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Precision agriculture for smallholder farmers

Contents

ICT Update

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The MUIIS Project: made to last

Mark Speer

If the world continues on its course, then estimates suggest that by 2050 population growth will have dwarfed food production. This will put an untenable strain on resources such as land and water as we search for ways to feed nine billion people. This strain is likely to be further exacerbated by climate change. Unpredictable farming seasons and weather patterns are making life even more difficult for food producers. Two ways of obviating these developments is to use resources such as water and agricultural inputs more efficiently and increase the crop yields of key actors in global food production: smallholder farmers.

These concerns are what led the Dutch Ministry of Foreign Affairs to award a subsidy of 4.6 million euros through the Netherlands Space Office to a consortium of partners led by CTA to implement the Market-led, User-owned ICT4Ag Enabled Information Service (MUIIS). The project has ambitious goals: increase crop yield, farmers' income, the use of agri-inputs and water, and trade and investment; and decrease the risk of using agri-inputs.

The project is designed so that each of CTA's six partners in the chain have a specific task to carry out over the project's three-year lifespan. aWhere, eLEAF and EARS-E2M handle the analysis and transformation of satellite data into practical advice for farmers. CTA works with the AGRA, EAFF and Mercy Corps Uganda on the ground to gauge farmers' information needs, train extension workers, digitally profile farmers and train them to use the information and advice they receive.

For the bulk of this issue of *ICT Update*, we interviewed people working for several of these partner organisations, from NSO to Mercy Corps. What exactly does each partner do? What makes the partnership strong? Is the business model holding up? The MUIIS project is now completing the second of its three years, so that raises several other interesting questions, not least of which: how have farmers responded to the idea of subscribing to the MUIIS service bundle? One thing all of the people we spoke to agree on is that this project is designed to last. Too often, once a project's funds dry up, so does the project. ●

About the author
Mark Speer is editor of *ICT Update* based in The Hague, the Netherlands.

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MUIIS http://muiis.cta.int
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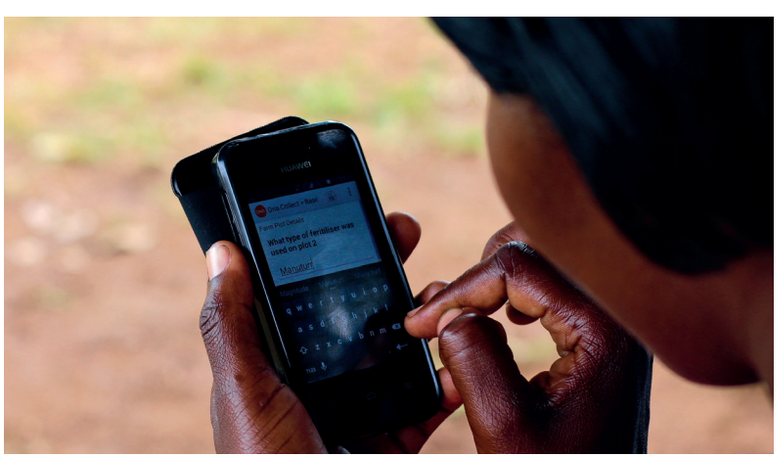


Space for food security

ICT Update spoke to **Ruud Grim**, senior advisor for applications and coordinator of Geodata for Agriculture and Water (G4AW) at the Netherlands Space Office, to find out more about the G4AW programme, which made the MUIIS consortium possible.

Right: Ugandan farmers at work in their field. (Laura Elizabeth Pohl).

Q *How did a space agency get involved in food security?*

NSO was founded in 2009. But the Netherlands has been represented at the European Space Agency for about 30 years. At a certain point we thought it's great that we've launched a number of satellites into space, but how are we going to start using them optimally? So that led to one of NSO's missions, namely to promote the use of satellite data in society. Another mission is to maximize the use of the entire infrastructure that has been developed. And at the same time look after the government's economic interests, especially in terms of innovation. In other words, we also want the Dutch business sector and knowledge institutes to benefit from satellite data. You could describes NSO's role as a driver of innovation, economic growth and the use of knowledge.

The lesson we've learned is that cultural and organisational problems are more challenging than technological ones

NSO got involved in the discussion with the Ministry of Foreign Affairs about food security and supporting smallholder food producers in developing countries. The G4AW programme emerged from this discussion. It's a special programme because it connects two worlds that had never directly interacted with each other before. On the one hand you have satellites – the high-tech, science side of it – and then you have the development cooperation side – smallholder farmers in developing countries, who are extremely vulnerable, because if a crop fails they're immediately in trouble. You could say the two have nothing to do with each other, and yet we've discovered that they actually have a great deal to offer each other.

Q *So how did G4AW come about?*

The discussions at the Ministry of Foreign Affairs explored the question of what aerospace's added value could be. Obviously it has added value for large organisations, for authorities, for knowledge institutes, as satellites collect basic data. And from this data you can create knowledge and act on it, often at the government level. But then someone raised the question, what exactly are the authorities doing with all of this knowledge? How, for example, does a farmer benefit from it? Do they receive advice that will help them make better decisions? We concluded that this wasn't happening at the operational level. There were a number of pilot projects, research projects and small demonstration projects, but they tended to end without much follow-up. That's when the ministry decided to take the link between satellite data and food security to the next stage.

So we examined that question for a year or so. We spoke to many players in the field, had a literature study carried out by students, and at a certain point it became clear that if we want to achieve our goal of improving food security, a number of things are crucial: first, quite simply, we need to connect to the smallholder farmer. If you can't do that, then you have no added value. You need to understand their needs, otherwise you won't be able to provide them with information that can be used to take action. So knowledge transfer and capacity building are part of this process, which is typically the domain of NGOs and extension officers from ministries of agriculture. Or companies. So that's the first step that you have to take.

Above: A field of maize in Uganda. (James Anderson, World Resources Institute).

The second important condition was that while you can develop a service that's suitable for farmers, it has to be economically viable as well, otherwise it's pointless. There has to be a party or an organisation behind it that develops a financial model for the provision of these services, and of course the service has to be affordable. Affordable could mean it's free, but it could come from other sources. It could be a system where customers – farmers or farmer cooperatives – pay, but then in such a way that they can benefit.

The most important criterion was that the initiative has to generate a service that has added value. We noticed that this market didn't really exist yet. Why? Because it entails a number of risks, and the services have to be developed. The customers won't be able to pay for it yet or may not want to, so essentially there's a huge disincentive for organisations to invest in it. That's why we as the government have been given permission to extend grants for projects such as MUIIS. That's basically what's behind G4AW.

Q *How do you actually calculate at what point a smallholder will benefit from the service?*

Assume that the operational costs of service delivery are a million euros a year. And assume a smallholder farmer earns 1,000 euros a year. Let's say he's prepared to invest 1% of that amount in the service, with the potential added value that he will stand to earn at least 10% more income. That means he will invest 10 dollars in the service and earn 100 dollars more a year as a result. So we said, that's the minimum the farmer will have to spend on the service. The initial response from the sector was: 'You guys are nuts, we cannot reach out to 100,000 farmers,' but ultimately the sector came up with clever, inclusive business models, including aggregators and governments that make the number of farmers that need to be reached realistic.

