Margret Kigozi, farmer in Uganda, SUM-Africa ©NSO/G4AW

Space for Food Security

Stimulating smallholders' access to emerging AgTech and FinTech markets

Part 1: Users and Services (Summary Report)

This report has been commissioned by the Netherlands Space Office and supported by the Ministry of Foreign Affairs in the framework of the G4AW programme.

Disclaimer

The content of this report is based on information gathered in good faith from primary and secondary sources and is believed to be correct at the time of publication. Recommendations are based on the author's interpretation of the information available. NSO can provide no guarantee regarding the accuracy of this content and therefore accept no liability whatsoever for any actions taken that subsequently prove incorrect.

Table of contents

Rice fields in Mekong Delta Vietnam (Sentinel-1), ©ESA, CC BY-SA 3.0 IGO

Introduction

This document summarizes the first part of two publications with lessons learned from the Geodata for Agriculture and Water (G4AW) Facility. In 2013 the Netherlands Space Office (NSO) launched the G4AW Facility to create digital advisory services for smallholder food producers, based on satellite data. Science and technology can improve food security by empowering the most important actors in the food production chain. Providing the right information at the right time to food producers can improve and sustainably increase food production, ensuring food security on a global scale.

At the start of the project, most of the services were still in the development or testing stages. They were often based on decades of remote-sensing research that used satellite data with a too coarse resolution to provide meaningful insights for smallholders. Some of the most significant game-changing satellites (Sentinel 1 and 2) were all launched between 2013 and 2017. These provide images at a spatial resolution starting at 10 metres and with a frequent overpass, enabling meaningful insights for smallholders.

The G4AW Facility was one of the first programmes[1] to support public-private partnerships creating satellite-derived digital services for smallholders, which led to many new insights. Insights are not only related to the success of services created, but also to the performance of public-private partnerships, the involvement of users, and the development of business models. Challenges still persist with a current focus on scaling the created services in a rapidly maturing market with increasing competition. The obstacles the programme and the supported projects have faced have been many and diverse.

Capturing lessons learned is an on-going effort throughout the life of the G4AW programme, we learn from our failures and our successes. This paper explores the most relevant and different levels of lessons learned. It focuses on the first phase of the project, the challenges related to product design, service delivery and product/market fit. The second paper focuses on the difficulties projects have faced (and are facing) towards the end of the project execution and in the following (post-project) trajectory. This includes steps required to scale to a sustainable business: the creation of a monitoring and evaluation framework, selection of suitable business models, different scaling options, and the role of technical assistance.

[1] Similar programmes have initiated by amongst others NASA/USAID, SIDA, GIZ and UK Space Agency.

GAP4A digitising agriculture in Burundi ©Auxfin Burundi

Improving food security

One of the world's biggest challenges is to feed our population, which is expected to grow to almost ten billion people by 2050[2]. The challenges that food producers face have increased rapidly over the past years. These include climate change (i.e. rise in occurrences of extreme precipitation events and more intense and prolonged droughts); regionally varying changes in the severity of damage caused by outbreaks of pests; loss of agricultural biodiversity; land degradation, and more. At the same time, the population is rapidly increasing in many of the least developed countries in the world, and there is little reduction in the prevalence of undernourishment.

On top of these challenges, the COVID-19 outbreak in 2020 has shown the vulnerability of the food distribution systems that depend on the import and export of commodities and an agricultural extension system based on field-visits. Digitalization of farming is seen as a key-component of climate-smart and corona-smart agriculture to increase yields and optimize the use of inputs at the same time.

Knowledge is vital for farmers when making decisions on crop and seed selection, crop rotation, effective water use, application of inputs, and more. Pastoralists have to make decisions on finding optimum grazing grounds and water, and fisherfolk on when to fish and where to find optimum fishing grounds. This is important to improve food security, achieve a higher and more reliable income, and to use inputs more efficiently. Improved decision making can also contribute to climate-smart agriculture, making farming more robust to climatic shocks.

