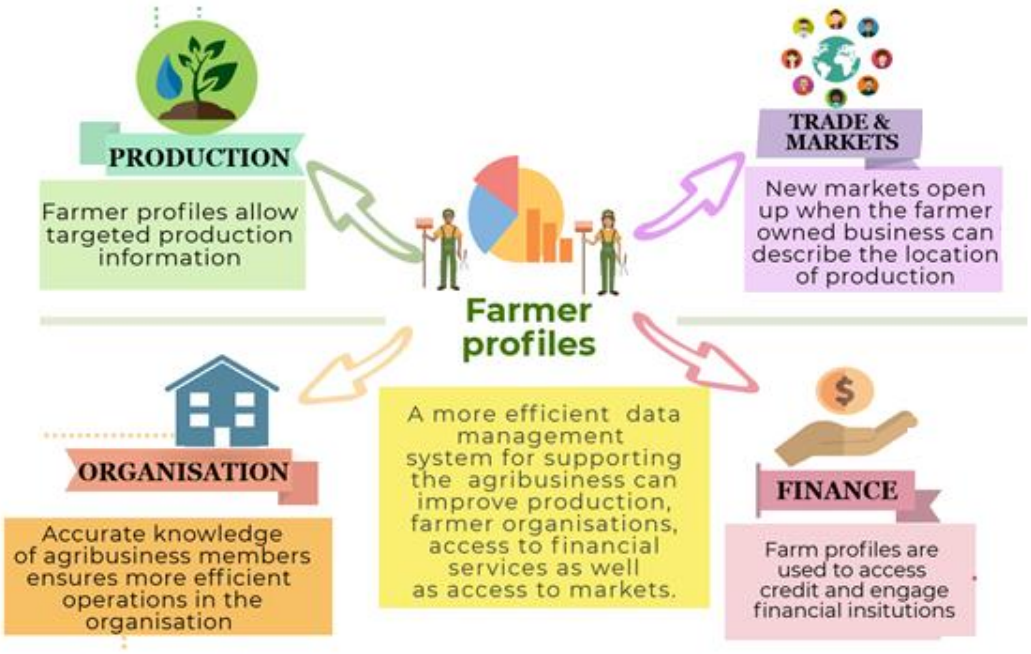
This Working Paper presents the impacts and lessons learnt from the Data4Ag project conducted by the Technical Centre for Agricultural and Rural Cooperation (CTA) and the Pan African Farmers Organisation (PAFO).

The Data4Ag project had four components: 1) Field studies, working directly with farmers' organisations in the digitisation of their membership records and farmer profiles; 2) Research examining the existing literature and findings from similar work, in particular farmers' data rights; 3) Capacity building, in particular training those working with farmers' organisations on data driven solutions; and 4) Policy formulation, for example working with the Global Open Data for Agriculture and Nutrition initiative (GODAN) on policy to support the local data ecosystem.

This Working Paper is produced to share findings and encourage discussion on the issues around data-driven services being implemented by farmer organisations and farmer-owned and farmer-led agribusinesses. The paper is intended for those involved in working in or with these organisations in implementing capacity development and data-driven projects for these groups.

Summary

This Working Paper considers the role of smallholder farmers in addressing the target of zero hunger in Sustainable Development Goal 2, in particular in addressing their productivity, sustainable livelihoods and resilience through digitalisation. It draws on examples that focus on the role of aggregators in bringing groups of smallholders together. Farmer profiles also provide targeted information for improving production; source location information can improve access to new markets; farm profiles are used to access credit; and accurate knowledge of members improves value chain organisation.



This Working Paper covers a range of impacts and lessons learnt in implementing data-driven services shown in the table below.

	Impacts	**Lessons**
Farmer profiles	Overall benefits of digital registration systems were demonstrated in all of the projects across Sub-Saharan Africa	The depth and scale of associated farmer profiling would vary depending on the value of the services using the data captured
Production	Increased yields have been demonstrated amongst those registered	Mapping of farms has led to better provision of inputs: fertiliser, weather advice, crop calendars and tailored extension advice
Trade and market access	Benefits demonstrated for registered origin of crop and for collective sales to new customers	Geolocation adds value to crop, e.g., altitude of coffee and use of geographical indicators

Financial services	Mapping with registration allows setup of SACCOs (savings and credit cooperative organisations), use of evidence from data improves credit access	Financial arrangements take time; transaction records, farm mapping and joint action can facilitate new credit
Value chain organisation	Mapping allows review of collection centres and support to farmers in remoter locations	Data allows improvements to logistics, value chain planning and improvements in trust

1 Introduction

Agriculture, the science and art of cultivating plants and livestock, has been impacted by the development of four phases[1]:

- **Adoption of modern agriculture** – 18th century plant and animal breeding and scientific testing of cropping approaches and soil management.

- **Mechanisation** – The invention of the internal combustion engine meant reduced horse and labour use and new processed foods introduced.

- **The Green Revolution** – The mid-20th century saw developments in the application of science in agriculture, both in chemistry and genetics. This precipitated the "Green" Revolution whereby the use of nitrogen and phosphate fertilisers became widespread and global grain output tripled. Towards the end of the century more environmental awareness grew with the negative effects of land clearing and deforestation.