Q *How does the raw satellite data get processed?*

ESA's Sentinel mission is an important source. It's a European satellite constellation basically consisting of three types of satellite, two of which deliver a new message about once a week, while another one transmits on a daily basis. These satellites supply different kinds of data. The companies and knowledge institutes have algorithms that can derive information from this data. Data that comes down from the satellite, before it even reaches the tech company, first undergoes several quality checks by the operator of the satellite, who has to make sure that the data have a certain reliability and quality. In aerospace terminology, they call it working from level 0, which is the raw data, to level 4. In other words, the information and quality improves as it goes from one level to the next.

The operator also carries out a number of corrections, for example

atmospheric or geographical corrections. Then ESA will put the data into a database, and that's where the tech companies source their data from. They have models that can derive information from this data. You could even say that the data is a 'half' product, because for a farmer it's not advice or an actionable product yet. It's the tech companies' job to take care of the primary processing of the satellite data and package it into a product. In the G4AW project MUIIS, which is coordinated by CTA, eLEAF, for example, focuses on water and vegetation, while aWhere focuses mainly on meteorological satellite data and weather forecasts.

Q *What happens next?*

Then at a certain point all of that converges in a model, or a large algorithm. Think of it as a decision support system that contains the knowledge from which advice is distilled. Often you'll need to supplement the data with other information to achieve your aim. You may need to combine it with information on local temperatures and moisture levels. How that's all organised is up to the tech companies. Eventually the central system will produce specific advice for farmers covering a specific region. The advice is delivered via telecom or extension officers who go into the field with their mobile phone, while some farmers receive it through SMS or radio. Those are essentially the different channels used to reach farmers. But NSO's role in all this is to ensure that the entire field of players come together and that the satellite data eventually gets turned into a service or financial product that reaches farmers.

Q *How is this advice benefitting smallholder farmers?*

Traditionally, a farmer in a developing country would respond to his environment or at most to a weather report that he received from the national meteorological service, but that is general information and not location-specific. So you have to realise that the reliability of weather data for farmers was poor. And there was no other way for them to source information. Farmers still depended on the traditional signals that they picked up on from nature. But unfortunately we're having to deal with climate change. That means weather seasons are starting earlier or later, droughts are getting worse or rain is intensifying. Essentially weather has become much more unpredictable.

Satellites generate much more precise, location-based, and therefore reliable, data. Providing farmers with better and timely information in the form of weather forecasting and crop management, for example, puts them in a position to make well-founded decisions – decisions that will increase yield and income and result in the more effective use of agricultural inputs and water. And because satellite data cover large areas and are consistent in time and space, the basic information is continuously the same. As a result, you can offer a high-quality service over time. Continuous, high-quality data is important. Take a local outdated weather station, for example. They break down sometimes or work at half strength. There are people at these stations filling in numbers all day long, so sometimes they get it wrong. So it's important to automate these systems as much as possible to eliminate human error and other factors you have no control over. In that sense, satellite data is extremely consistent and reliable.

Q *G4AW has initiated 17 projects to date. What lessons have you learned so far?*

Essentially the lessons we've learned is that cultural and organisational problems are often much more challenging than technological ones. Clearly, the organisation and the partnership have to be handled properly, otherwise you'll suffer delays and risk not achieving your goals. We deliberately put a limit of three years on our projects. The idea being that in the first year you set up the partnership, and develop and offer your first service.

In the second year you roll out the service in the field and get feedback. Then you make plans to scale it up and roll out your training plans. And in the third year you have an improved service and take care of the full roll-out of the service. That's the ideal situation. But many of these projects are being extended to a fourth year. Why? Because the reality is that the partners need more time in the first year to take all the necessary steps to work well together, to reach the farmers properly.

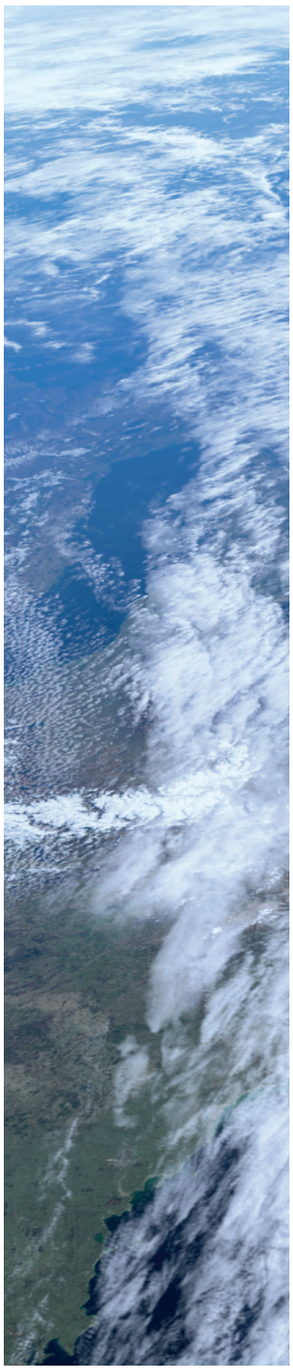
Another lesson is that the development of a business model can be very tricky. We have several projects in which the partnership has had to adapt the business plan, the business model. But we build space for that into our projects. We're not dogmatic about that. We don't tell our partners that they have to stick to every detail of their plan and business model. That's simply not how it works. These models are based on our best insights, and if these insights change along the way we simply have to adapt the plan and activities.

But it's important to have companies on board to pull the cart. They can provide continuity because they have the business drive. Profit is considered a dirty word because it's sees as coming at the expense of the farmers. But these companies are often social enterprises involved in the environment, who are not in it to earn millions but want to continue to provide a service. Without that business drive, a researcher will wander from project to project, and without continuity the impact will be negligible. You certainly won't achieve what's needed to ensure food security.

In the end, the involvement of the private sector stems from the Ministry of Foreign Affairs' realisation in 2011 that support for development cooperation was waning, and the way to turn that around was to introduce the economic component. ●

Ruud Grim is senior advisor for applications and coordinator of the G4AW Facility at the Netherlands Space Office.

The G4AW programme is special because it connects two worlds that had never directly interacted with each other before



Transforming satellite data for smallholders

Remco Dost

ICT Update spoke to Remco Dost, senior project manager at eLEAF, about the company's work, what it does with the raw data it sources from satellites and what role it is playing in the Market-led, User-owned ICT4Ag-enabled Information Service (MUIIS).

eLEAF procures satellite imagery from the vast fleet of satellites orbiting our planet launched by space organisations such as ESA and NASA. Once sourced, eLEAF converts satellite pictures into quantified data. 'It's a process called PiMapping,' says Remco Dost. 'What we basically do is measure how much radiation solar has been emitted by the sun, how much of that has been used, reflected back into space, absorbed by the soil, and that allows us to calculate how much is used by vegetation for photosynthesis.'

From that, eLEAF can get an idea of the status of the actual crop in the field. What is the current state of the vegetation growing right now? PiMapping tells you this in kilogrammes or tons per hectare. 'It also reveals the condition of the crop in terms of water,' says Dost. 'Is the crop thirsty, does it need water?' The technology also makes it possible to see in-field variation. 'It shows you that a crop is doing well at the edge but not at the centre, for example,' Dost says. Or compare two fields. 'Because we have detailed input information, we can see whether a given field is suffering from water stress or soil compaction. Then you can compare that to the neighbour's field and ask why one is doing better than the other. Is it variety? Is it management?'