- **Digital agriculture** can allow to move from an often inefficient and ineffective utilisation of inputs (water, seeds, fertilisers, pesticides) to an intensive utilisation of knowledge based on up-to-date data and information. Agriculture can now be more precise due to the combination of connectivity, apps development and new data collection. It is now possible to weigh up the use of inputs with yield forecasting and improve long-term management of farms. This use of technologies and data science has improved production and supply chains that are responsive to real-time consumer demand and can reduce social and environmental negative impacts. One of the key differences in this fourth phase of agricultural development is the potential to shorten the link between producer and consumer in a transparent way.

We will focus on the role of data in digital agriculture from the perspective of those organisations most closely working with the smallholder farmers – their associations, development practitioners and agribusinesses. We will examine the many opportunities digitalisation can bring to the value chain actors and to the farmers in particular, but also the challenges and further divide it can create and how we can minimise them.

Whilst digitalisation started with a focus on the commodity and product, it has now moved to also cover the farmer, farm and geographical information. Without a "digital ID" the farmer cannot fully be part of this digital world and reap the benefits. But special care must be given to avoid bias in the type of data collected, to avoid digital gaps and exclusion and make sure that smallholder farmers (men and women) are the first beneficiaries of digitalisation.

The livelihoods, productivity and resilience of the smallholder farmer is essential in delivering progress on sustainable development goal 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture".[2]

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[1] Rose, D.C. and Chilvers, J. (2018). 'Agriculture 4.0: Broadening Responsible Innovation in an Era of Smart Farming', *Frontiers in Sustainable Food Systems*, Vol. 2: 87, https://www.frontiersin.org/article/10.3389/fsufs.2018.00087

[2] Sustainable development goals knowledge platform https://sustainabledevelopment.un.org/sdg2

This Working Paper discusses the various issues, draws conclusions and offers recommendations for farmer organisations and development practitioners, based on CTA's and partners' experiences.

2 Role of aggregators and the registration of smallholder farmers

A farmers' organisation or association can act as an aggregator of smallholder farmers' production, improving collective bargaining power, access to inputs, credits and markets. In many countries, as many as 60% of farmers are member of an association (FAO smallholders dataportrait[3]). By working with these aggregators and improving their efficiency, the productivity, resilience and income of the smallholders can be improved, allowing economies of scale along the value chain.

The main advantage of aggregators is for collective access to services and markets. The dispersed nature of the smallholder farmers producing small volumes makes working with them as individuals difficult for many value chain actors. For example, the agriculture sector in East Africa is dominated by smallholder farming (averaging 0.2–3 ha), with 60% of farmers making less than €1.5/day. Fertiliser use among these farmers is low; about 1.7 kg/acre against 60 kg/acre globally. The sector is mainly rain-fed and dependent on bimodal rainfall, making it vulnerable to drought-related crop failure. Smallholder farmers who do not aggregate around input and output markets or other agricultural services may fall short of their potential for agricultural production and sales.

Aggregation allows cost saving on logistics and access to machinery/technology, marketing and distribution, training and access to certification. Aggregation can also support efficient agricultural service delivery, allow input procurement at favourable prices and provide competitiveness in output markets. This aggregated action can be informed by access to aggregated data.

2.1 Use of data-driven services by aggregators

Agriculture is back at the top of Africa's development agenda, enjoying the support of governments and attracting significant investments from the private sector. Smallholder farmers that are central to the agricultural transformation in Africa struggle to benefit from these developments due to their dispersed and small-scale nature. Aggregation of smallholder farmers' needs may provide the solution, according to Norbert Tuyishime of the e-Granary system run by the Eastern Africa Farmers Federation (EAFF).

e-Granary – Eastern Africa Farmers Federation (EAFF)

- Profiles: approximately 190,000 in Kenya and 14,000 in Uganda
- Profile use:
- Access to credit
- Access to cheaper input (group buying)
- Market linkages (group selling)
- e-Extension
- e-Granary platform
- Output
- Greater revenue for farmers
- Access to larger credit for farmers
- Greater advocacy power for the EAFF

[3] http://www.fao.org/family-farming/data-sources/dataportrait/farm-size/en/

- Design of a future business intelligence service for the EAFF
- Challenge: credit interest rates

The EAFF is supporting this aggregation of members by shifting its focus from lobbying and advocacy to strengthening the role of farmers in value chains enabled by strong entrepreneurship. The EAFF focuses on knowledge, institutional development, policy, partnerships and youth, and has embraced the use of technology to help achieve the objectives of this new strategy. It launched the e-Granary project in Kenya in 2016 to develop a digital platform for its members and has used this to improve agricultural extension delivery in partnership with PAFO, Agriterra, AgriCord and CTA.

Where finance is unavailable, farmers do not use new seed stock even if this is appropriate, use less inputs and rarely use chemical fertilisers and pesticides to protect their crops. The most effective smallholder farming financing is non-cash input loans, such as seeds, fertilisers and insurance. It should be noted that organic agriculture could be seen as a chance for agriculture as advocated by FAO and others.

The EAFF has found that bundling services such as insurance with input loans bring faster uptake and that e-extension provides farmers with timely information so that they are able to anticipate risks and avoid losses.

Farmers across the region are eager to participate in the e-Granary service due to their concerns for climate change vulnerability and access to markets and certified inputs. In 2019 the platform intended to register 340,000 farmers, of which 150,000 would receive e-extension services. The objective is to turn 10% of e-Granary member farmers into active users of loans worth €879,000 with the volume and value of sales reaching 1,000 metric tonnes (MT) and over €1,300,000 respectively. e-Granary was launched in Uganda and Rwanda.