That's one side of the eLEAF story. The company helps farmers to monitor their crop over the season. Once it figures out why a crop is producing less, it provides the farmer with advice on how to improve production. But eLEAF also combines data. 'We can monitor a crop over the years and establish what its potential growth would be in a given region. And by combining that with climate information we can even provide information on what kind of yield to expect,' says Dost.

We're already working on the tooling that smallholders can use on a simple smartphone up to an advanced smartphone

So the next question is, how is this advice packaged so that it is useful for farmers on the ground? 'There are a number of access structures,' Dost says. 'Indeed, satellite imagery in itself would not be useful information for a farmer. So we provide a derived product with weekly updates on the status of the crop. We have our own interface, called FieldLook, so you can access it online. There farmers can log in and get all their fields spatially visualised in graphic form so they can also see the evolution over time.'

The Gezira Irrigation Scheme

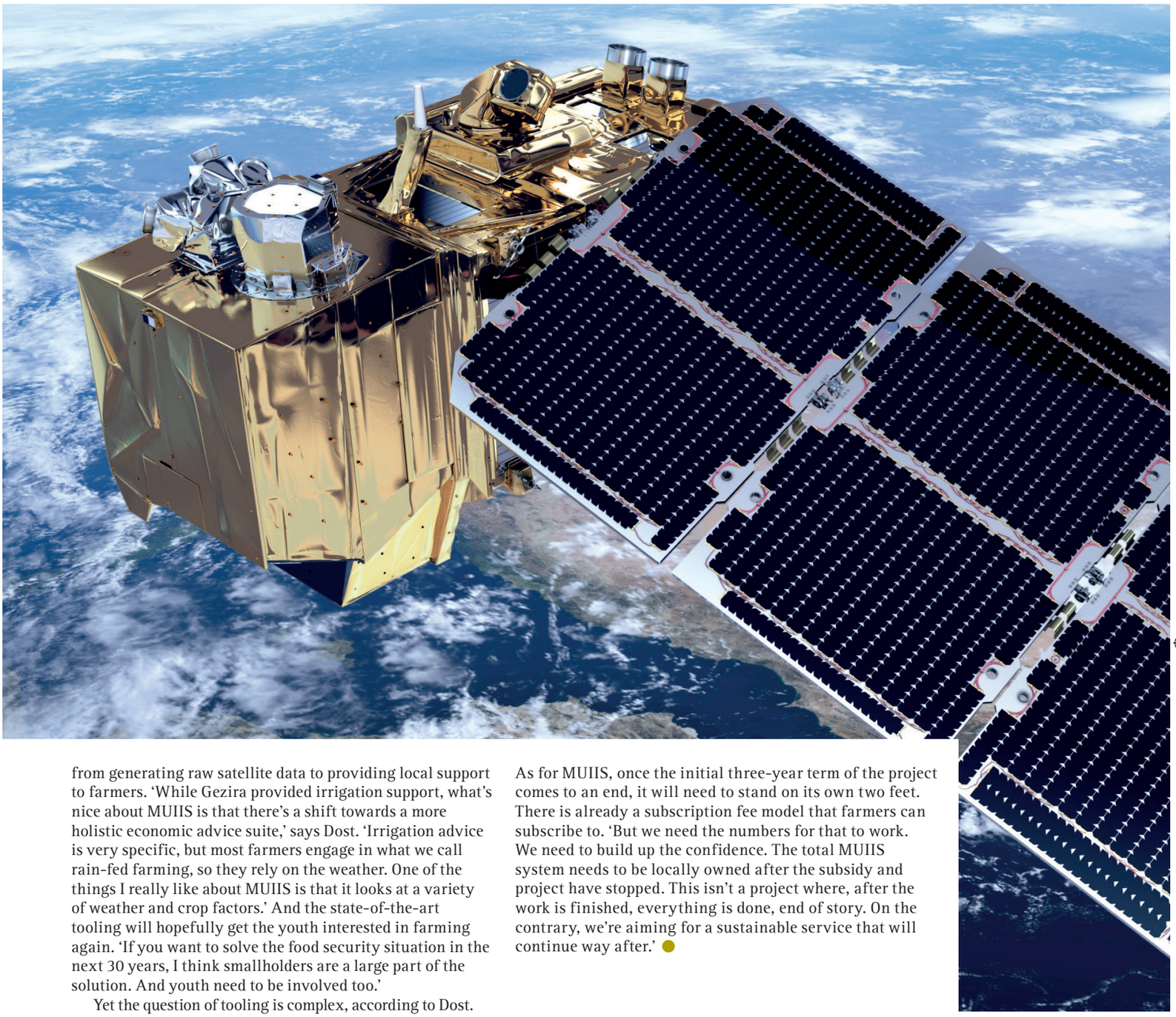
eLEAF and CTA worked together prior to the MUIIS project. 'We worked together on the Gezira project in Sudan, which was very successful,' Dost says. Gezira is a large irrigation scheme, more than a million hectares. But farmers were having productivity issues. 'It was all gravity-based irrigation: the gates open and water flows over the fields. So we provided farmers there – who have mobile phones but not smartphones – with irrigation advice by SMS. We calculated the status of the participating farmers' crops and linked that to the weather forecast. Based on that we were able to determine when to irrigate a crop before water stress sets in.'

Once a crop suffers from water stress, farmers start to lose income. The irrigation advice that eLEAF gave farmers had stunning results. In some cases, the yield increased by as much as 200% to 250%. In fact, the advice was to irrigate more, not less, which had two benefits. First, it solved the water stress problem. But second, farmers actually used less water. Because they were irrigating more, they became more conscious of the amount of water that they put on the field.

eLEAF's role in MUIIS

Gezira was the start of the collaboration between CTA and eLEAF and the use of this type of technology for smallholders. 'Many of these services are normally used for large corporations, commercial companies that have some money to spend,' Dost says. 'But of course smallholders are a completely different sector. They have small fields, limited access to information, and willingness to pay is also usually low. That makes it difficult to provide them with these kinds services.' That is where combined services comes in, which is precisely the strength of the MUIIS project. 'That kind of project requires an investment and you have to get the technology to work. You have to put a team together, and all of these things are difficult for smaller companies. The Netherlands Space Office's tender through Geodata for Agriculture and Water (G4AW) solved this problem.'

It effectively made it possible to create a consortium of partners, each responsible for a service in the MUIIS chain,



from generating raw satellite data to providing local support to farmers. 'While Gezira provided irrigation support, what's nice about MUIIS is that there's a shift towards a more holistic economic advice suite,' says Dost. 'Irrigation advice is very specific, but most farmers engage in what we call rain-fed farming, so they rely on the weather. One of the things I really like about MUIIS is that it looks at a variety of weather and crop factors.' And the state-of-the-art tooling will hopefully get the youth interested in farming again. 'If you want to solve the food security situation in the next 30 years, I think smallholders are a large part of the solution. And youth need to be involved too.'

Yet the question of tooling is complex, according to Dost. 'If the farmers in Uganda had access to smartphones we could provide them with more tooling and they could also provide us with useful feedback and data. The way we see it, the technology is there, and we are basically adapting how we deliver the messages.' eLEAF is currently conducting a feasibility study in Ghana, where literacy is an issue, so they are using voice messaging. 'But 20 years ago when I started my career there were no mobile phones, let alone email,' Dost says. 'We communicated by fax. So we're already working on the tooling that smallholders can use on a simple smartphone up to an advanced smartphone. I don't know whether they will all have a smartphone five years from now, but a number of them will. And having the access structure to those services doesn't only mean that they get better services but they will also become better advocates of the services that are there.'

As for MUIIS, once the initial three-year term of the project comes to an end, it will need to stand on its own two feet. There is already a subscription fee model that farmers can subscribe to. 'But we need the numbers for that to work. We need to build up the confidence. The total MUIIS system needs to be locally owned after the subsidy and project have stopped. This isn't a project where, after the work is finished, everything is done, end of story. On the contrary, we're aiming for a sustainable service that will continue way after.' ●

About the author

Remco Dost is senior project manager at eLEAF, a company based in Wageningen, the Netherlands whose mission is to provide data on crop growth and water use to increase food production, support sustainable water management and protect environmental systems worldwide.

Above: This is where it all begins. A satellite above the Earth transmits data that will eventually help farmers on the ground (ESA/ATG medialab).

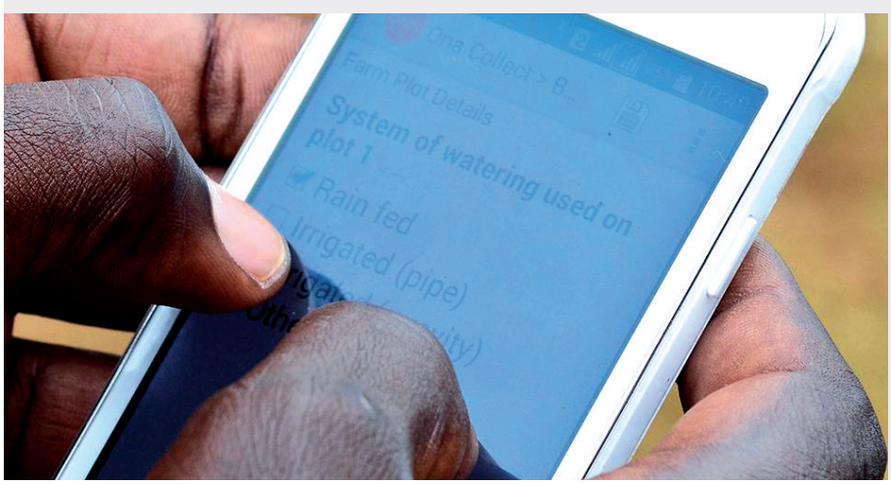
Helping farmers make real decisions

Hanna Camp

ICT Update spoke to Hanna Camp, client engagement manager at aWhere, to discover in more detail what the company's role is in the Market-led, User-owned ICT4Ag-enabled Information Service (MUIIS).

aWhere is a small company that has been in the business of providing agricultural intelligence for almost 20 years. The company focuses mainly on weather and agronomic data. 'We use 3D modelling on top of satellite and ground station data to create a global grid surface,' says Hanna Camp, client engagement manager at aWhere. 'The grid is approximately 9 km by 9 km and covers all of the areas that we refer to as agricultural earth. So we'll have some modelled weather for any place where someone is growing something.' These datasets reach back at least 10 and sometimes 20 years into the past. 'We want to be sure that farmers all over the globe have access to a forecast and truly historical record of their farm, not just the closest ground stations but a real location-specific record and a forecast for their farms so that they can start to make real decisions based on the weather,' Camp says.

The impetus for that, of course, is climate change. Weather has become much more volatile and unpredictable recently. This has made it more difficult for farmers to make decisions, especially when they do not have access to any real weather information for their farms. That is where a company like aWhere can make a difference. It can use its database to get a high-resolution look at food and food growth all over the world. 'For example, if we think that cocoa is going to be facing serious challenges in the next couple of years in West Africa because the conditions are becoming more hostile to the trees, then we look at where conditions might be getting better. What we can do to partner with people who want to start growing new types of food in places where they maybe weren't able to grow it before? What kind of tools do they need, and what sort of historical analysis might they need to convince them?'



Below: Farmers receive a 150-character text alerting them on risks and suggesting what action to take (© CTA).

Converting data into 150 useful characters

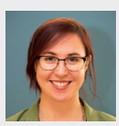
aWhere uses a multipronged approach. It partners with both private companies and NGOs. Indeed, the Market-led, User-owned ICT4Ag-enabled Information Service (MUIIS) project fell very much in the sphere of the projects that the company likes to take on: farmer-specific projects that try to get high-resolution information down to the farmers. Another appealing aspect of the project was the idea of creating a business model that would sustain itself after the project is done. 'Too often, a project's funding dries up and then it no longer sustains itself,' Camp says.

Like eLEAF (see pages 6-7 of this issue), aWhere's role in MUIIS is to package the satellite data so that it is useful for farmers on the ground. The satellite data is processed on aWhere's server every day. In the case of forecasts, they are updated every four to six hours. The data is immediately available on aWhere's application programming interface (API). 'That's the primary tool that we use to communicate with the ground,' Camp says. 'We work with Ensibuuko, our main ground partner, who run the ground systems. They also have some developers on the ground who we work with to connect to the API so that they can automatically update their data for all of the subscribed farmers as frequently as they like.'

The data is filtered out by farmer location and then aggregated into a seven-day recent history, for example. 'We check whether the rainfall has been above or below a set amount. If it has been below a set amount, that triggers a pre-set message. And if it's been above a certain amount that may trigger a different message.' The system also checks for a different set of risk thresholds, not just precipitation but also temperature, for example. If it has been unusually humid, for example, that would be a risk factor for diseases. When there are multiple risks, the system sends priority messages. 'What it really amounts to is that people have taken the data from our system and translated it into a very simple 150-character text alerting the farmer of the risk and telling him a very simple action he might be able to take,' Camp says.

Farmer feedback

MUIIS is a three-year project funded by the Dutch Ministry of Foreign Affairs through the Netherlands Space Office and its Geodata for Agriculture and Water (G4AW) programme. One of the things that makes this project stand out is that it is designed to be a sustainable venture that continues after the initial three years are over. 'G4AW has been incredible ambitious and supportive,' Camp says. 'This long time period that we were given to develop this product has been really important. Some of the other projects we work on tend to be very short-going. While you can develop a product in that time period, you really don't get the chance to deploy it in the field, test everything out and get the farmers' feedback.' Feedback is an important aspect of the product development cycle. It gives the partners in MUIIS the opportunity to sit back and assess what works and what does not work. And ultimately improve the service. ●



About the author
Hanna Camp is client engagement manager at aWhere in Broomfield, Colorado in the United States.

How the data revolution can benefit farmers

Stéphane Boyera

The data revolution is transforming the traditional role of farmer organisations and cooperatives. What challenges do they face in ensuring that the data revolution benefits their members? **Stéphane Boyera** explores options, such as providing specialised services and creating farmer profiles.