The Data4Ag project identified that a lot of capacity building is needed with farmers' organisations and supporting actors on the use of business services linked with data-driven solutions in agriculture to enable smallholder farmers to benefit from digitalisation. The CAPAD project described below is another example of the benefits of collective access.

***Confédération des associations des producteurs agricoles pour le développement* (CAPAD)**

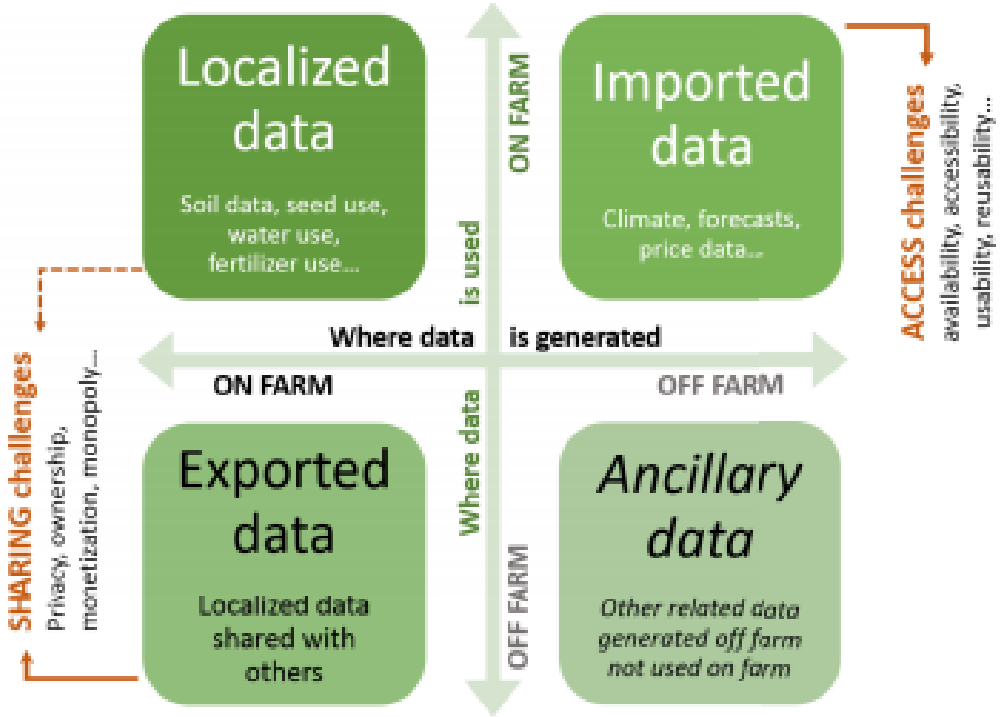
- 14,153 farmers from 39 cooperatives profiled
- Main objective: support smallholder farmers in production and selling of agriculture products
- Profile use: help CAPAD provide better on-time services (input provision, credit) to their members
- Main outputs:
- More cooperatives are able to sell products to the World Food Programme (WFP) schools' cafeteria programme
- Cooperatives have data to support dispute resolution with the tax authority
- More advocacy power for CAPAD
- Main challenges: technical platform (offline capabilities)

Bundling a variety of services onto one platform is a common theme emerging in digitalisation and there is much discussion on who should take the lead on these developments, be it government or private sector actors. In particular another kind of aggregator is entering the scene: the aggregator of data, offering services in various development sectors such as agriculture, water, health, education, etc. There are concerns that if the emphasis is on super platforms that provide all services these will only be possible to deliver and support at a multinational level, with a concentration of power and control. It seems more interesting to encourage a local ecosystem of services to support these platforms, as long as these platforms are respecting farmers.

2.2 Data serving farmers

Whilst the new technologies offer great opportunities for improving efficiencies in value chains, improving profitability for smallholder farmers and reducing environmental impacts is not without significant challenges, particularly around who controls the flow of data. The main challenges facing smallholders are to gain access to relevant data and services, while at the same time ensuring that data they shared is used for the benefit of their own activities and the sustainable development of their communities.

The data ecosystem around farming has been described as falling into four domains as shown in the figure below.



Source: CC BY 4.0 from Maru *et al.* (2018). Digital and data-driven agriculture: Harnessing the power of data for smallholders, Rome: Global Forum on Agricultural Research and Innovation (https://doi.org/10.7490/f1000research.1115402.1)

“Localised data” is data generated and collated on the farm for use on the farm only. This might relate to water, soil data, seed and fertilisers/pesticides’ use and management practice.