Farmer organisations (FOs) and cooperatives have traditionally played an important role in society. Indeed, they help to improve their members' living conditions, particularly the low-income earners. More than 40% of all households in Africa are members of a cooperative society, and the cooperative movement is Africa's biggest NGO. But what is their role in the data revolution? How can they both ensure that this data revolution benefits their members, and smallholder farmers in general, and at the same time contribute to the revolution by providing valuable information to policymakers or other stakeholders of the ecosystem?

Providing specialised services

Numerous literature and data (see related links) show that there is a huge gap in terms of productivity for most crops in sub-Saharan Africa and other developing regions. This gap is also a tremendous opportunity to support smallholder farmers and increase their income and food security. There are a series of challenges at each stage of the crop cycle, and providing the right information or the right instrument at the right time (credit and insurance, for example) can help farmers to bridge at least part of that gap.

The best way to use this information is by providing individual farmers with specialised services. The delivery of these services can largely be supported and improved by using open datasets. The Agriculture Open Data Package is a major resource that identifies high-value data in various agricultural activities. But those datasets are only one part of the picture.

The equation relies on the mash-up of global data (for example, satellite images, research, information databases on crops, seeds, and pest and diseases) with farmer-level (credit records and field ownership documentation) and field-based information (soil information, geographic location, state of the fields and crops) to determine the appropriate individual actionable information.

The result at the farmer level is the availability of new products to support their production (credit and insurance) and timely information to support decision-making.

Creating farmer profiles

Farmer-level and field-based information is local information that can be used to create a profile of farmers. FOs and cooperatives are in the best position to build and maintain those profiles. The value of these profiles, apart from enabling specialised services for farmers, can also benefit other stakeholders, such as cooperatives and FOs themselves. The value of membership profiles spans across many of these organisations' activities:

- planning and strategy based on real data (identification of new opportunities and new services);
- easier membership management;
- easier communication if the profiling platform includes ICT communication options (such as SMS, IVR and social networking);
- greater advocacy power (ability to show who and where the organisation's members are, what they do, ability to simulate impact with real data on specific interventions, and the ability to survey members); and
- potential new sources of revenues.

The value of these profiles can also benefit policymakers. At a basic level, policymakers want to speak to the most representative organisations with real data about their membership. The management of profiles is a way to demonstrate this representativeness.

There is a potentially greater impact at the data level, however. Profile information provides disaggregated data at a hyperlocal level. Those data point mainly to the agricultural sector, but given the importance of agriculture in rural areas, these data also provide detailed information on most households. The data stored in profiles, after anonymisation and publication as open data, can contribute to many national datasets:

- core agricultural datasets (land usage and production);
- measurement of public policies impact (reach and impact of subsidies schemes);
- Sustainable Development Goals (contribution to many targets and indicators, such as zero hunger, decent work and economic growth and responsible production); and
- general household data (education, household composition, income and land ownership).

The core question is to know how to build such profiles and its exact content. The set of information largely depends on the usage and focus. Depending on where FOs and cooperatives want to focus their activities, and the type of services they want to offer to farmers, very different information has to be collected. An exhaustive analysis of these data, the currently available technical solutions to store them, the options for collecting and keeping them up to date, but also all the concerns around data ownership and privacy are topics of a larger study funded by CTA through GODAN participation, and realised by SBC4D that will be published soon.

About the author

Stéphane Boyera is CEO and founder of SBC4D, a French consulting company that specialises in research and development, and programme management and execution in the ICTD sector.

Related links

goo.gl/C5srmU
goo.gl/iPcvfT
goo.gl/r4yrhu
http://agpack.info

The last mile

ICT Update spoke to **Ronald Rwakigumba** of Mercy Corps, who is responsible for the last mile of the Market-led, User-owned ICT4Ag-enabled Information Service.

Right: Agents are trained in mobile phone literacy and made comfortable using smartphones (© CTA).

Q *Tell us a bit about your role in the Market-led, User-owned ICT4Ag-enabled Information Service (MUIIS).*

My role was related to the agents who gave training. I have also been involved in setting up the ICT infrastructure. Specifically that means mobile phones, which had to be set up with a data collection tool called ONA that would make it possible to profile the farmers. If you're familiar with mobile data collection tools, ONA falls in the family that they call open data kit. So my role was to train the agents in mobile phone literacy and make them comfortable using smartphones, because not all of them had used smartphones before.

The next phase was to introduce them to the application so they could start profiling farmers. To make the graduation model a bit easier for them, we started on the first day by introducing to them the profiling tool on paper. That familiarised them with the questions that they would be asking farmers, before they get distracted by smartphones, connectivity and applications. On the second day we trained them in mobile phone literacy. How to turn on internet mobile data, for example. How to turn on GPS, because some of the questions required the GPS location to be captured. How to increase the accuracy level, because many of the farmers live in rural communities with serious barriers, such as hills and vegetation that would sometimes make it difficult to capture GPS accurately. So that was the kind of training we were giving the MUIIS agents.

The task of profiling was pretty much the work of 2016, and so towards the end of that year we started developing another technology solution, but this time with a farmer interface to make it as easy as possible for farmers to subscribe to the MUIIS business service. Based on the profiling data that we had gathered we discovered that the majority of the farmers had feature phones. So the mobile application that we developed, which is a mobile banking and information system, uses a USSD communications protocol, because that can be used on feature phones. Most farmers don't have smartphones, let alone mobile phone access.

Q *How do farmers benefit from profiling?*

Once farmers have been profiled, their data is on our server and they can subscribe to the MUIIS bundle service. We also provided farmers with a way to pay, because a subscription is both an expression of interest and a paid transaction. Farmers pay 14,000 Ugandan shillings via mobile money, which goes directly to MUIIS. We had already set up a dashboard that enabled the consortium members, including CTA, to be able to view the subscriptions in real time. And when we launched the MUIIS service live for the farmers we also had a TV screen where we could actually see in real time how the subscriptions were progressing.

Uganda has two rainy seasons, so our initial launch was in March to target the first season, which runs through March, April and May. By September, when the second rainy season starts, most farmers will have harvested and aggressively sold their produce, so that's when we did our second launch. The reason we open and lock this platform is that there is crop insurance embedded in this bundle, and to be eligible for crop insurance you should reasonably plant in the right planting season. That's why we closed it after the first season and then opened it up in September again. We gave farmers till September–October to subscribe on an instalment plan, because some farmers cannot pay the full season's subscription in one month.

Q *How have farmers responded to the service?*

In the first season, about a hundred farmers paid 14,000 Ugandan shillings for the MUIIS service. What we've learned is that we need to adapt the marketing model because a hundred is a small number compared to the 40,000 farmers that were profiled by March 2017. In other words, we haven't been able to sell the idea of this service to a large number of farmers yet. So this time around we are targeting more group purchases, whereas in the first season we targeted a lot of individual farmers to subscribe to the MUIIS service bundle. That means that a farmer group can buy on behalf of its members, which will hopefully increase membership numbers. We've adapted the MUIIS mobile purchase application to be able to accept group subscriptions now.