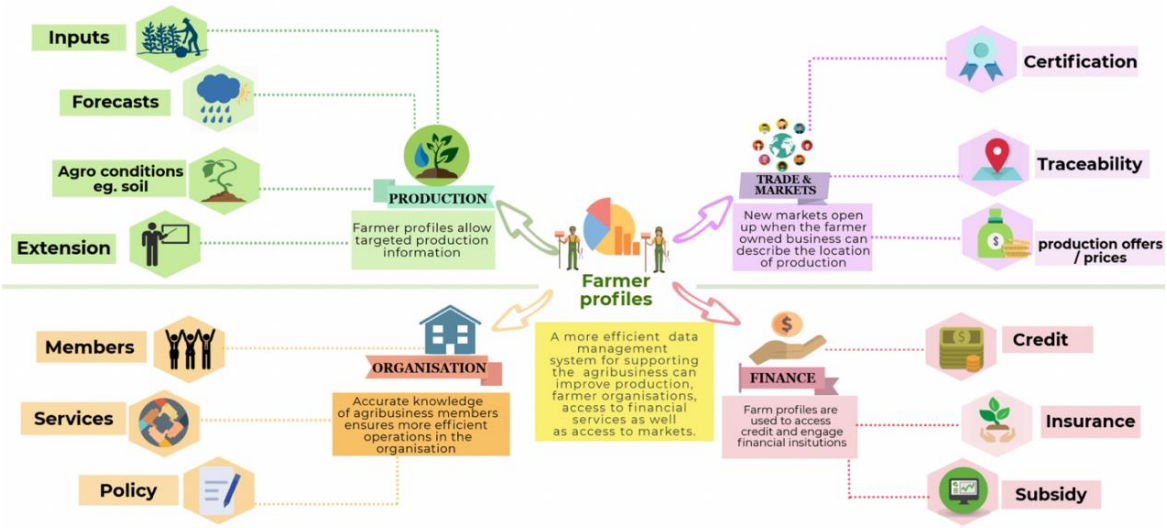
“Imported data” is data generated and collated off the farm, for example meteorological data and market prices. This data is normally made available to a farmer through another party who often sells it to the farmer.

“Exported data” is data generated and collated on the farm for use off the farm and will often be aggregated externally. Governments, NGOs and/or private sector value chain actors may use this data.

Finally, “Ancillary data” is data generated on and off farm which is used off farm. This may be used for government statistics, research by knowledge institutions, capacity building by NGOs, client survey and marketing.

2.3 Farmer profiling

The data collected on the farm and exchanged to provide services to the smallholder revolves around the data collected about the farm and the farmer. The benefits of farmer profiling were clear in all the cases that were supported in the farmers’ organisations. The services that you want to provide determine which information you can and may want to collect. If farmers do not understand why you want to collect certain information from them, they will not provide it. Data and profiles need to be maintained and updated; else they are of no use. The benefits come from the link between the data collected and the service provided as shown in the graphic below.

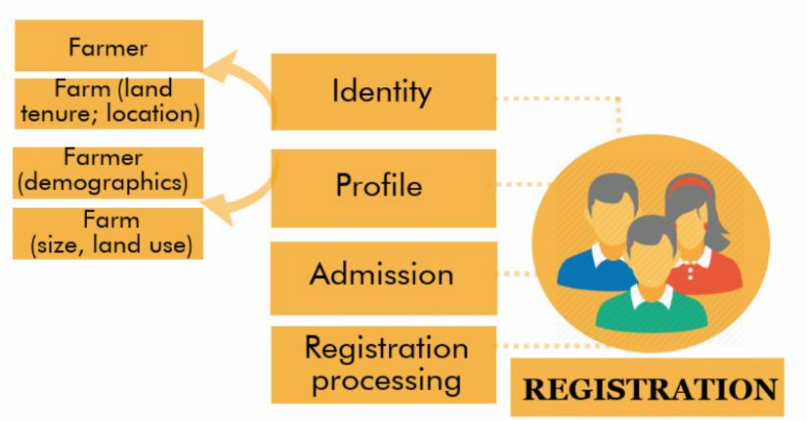


The successful projects had a demand from farmers for registration. This demand depended on a critical mass of profiled farmers and delivery of services that financially benefited the farmers.

Sustainability also relied on low operational costs. Software as a service cost proved too high for many of the projects and functions were replaced by local software.

Changes in personal data protection legislation during the projects have affected registration and this varies from country to country. Burundi for example had to acquire a data collection visa to undertake the registration of members. In Uganda, legislation is being developed for coffee farmer registration which could affect how the National Union of Coffee Agribusiness and Farm Enterprises (NUCAFE) collects data.

2.4 Lessons from farmer profiling and registration



For all organisations, the profiling project was beneficial and was instrumental to unlock new opportunities in the form of new projects funded by other stakeholders/donors.

There were two main findings:

1. The development of a profiling project demonstrates the capacities of the farmers' organisation, usually acquired as part of the project, to organise a large-scale data collection and use ICT tools to collect field data. One of the major outputs of such projects is the ability for the farmers' organisation to conduct such a process in a short period of time, and to interact in a trustful way with usually hard-to-reach populations (rural farmers). The technical and managerial capacities demonstrated by such projects are not very common in developing countries and are therefore in demand. This situation creates opportunities for farmers' organisations, and many of them were involved in similar tasks after the profiling project and were able to establish new partnerships with governmental agencies/ministries and/or international organisations.

2. The profiling data is valuable and can be used for other purposes. Profile content is essential for a number of digital services. Some of the farmers' organisations were then involved in subsequent initiatives thanks to the data they gathered in the profiling project.

The distinction between digital profiles and farmer registration is that:

- **Digital profiling** consists of gathering and analysing data provided by a farmer on his/her farm to improve his/her own "business" (from production to harvest and commercialisation).

- **Digital farmer registration** is the process of collecting the various types of data related to the farmers and their business activities; registering this data in a digital system (database, platform) for further analysis and potential use by external groups of stakeholders.

Farmers may be reluctant to take a profile/register for services if it requires a subscription with a telecoms company that has bad coverage in their area.