Q *Do group subscriptions affect the amount of revenue you get per farmer?*

Individual members still pay the same amount when they're in a group, but MUIIS will give group organisations a commission. They incur costs in terms of mobilising farmers and selling the idea. But the revenue for that will come from what was initially being used for radio campaigns targeting individual farmers and other marketing costs. You could almost say that we've enlisted the farmer organisations as marketing partners. In fact, we will have a business partnership with

them in the future under MUIIS where they get a commission in the same way that MUIIS gets a commission for bringing insurance business to the insurance companies.

Is there a specific example of how the MUIIS service has helped farmers?

In the first season we were able to get an idea of which farmers were prone to particular pest and disease attacks because we knew their locations. In one case, we were able to send timely SMS messages to subscribed farmers about how to deal with a major outbreak that had affected Uganda. It was even covered in various news outlets internationally. It concerned the fall armyworm, which was particularly destructive to maize. We were able to advise the farmers on which pesticide to use and how to apply it in order to address the fall armyworm. Although the attack was quite severe, some farmers who had subscribed to this package were able to salvage some of their crops.

That experience is something we've taken with us into the second season. For example we've already developed the messages for the entire season based on satellite data. And we've been translating those messages, because part of the feedback that we got from the first season is that English is not the best medium for most of these farmers. As a result, we have contracted translators to translate these messages into local languages to send to the farmers.

I think this will help sell the MUIIS service too. I really do feel it's going to be unique, because no one else is providing a service like this to these farmers. Most of the information they get over the radio is very short term, usually weather predictions for a day or a week. And even then, the information isn't always relevant to their crop levels. I think the added value of MUIIS is that instead of simply telling farmers that it's going to rain or what the temperature is going to be, it focuses more on solutions. We can calculate how many millimetres of rainfall your crop needs or how much water over a longer period of time. And that can be translated into advice, as we can tell farmers that a set amount of water might not be sufficient for their crop. And that they therefore may want to consider either conservation methods of cultivation or irrigation methods. So we're focusing more on the actionable methods as opposed to just passing on information. ●

I think the added value of MUIIS is that instead of simply telling farmers it's going to rain, it focuses more on solutions.

Ronald Rwakigumba is Agri-Fin Mobile Uganda Country Coordinator for Mercy Corps.

The partnership and business model behind MUIIS

Ben Addom

ICT Update spoke to Ben Addom from CTA, who is the programme manager of the MUIIS project in Uganda, to find out more about the partnership and business model that he hopes will ultimately make this a standalone, sustainable project.

MUIIS – the Market-led, User-owned ICT4Ag-enabled Information Service – is a project funded by the Dutch Ministry of Foreign Affairs through the Netherlands Space Office's G4AW programme. The initial subsidy was for three years, after which MUIIS was intended to stand on its own two feet. The consortium, with CTA as its lead partner, developed the business model and put together a team of partners. With the second year now coming to a close, the moment in which MUIIS will have to stand on its own two feet is drawing nearer.

Step one: forming a solid partnership

'As soon as we heard about the grant,' says Ben Addom, MUIIS programme manager at CTA, 'which asked us to form a public-private partnership, we realised that we were well positioned to meet the requirements.' Indeed, CTA has been cooperating with other organisations from a variety of sectors for years, especially with ICT partners. 'In the case of MUIIS, we needed a mix of partners, from data companies to package the raw data into something useful for farmers, to people on the ground to train farmers, the ultimate end users, to use the service. We started modestly and contacted those in our network that we thought would fit into this long chain of partners. And in the meantime, others had gotten wind of the fact that CTA was putting together this consortium. So we were approached by them as well.'

Indeed, CTA had no problem putting together a list of potential partners. In fact, one of the projects requirements was synergy, as opposed to duplication. In other words, the chosen partners had to complement each other, rather than do the same work. 'That's ultimately how you form a strong partnership. To avoid duplication, we had to eliminate some of the shortlisted partners, and that's how this consortium of seven came about. We had worked with some of the partners before, such as AGRA, EAFF and eLEAF, but we also started to work with organisations that were less familiar to us, such as Mercy Corps and aWhere.'

Step two: the initial business model

So with such a variety or partners, from both the private and public sectors, what kind of a business model was developed to satisfy everyone's wishes? 'The initial grant was meant to cover three years,' Addom says. 'We've just finished the second year, so there's one year of subsidy left to lean on. In our proposal for this grant, we set the aim of breaking even in this project by the fourth or fifth year. We knew from experience that MUIIS would not start to earn a profit by the end of the third year.' That meant that the MUIIS project needed to find other resources to bridge that gap, which CTA is attempting to mobilise during the transition period to make sure that the project moves forward.

'The idea behind the original business case was to simply put forward the argument that MUIIS is a service that has value that people are willing to pay for,' Addom says. 'We worked together with farmer organisations to help us estimate how many farmers could potentially use this product, which ended up being about 4 to 4.5 million farmers.' Based on that advice, CTA targeted 350,000 farmers for the MUIIS service, which are being reached through awareness creation training. But CTA's ultimate goal – based on its calculations and cash-flow analysis – was to have 200,000 of these farmers subscribing to and using the MUIIS information service for three years. This would mean breaking even.

In the end, it took a year to actually develop the product. 'So a year passed without a sale,' Addom says. 'We've now ended the second year and are starting the third. We've only had one test season to gauge the minimum viable product, in other words whether the MUIIS product has what it takes to satisfy early customers. The test season involved about 100 farmers, who paid for the information service, and we're waiting for their feedback.'

Step three: the model for the future

CTA hopes that the second season, which is just underway, can attract more subscriptions. 'It's clear that we won't achieve the goal of getting 200,000 paid subscriptions by the end of the third year, so we're updating the business model.' One of the obstacles is that smallholder farmers are much more willing to pay for tangibles, such as fertiliser, seed and chemicals, than they are to pay for intangibles, such as information services or insurance.

'That's why the original design was to organise farmers into groups and cooperatives and have them pay for a subscription through them, a bundle that includes the information service and insurance. That hasn't quite worked out yet, so we're now concentrating on increasing the number of groups that subscribe to the MUIIS service. But we're also looking for other resources, financial investors interested in accessing the farmers' data.'

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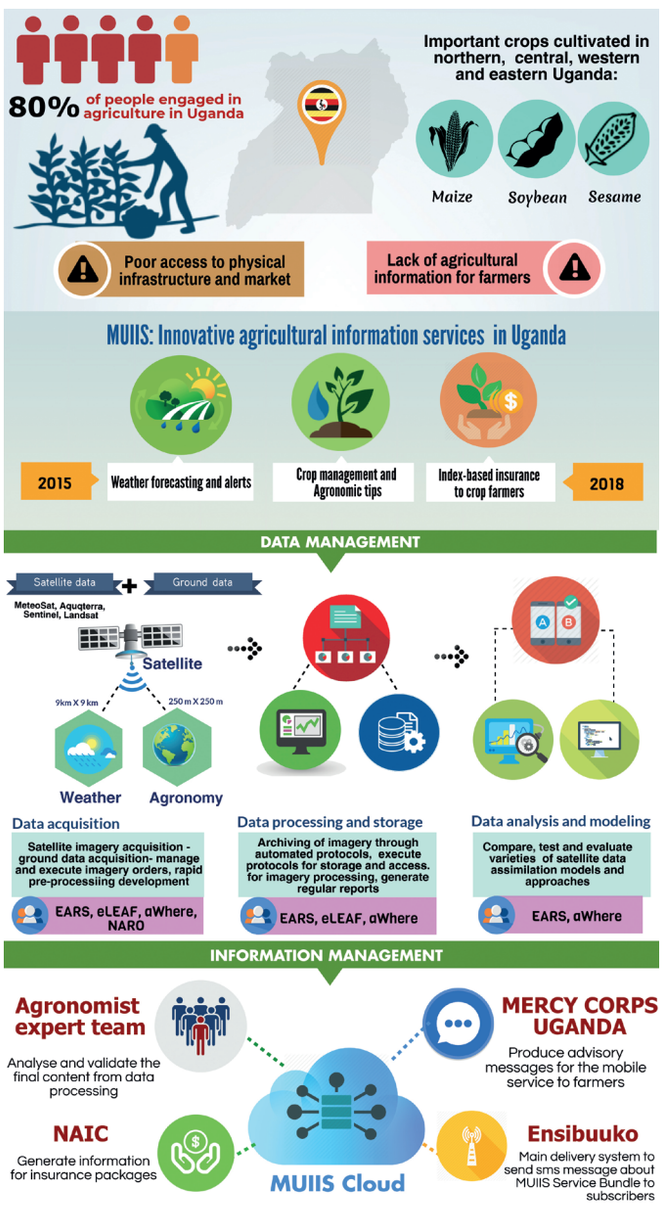
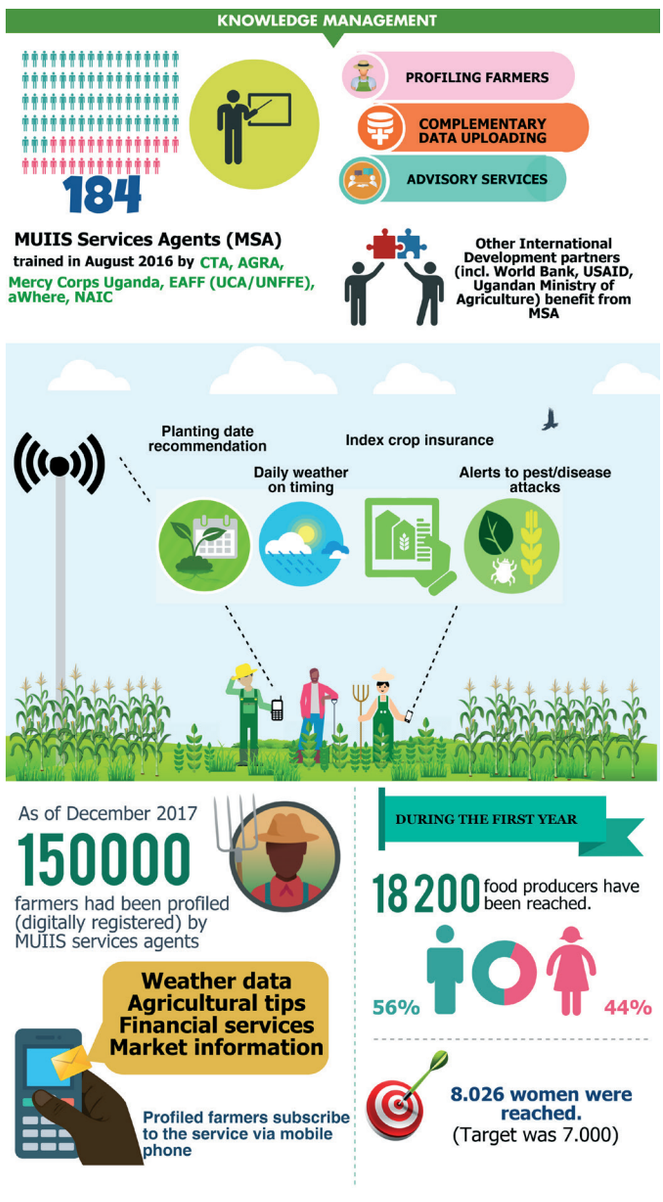
Our focus now is the future ownership of this unique satellite data-enabled information asset, which currently comprises over 130,000 farmer profiles. Now MUIIS needs an investor, a social entrepreneur or a business entity that can turn it into a business - not for themselves but for the smallholder. In the coming months, we are going to engage with different entities to identify the ideal profile that will encourage smallholder farmers to work with farmer organisations for sustainability. ●

About the author
Ben Addom is ICT programme coordinator at CTA in Wageningen, the Netherlands and programme manager of the MUIIS project.

Market-led User-owned ICT4Ag-enabled Information Service – MUIIS





A new way to practice agriculture

Christel Kenou

Rather than treat a farm and crops as if every plant is the same, farmers can use precision agriculture to apply inputs only where and when they are needed.

Precision agriculture (PA) is a smart farming system that helps farmers collect information and data for better decision making. PA requires the use of inventive data on environmental and soil conditions. Then farmers use collected information to add precision to the quantity, quality, timing and location in the application and use of agricultural inputs. PA allows crop farmers to take into account the variation in the field and to apply variable rate treatments with a much finer degree of precision than was earlier possible.

PA is, therefore, an ICT-based farm management system that permits farmers to consider the field as a heterogenous entity and then to apply selective treatment, rather than seeing it as a homogenous entity where all is treated equally. The technology involves a process of data collection, data mapping and analysis, and site-specific treatment.

Conventionally, agronomic practices and treatments are applied in uniform fashion. For example, a plot is designed to operate at uniform depth and produce uniform results over a wide range of crop and soil conditions. Similarly, a sprayer will apply the same amount of solution containing either fertiliser or pesticide. In contrast, precision agriculture helps to meet site-specific needs. It involves better management of farm inputs, such as fertilisers, herbicides, seed and fuel by helping the farmer to employ the right management practice at the right place and the right time.

Adoption

The first applications of PA around the world started in the early 1990s, mostly in developing countries, including some ACP nations. However, it was really only adopted at the end of the 1990s, with yield monitors and soil mapping, which remain important for PA. Techniques then progressed to site-specific crop management based on grid sampling and management zones. More recently there has been increasing emphasis on real-time on-the-go monitoring with ground-based sensors.

PA covers four key ICTs: location determination via GPS; GIS; computer-guided controllers for variable rate application (VRA) of crop inputs; and sensing technologies for automated data collection and mapping. The GPS and GIS technologies underpin the major PA practices that farmers have begun to adopt. One of these is nutrient management; it involves spatially referenced soil sampling, often linked to VRA fertiliser spreading. The other is yield

monitoring, usually tied to yield mapping.

Yield monitors are mainly used in North America, Europe and Australia, but countries like Argentina, Brazil and some East Asian countries have also adopted these practices. The adoption of PA is related to socio-economic, agro-ecological, institutional, technological and behavioural factors, in addition to the sources of information and perception of the farmer.

Global applications

Remote sensing in PA includes using satellites, aircraft, balloons and helicopters, small unmanned aerial systems, or drones, and a variety of sensors, such as optical and near-infrared and radar.