2.4.1 Identity

Research has shown that who should be registered is a social issue in which gender plays an important role. The head of the household is not necessarily the primary farmer. In farmer profiles a pragmatic choice should be made. The person who is registered should be the person to whom the messages about a service should be directed. Care should be taken to understand that different family members are working on a farm with different crops and roles, in particular being clear on the role of women farmers. In the farmer profiling undertaken by the Igara Growers Tea Factory (IGTF) and NUCAFE, the ratios were the same in registered and unregistered plots. Whilst this suggested that the digital registration was not discriminatory compared to the previous registration, it was difficult to assess any other bias. The Southern Africa Confederation of Agricultural Unions (SACAU) identified that in future registration there could pay more attention to training the enumerators to avoid gender bias in the registration process.

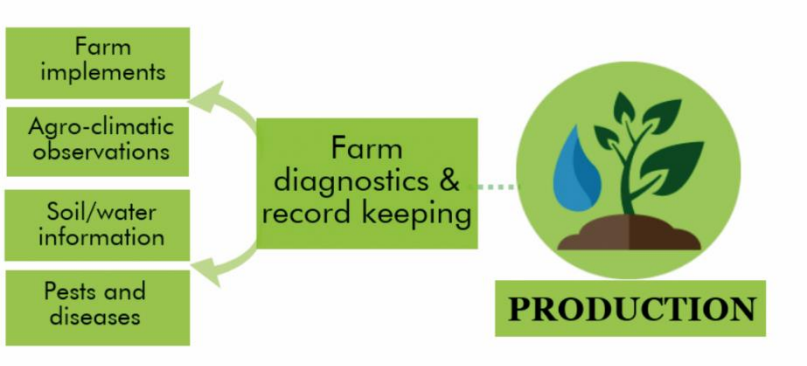
2.4.2 Data collection

Some fields that have been indicated as necessary for market participation are field position (which may attract specific buyers interested in specific local products), field size (essential for yield forecast), type and variety of crops, and certification. Prices at which farmers sell products is a relevant piece of information to collect in profiles, but it was observed that it is very hard to collect this type of information – both for taxation issues and for reluctance to reveal actual prices – and at the same time there is generally little to no incentive to provide this information as this will mainly benefit others. The source of reliable information about prices is not farmers but markets. Nevertheless, the trust in the person/organisation collecting the data on the markets is essential.

2.4.3 Practical issues

These may arise depending on local conditions (legal land tenure documents may be missing; in electronic systems the SIM cannot be used to identify people if they share telephones). There may be an additional step to decide whether a farmer will be admitted to the organisation.

3 Production



Production can be increased through a number of data-related services: better targeting of advisory services, cheaper acquisition of inputs and more accurate application, better targeted forecasts and information on soils. The supported projects have seen benefits in four areas: provision of inputs; more precise forecasting; understanding of agro-conditions; and more targeted extension.

3.1 Advisory services

Advisory and information services cover digitally delivered information on topics such as agronomic best practices, pests and diseases, weather and market prices, as well as more sophisticated digital advisory services and farm management software tailored to the specific farmer, farm or field that enable smallholder farmers to make decisions that maximise output from their land, improve the quality of agricultural production and maximise farm revenues and profits.

CTA and AgriCord co-financed a 2018 PAFO project to provide access to market-oriented agricultural extension and advisory services via mobile phones to smallholder farmers in Kenya.

The EAFF is running the e-Granary mobile platform to increase access to market information and e-extension services for farmers by using the e-Granary mobile platform to mitigate the lack of access to conventional extension services.

The project meets the needs of the farmers by using mobile phones to increase their access to real-time market information and enables the farmers to decide when, where and at what price to sell their products at. Currently, 43,400 farmers are registered with the e-Granary platform in Kenya, which sends targeted voice messages to the registered farmers based on location and crop.

Farmers need very localised and tailored market information, and this is considered a very powerful case for collecting profile data. Farmer profile data like location or crops to be marketed is essential for instance for efficient interactive voice response (IVR) systems.

3.2 Better management of inputs

Provision of fertiliser by the IGTF suffered from not having accurate measurements of field size and location. By improving the inputs provided, the IGTF saw a return from profiled farmers of 30% more leaf through the first two seasons after registration. The geospatial data required to provide these services is the mapping done by the

enumerators when profiling farmers. There needs however to be a key economic gain as the mapping is estimated to cost €4 per farmer.

Providing better advice on forecasts, land conditions and extension has been taken up by the EAFF in Kenya with 4,674 farmers currently in the programme and a target of 20,000 being reached through mobile text and other channels. It should be noted that even if short term economic benefits are important for the farmers, attention should be given to the (longer-term) return on social and environmental investments (sustainability).

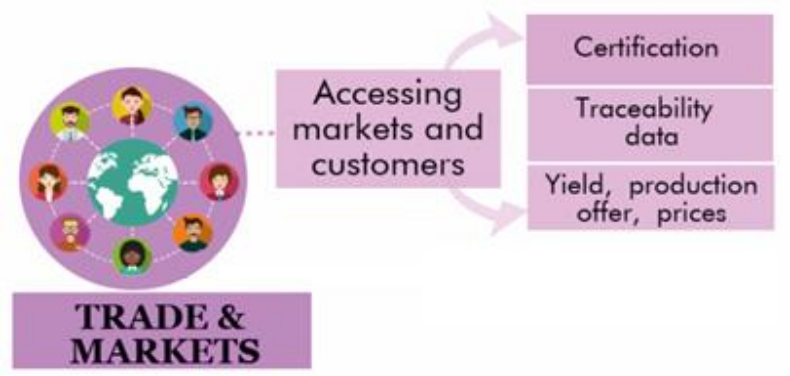
3.3 Electronic record keeping

These systems can provide new opportunities for farmers but also to their service providers in a production chain. The real challenge is to keep the records up-to-date and the success of remote systems depends on network coverage in an area and/or the opportunity of offline storage of data before transfer to a central system. A number of approaches have been trialled in particular using SMS updates, but it would seem important to work with the farmer organisations as the details are updated when produce is brought for sale.