Drones could be a potential alternative to satellites and aircraft given their low cost. Farmers can use them to spray pesticides over their crops or for tracking livestock and crop monitoring. Other potential applications of remote sensing in PA include bare soil imaging for management zone delineation, weed mapping, nitrogen stress detection, crop yield mapping, and pest and disease detection.

Benefits and impacts

PA offers many benefits in terms of profitability, productivity, sustainability, crop quality, environment protection, on-farm quality of life, food safety and rural economic development. Indeed, it has the potential to increase crop yields and ensure food security. PA tools can help farmers save money by increasing efficiencies in broad acre cropping systems and it can improve crop productivity and farm profitability through the improved management of farm inputs.

As pests and disease cause huge losses to crops in ACP countries, remote sensing can help to detect even small areas troubled by pathogens. The application of fungicides can then therefore be optimally timed. Moreover, remote sensing combined with GIS and GPS can help in site-specific weed management.

In addition, PA benefits the environment from more targeted use of inputs that reduce losses from excess applications and from reduction of losses due to nutrient imbalances, weed escapes and insect damage, for example. Indeed, studies revealed that site-specific nutrient management reduced nitrogen fertiliser use in Vietnam and the Philippines by 14% and 10%, respectively. It also reduced total nitrogen losses from the soil by 25% to 27%. The variable rates of herbicide application reduced total herbicide use, and preserved surface and groundwater quality. As a result, soil and water contamination is minimised.

PA offers many benefits in profitability, productivity, sustainability, crop quality, environment protection, on-farm quality of life, food safety and rural economic development.

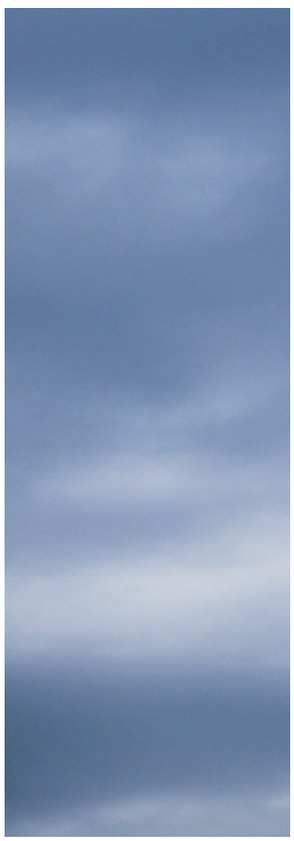
Society also benefits from PA as it creates technology jobs (computer hardware, computer software, machinery guidance, soil and crop sensors, information management, decision support systems) and mitigates environmental pollution from the over-application of agricultural fertilisers.

In a nutshell, farmers using PA can reduce their environmental impact while improving productivity and profits. In addition to reducing inputs through improved accuracy, the information from PA technologies allows farmers to produce more output with less input.

Challenges

The challenge is to develop PA approaches that can provide customised management of farm inputs for individual plants by using data from field sampling, laboratory analyses, and proximal and remote sensors (for example, spectral, electrical, electromagnetic or radiometric measurements of soils or of plants) with different spatial and temporal scales.

For smallholder farmers, the amount of data may limit the adoption of this technology. Therefore, to spur adoption in ACP countries, the operational implementation of the technology and complete analysis of the costs need to be emphasised. In addition, the role of extension services and agricultural cooperatives are important to spread the use of these technologies. ●



Above: Remote sensing in PA includes using satellites, among other things, and a variety of sensors.

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Related resources

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Farmer organisations and precision agriculture data services

Chris Addison and Chipo Msengezi

A recent CTA workshop 'The value of farm data: Farmer-representing organisations and farmer-owned data' gained insights into the role these groups can play in using and delivering services to the smallholder farmer.

Farmer organisations are building and reinforcing various services to their members delivered through mobile phones. These services, particularly those relating to precision agriculture, are based on one key data input: the farmers' location and a profile of them and their operations. This farmer profiling is the fundamental foundation for these organisations.

Ishmael Sunga of the Southern African Confederation of Agricultural Unions stressed the importance of farmer profiling to farmer organisations' in a recent interview (on CTA YouTube). He explained that this data not only demonstrates the legitimacy and reach of a farmers' organisation but also provides precision services. He argues that farmer organisations need to understand the value of the data they have and how they can capitalise on it. Then they can begin to collaborate with partners to deliver data-driven services. The farmers need to understand the potential benefit of their data as it gives them a stronger voice.

On profiling, he concludes:

- Farmer registration activities can be very costly – in terms of data collection costs and time involved.
- The process requires a last-mile effort of human contact – someone to explain to the farmer why the data collection is important and collect it face-to-face. It is not easily done remotely via the phone.
- Be careful about farmers' ethical and privacy issues.
- Ask the right questions to get accurate data – and avoid over-collecting data that will not be used.
- There is a need for public investment in these activities.

Data – on, by, of and for farmers and their products – is bringing in investments in big data, precision agriculture, data-driven agronomy, e-extension and applications – which are turning data into intelligence and improving decision-making and ultimately livelihoods. Better data access and use is increasing the number of products and services of those keen to boost agricultural production and enhance resilience.

Turning this into a reality in Africa, the Caribbean and the Pacific is still a challenge. It calls for new adapted business models, service design and delivery systems. It means turning data into actionable information, and having clear guidelines around data ownership and use that protect farmers from unfair exploitation.

Mapping data services and products

At a recent workshop organised by CTA participants started by mapping the main result areas where data-driven services for, from and by farmer organisations are taking place. Three broad categories emerged from the exercise:

Data-driven services and products that enhance **PRODUCTION** include: accessing diagnostics and advice in areas such as agro-climatic forecasts, agronomic advisory recommendations, soil-water, pests and diseases; and accessing early warning on threats though alerts services.

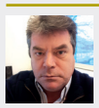
Data-driven services and products that enhance access to **TRADE and MARKETS** include: accessing markets and customers in areas such as product certification, product tracking and traceability; market information – supply, demand, competition and prices; sourcing knowledge, inputs and advice; knowing value chain actors, networks, expertise and the resources, products and services they provide.

Data-driven services and products that enhance access to **FINANCE** include: accessing financial services such as banking, insurance, credit, money transfer and microfinance.

Key actions for farmer organisations

The workshop identified key action areas for the future:

- Having effective data policy, management and systems within an agri-enterprise is essential for its sustainability – data helps drive delivery, advocacy and legitimacy.
- Developing the overall value proposition of data-driven products and services is critical – providers need to be able to demonstrate it, sell it to investors, and use it to build trust and confidence.
- Feedback loops need to be built in and are necessary to ensure data ownership and provenance. They also help to ensure that services are connected to the ground, i.e. tailored to needs. Critical actors in these loops are the farm families and producers themselves.
- Access to markets, consumers and trade opportunities requires certification, which is costly and needs plans covering who pays for it and how quality and integrity of the data can be assured.
- Building trust is fundamental and needs to be done by building quality relationships with farmers and their organisations and practicing ethics around the ownership of data.
- Ethical and cost-effective registration and profiles of farmers, agri-producers, customers and other value chain actors are at the core of business models.
- Capacity development at all levels is key to ensure that there is greater uptake of data-driven services.

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Related links

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