3.4 Information requirements

These may differ for various groups of farmers. For example, in a dairy production chain, herd information is not relevant for farmers with a small number of animals. Nevertheless, it is important to keep in mind that smallholder farmers, often family farmers, may have multiple requirements: some crops may be good for markets, others are just for own consumption and in the family, some are relevant for the wife, others for the husband. Combining information requirements may increase the use of the system and help to close the digital gap between women and men.

4 Trade and market linkages



Market linkages are digitally enabled solutions that link smallholder farmers to high-quality farm inputs, production and post-harvest machinery and mechanisation services (e.g. irrigation, tractors, cold storage), or off-take markets, including agro-dealers, wholesalers, retailers, or even end-consumers.

4.1 Premium prices from geolocation

Smallholder farmers in Uganda are seeing better incomes and a premium price for their coffee as a result of using a digital farmer profile system to improve their market access.[4]

The design of the NUCAFE geospatial database is helping Ugandan coffee farmers to provide traceable products, ensuring access to new markets and higher prices. With support from CTA, NUCAFE has generated farmer profiles and maps of coffee farms. NUCAFE represents 210 coffee farmers' and farmers' organisations – 205,120 farming families – and focuses on advocating on their behalf, facilitating their access to services and resources and promoting farmers' access to local and international markets.

National Union of Coffee Agribusiness and Farm Enterprises (NUCAFE)

- Almost 19,000 farmers
- Main objective: digitisation of membership
- New services: value chain support and access to credit
- Profile use:
- Work at individual farmer level (training needs…)
- Geographical indication and certification (fair trade, organic)
- Traceability
- Advocacy and global impact measurement
- Main output
- Increased farmer production
- Increased coffee revenue for farmers (geographical indication, traceability)
- Better position of collection points

[4] Solange Tetero (2019). *Data leads to bigger profits: Traceability gains for coffee farmers in Uganda*, https://www.cta.int/en/blog/all/article/data-leads-to-bigger-profits-traceability-gains-for-coffee-farmers-in-uganda-sid06cfb7c03-8d65-4efc-a153-ba1411ec77fb

NUCAFE started with an Excel database with basic member information, based on manually uploaded questionnaires. Realising the limited capacity of this database, NUCAFE then worked with CTA support to develop a spatial data management system. Between June 2017 and April 2018, farmers were profiled using a tablet-based questionnaire that captures the coffee farm family details, production information and GPS location of the household and farm. With data privacy consent, the data was transferred to the NUCAFE servers, using the ONA survey software, and processed using QGIS and ArcGIS geographical information systems. This generated individual coffee farms field maps. To obtain higher resolution images of the individual farms, the GPS coordinates were used to produce flight plans for drones. In the second phase of the project, the improved database is used to generate added value by effectively providing each batch of coffee with a QR-code, proving its authenticity and origin. This QR passport includes information about the farmer who grew the beans, the farmer group, farm location, the product, date of delivery to the warehouse, and details of the coffee's subsequent journey along the supply chain.

4.2 Certification helps increasing farmers' incomes

Certification helps farmers produce better crops, adapt to climate change, increase their productivity, and reduce costs. These benefits provide companies with a steady and secured supply of certified products. Certified products also help businesses meet consumer expectations and safeguard their brand's credibility.

International buyers from Italy and South Korea offered higher prices for coffee produced by the profiled farmers, paying €3.51 per kg instead of the less than €2.16 generally paid for untraceable coffee of similar quality. For a typical Arabica coffee farm of 0.4 hectares producing an average 600 kg each year, that translates into an additional annual income of €850.

Bufumbo Organic Coffee Farmers Association used data about its farmers and their coffee farms from the NUCAFE spatial database, for a critical external audit for organic and UTZ (an international standard for fair, sustainable and transparent production) certification. The association obtained both certificates, and subsequently sold 19.8 MT of organic/UTZ-certified coffee to an Italian buyer for roasting, and a further 160 MT to other buyers. Other farmers are now motivated to change their practices to obtain certificates and coffee farmers' associations are expressing interest to use the database for certification. This requires an ongoing data collection process as the certificates need to be renewed.

A regular workflow needs to be set up to maintain the data for certification. "The first challenge relates to smallholders' understanding of concepts and terms used by sustainability standards and certifications. (…) Many smallholders are even unaware that they participate in a certification scheme."[5] "Controls of farmer registration are frequent, and it has become increasingly commonplace for OPACS to have to re-register organic producers associated with participatory systems."[6]

[5] https://cris.maastrichtuniversity.nl/ws/portalfiles/portal/16087033/c5768.pdf, p. 24.

[6] Radomsky, G.F.W. and Leal, O.M.F. (2015). 'Ecolabeling as a sustainability strategy for smallholder farming?: the emergence of participatory certification systems in Brazil', *Journal of sustainable development*, Vol. 8:6, pp. 196-207 https://www.lume.ufrgs.br/handle/10183/130192

It should be noted that the management of data for certification should be kept at the farmer organisation (and not at the certification body) as there are different kinds of certification (for different purposes) and any farmer organisation should be allowed to keep the independence to choose.

4.3 Upscaling digital profiling for market access

Buoyed by its early success with the digital database, NUCAFE has received more than €1.2 million from the European Union to help establish geographical indications for coffee in six member cooperatives in the Rwenzori region during the next four years (2018 to 2022). Targeting 20,000 coffee farmer households, many located in the remote area of the Rwenzori Mountains, the initiative seeks to obtain organic, fair trade and geographical indicator certification, using GIS-based tools. The ultimate goal is to secure improved livelihoods, job creation and poverty alleviation for coffee farming families.

Growing awareness of the potential benefits of being profiled is starting to attract new members to NUCAFE. Furthermore, the state-run Uganda Coffee Development Authority (UCDA) wants to use the same profiling methodology for all Ugandan coffee farmers to facilitate service provision and distribution of inputs, and to upgrade speciality branding of Ugandan coffee on the international market.

4.4 Attracting new customers

Lesotho National Farmers Union (LENAFU) has used the database to improve its standing with new customers, most recently with the WFP who now source maize and beans from the Union. The database has improved the Union's standing with other potential customers and partners as it now has more data about its members and can prove to be representative.

Lesotho National Farmers Union (LENAFU)

- Joint initiative with SACAU
- 52,000 farmer profiled
- Main objective: digitised LENAFU farmer registry
- Main output: data collection capacities
- Profile use:
- Communication with members
- Design new services for members
- Business intelligence service
- Challenges
- Business model
- Technical platform

4.5 Collective market participation

Participants highlighted the importance of this aspect which is also found in the literature. In an example from Cameroon, farmers overcome difficulties due to lack of money, debt and other constraints by coming together, identifying buyers and a market, commercialising their collective produce and retaining some profit for the members. This gives them more negotiation power. According to another participant, farmer organisations have a key role in collective market participation and using farmer profiles helps to manage these tasks easily. Registration can make collective

market participation possible. There are several positive examples where knowing the yield prediction for a group can help reach new markets. “The odds of participating in collective marketing by smallholder farm households in Balaka was significantly influenced by gender, education level, access to social capital through membership in farmer groups that form the innovation platform, farming experience, adoption/practice of conservation agriculture and possession of assets e.g. cell phone and bicycle.”[7]

[7] Mango, N., Makate, C., Lundy, M., Siziba, S., Kefasi, N. and Fatunbi, O. (2017). ‘Collective market participation for improved income among smallholder farming households: a case of Balaka Innovation Platform in Malawi’, *African Crop Science Journal*, Vol. 25, pp. 97-108.

5 Supply chain management

Digital supply chain management solutions are business-to-business services that help agrobusinesses, cooperatives, nucleus farms, input agro-dealers and other smallholder farmer value chain intermediaries to manage their smallholder relationships in ways that lower costs through greater efficiency, improve value chain quality through better traceability and accountability and ultimately increase smallholder farmer yields and incomes.

5.1 Improved logistics

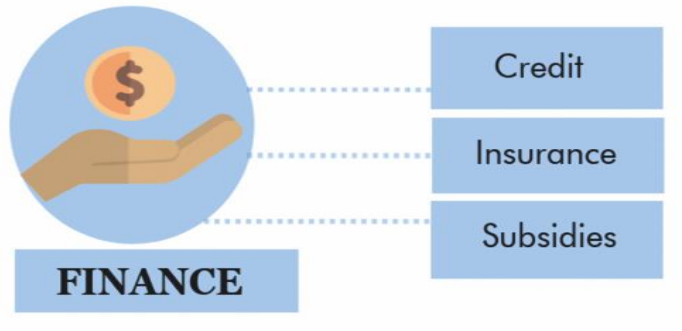
At a practical level, the geo-referenced data has enabled extension workers, businesses and hub managers working with the coffee farmers' associations to improve logistics planning. Having a detailed overview of the territory and location of farmers makes it easier for them to schedule coffee bean collection, effective agricultural advisory support and supplementary services. Awareness raising on the value of drought insurance, training in climate-smart agriculture, and positioning of strategically located wet processing machines in the Mabira Coffee Farmers Association are among the services delivered by NUCAFE.

In the case of the IGTF example, better supply management was possible through digitalisation of the delivery and collection points.

Igara Growers Tea Factory (IGTF)

- Almost 20,000 farmers and more than 22,000 gardens profiled
- Profile use:
- Input calculation
- Access to credit
- Main success
- Saving for the IGTF on inputs
- More farmers delivering to the IGTF
- Better position of delivery points
- Digitalisation of collection points
- Easier access to credit for farmers
- Greater trust from farmers

6 Financial services



Many digital financial services are relevant for smallholder farmers, such as digital payments, savings, credit and agricultural insurance. They increase financial access and equip smallholder farmers to improve yields and incomes and invest in the long-term sustainability of their farm. Financial access also includes business-to-business digitalisation and data analytics services for financial institutions to serve smallholder farmers at substantially lower cost and risk. Getting access to financial services by the smallholder farmers can be done only with digital farm profiling.

6.1 Access to credit

Specific data is required to support credit-based decisions with other financial services reliant on different data. For credit for example this can cover field information, crop data, farm management details, production information, post-harvest information, selling opportunities, financial data and insurance information.

Greater access to, and management of, farmer information is also enabling farmer organisations to improve financial services for their members. The e-Granary described earlier uses farm-level data to build automated risk profiles for farmers. Credit providers use these profiles to determine various micro-finance parameters. The technology, which is rolled out to farmers by the EAFF and represents about 20 million farmers in the region, is accessed using USSD technology; similar to SMS, the technology serves as a platform between mobile phones and the computer software of a service provider to send and receive text messages. Farmers log the metrics of their production into the platform, including the size of their farm, the crops grown and how much they pay their workers. Based on this information, and using advanced analytics, the app works out what inputs they need to maximise their yield, such as quality seed and fertiliser, and these are made available to them in the form of credits disbursed by the credit provider.

Examples already exist where farmer profiles improve access to credit. This is achieved by using profiles based on yield potential of farmers' fields calculated from satellite images. An example of local dossiers was tested with the IGTF and NUCAFE providing more interest from prospective banks for loans but as yet not resulting in new credit arrangements.

6.2 E-wallets

Farmers may trust electronic money (e-wallets) to manage cash flow during the cropping cycle, but experiences are mixed. There should be affordable options to convert electronic money into cash that can be spent. From field work and the literature, it appears that network coverage is a crucial factor for success. However,

there are other factors. Even if farmers are able to receive crop revenues and other payments electronically, they need to convert it into cash if they want to spend it. So, it may depend on the options and the cost to do so whether an e-wallet is an attractive option.

"Network coverage has posed a challenge in some rural areas. As a result, some farmers appear to be reluctant to activate SIMs in areas where [the preferred provider's] coverage is limited."[8] Apart from network coverage, issues may arise from a change in SIM between registration; a delay between registration and validation of eligibility. There is more need to validate identity if registration brings financial benefits: "Increased numbers of 'split' and 'ghost' farm families."[9] "Sharp practices" may occur like multiple registrations, sale of e-wallet (with credentials).[10]

6.3 Subsidies

Issues may arise around 'identity' if the profile is used for a subsidised input scheme (split farms, multiple registrations). Several e-voucher systems exist: electronic cards enable eligible beneficiaries of subsidised input schemes to purchase farm implements from registered suppliers. In that case there is no problem to convert electronic money to cash.

As highlighted in the literature and field experience, duplication of registrations and reliability of data are especially problematic if registration is linked to subsidies. Data quality control during the process of collection, storage and treatment is fundamental.

6.4 De-risking agricultural value chains

Scaling these successes is much more challenging. Perceived and actual risks in the agricultural sector are key reasons for financial service providers' reluctance to invest in scaling ICT-supported innovations for agriculture. Often, these providers lack information about the sector, resulting in limited financial products being made available to agricultural value chain actors.

Some agricultural companies, traders and larger businesses with greater access to financial services have created formal and informal mechanisms to provide financing for smallholder farmers and pastoralists. Examples include agricultural value addition companies providing linkage services by making produce payments to farmers through financial institutions – banks and cooperatives. By using digital payment channels, value chain actors create a trail of transactions for farmers, which can help financial institutions to better understand their businesses and develop more suitable financial services.

Other innovative de-risking mechanisms include guarantee arrangements between value chain actors, such as the issuing by financial institutions of electronic vouchers, reducing the risk of credit diversion. Farmers taking out loans receive in-kind

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[8] CGAP (2014), p. 5. https://www.cgap.org/sites/default/files/Focus-Note-Serving-Smallholder-Farmers-Jun-2014.pdf

[9] Dorward, A., and Chirwa, E. (2010). *The Farm Input Subsidy Programme (FISP) 2009/10: A review of its implementation and impact – A review of its implementation and impact.* London: Centre for Development, Environment and Policy, SOAS, University of London, and Wadonda Consult (unpublished).

[10] See: Ladele, A.A. and Oyelami, B.O. (2015). 'Incidence of sharp practices in growth enhancement support scheme redemption centres of Oyo State', *Nigerian Journal of Rural Sociology*, Vol. 16(1).

products, such as inputs from farmer organisations or traders partnering with the financial institutions utilising electronic voucher systems (see the SNAU example below). This increases the appetite of lenders to provide more credit, due to the higher prospects of payback, while simultaneously increasing farmer productivity through access to higher quality inputs. It should be noted that this approach may limit the ability of smallholder farmers to choose the inputs they prefer.

Eswatini National Agriculture Union (SNAU)

- Joint initiative with SACAU
- Approximately 23,000 farmers profiled
- Main objective: digitalise farmer union membership management
- Main output: better understanding of membership
- Profile use:
- Government e-voucher scheme
- Direct communication
- Policy studies
- Advocacy
- Challenges
- Business model
- Technical platform

Digital profiling of farmers and pastoralists, together with the use of other digital information on weather and other external factors, has strong potential to further de-risk value chain investments in ICT-supported solutions to upgrade value chains.

6.5 De-risking to promote investment

Successful scaling of ICT-supported solutions requires an approach to de-risk investments for business models to attract major investments. The examples highlighted here show that this is mostly achieved through specific arrangements in the value chain, together with high and short-term returns. Nevertheless, attention should be given to long term views related to social and environmental benefits for farmers that may not be the priority of lenders trying to maximise their short-term profit.

Market segmentation and value chain coordination are key to increase return on investment, since farmers, input dealers, traders, processors, transporters and other agricultural value chain actors all have unique financial requirements.

Last but not least, an enabling environment, with the right infrastructure and policies, is critical to unlocking systemic change. In practical terms, mobile digital innovations rely on an effective telecommunications infrastructure, and coordinated policies will help to increase the appetite for investments in digitalisation, and consequently, to transform agribusiness.

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