In numerous regions, many of the decisions smallholders make are based on their 'traditional' knowledge. The changes in weather patterns, outbreaks of new pests, threats from invasive species and diseases and the availability of new inputs create the need to combine the benefits of indigenous knowledge with new sources of knowledge to adapt to this new context and improve the livelihoods of food producers. Mobile phones (smartphones), soil and weather sensors, real-time market prices, and satellite data are increasingly used to improve the farmer's decision-making process. Satellite data is also fuelling digital solutions in the field of inclusive finance and (index-based) crop and livestock insurance.

[2] United Nations World Population Prospects 2019

G4AW as an early adaptor

Digital innovation is a very promising approach as it allows for reaching scale, and it is cost-effective. Satellites and mobile connectivity are the two pillars of the Geodata for Agriculture and Water Facility (G4AW), a programme to stimulate digital innovation in agriculture and achieve sustainable service provision to millions of farmers. Increased access to information and financial products helps food producers become more resilient to climate change.

G4AW supports 25 partnerships in 15 countries in Africa and Southeast Asia that have taken the challenge to develop digital solutions using satellite and geodata to improve food and income security at food producer level. The major findings of these projects and G4AW programme as a whole are summarized below.

- G4AW has supported the opening and stimulation of an emerging market; since there was no market in 2013, the G4AW Facility can be considered as a catalyst for early adoption;
- Over time, there has been a shift in the type of organization that shows interest and leads the G4AW partnerships, starting with research organizations in call 1 (2013), NGOs in call 2 (2014) to businesses in call 3 (2017). This demonstrates the emerging market for digital advisory services for smallholder food producers. User engagement is essential to develop services and to retain clients;
- Innovation and market development requires strong entrepreneurship, flexibility to adapt and long term (financial) planning;
- Public-private partnerships have an added value at the start of the innovation process, but can slow down entrepreneurship and business development if roles and responsibilities are not well defined;
- Creative business models are needed since smallholder food producers generally do not subscribe to paid B2C agro-advisory services;
- Bundling of agro-advisory with other agricultural or financial products and/or services could lead to a win-win situation for smallholders and businesses;
- Engagement (education, training) with smallholder food producers is essential to understand the advantages of the offered services in relation to their indigenous knowledge;
- Satellite and mobile/ICT technologies enable scaling;
- As a spin-off, the potential of the use of geodata for inclusive finance is stimulated and piloted in the Geodata for Inclusive Finance and Food security (G4IFF) initiative coordinated by the Dutch Platform for Inclusive Finance;
- Sharing lessons learned through the G4AW Facility with partnerships, donors, and other actors supports the further development of digital services for smallholder food producers.

Opening and stimulating an emerging market

An analysis of 250+ research and demonstration projects on digital and geospatial innovation in agriculture by the Netherlands Space Office (NSO) showed that most project activities ended when the project budget expired. The G4AW Facility started in 2013 with the ambition to support the development of digital advisory and/or financial service provision using satellite and other geodata. Each project's objective within this Facility was to reach 100,000 farmers (or 50,000 pastoralists, fisherfolk) and create a sustainable business model. There have been three calls in the G4AW Facility in the period 2013-2017. Most of the awarded projects (23) targeted smallholder farmers, while a limited number (2) targeted pastoralists and none targeted fisherfolk. Relatively more projects were granted a subsidy in Asia compared to Africa. This is generally due to the more favourable business conditions in Asian countries.

Innovation and market development

G4AW supports innovation with a co-financing grant. The G4AW project lifetime, three years with a possible budget-neutral extension period of maximum one year is too short to design and develop a proof of concept, reaching large numbers of food producers and creating a sustainable business model. Inception, partnership formation and user engagement took considerable more time than anticipated at the start of the programme. Another significant finding was that food producers in most G4AW projects were expecting free delivery of weather and agro-advisory services. To close the business case for service provision to smallholders, G4AW partnerships started to look for new customer segments willing to pay for services. Overall more time was needed to develop a sustainable business model. At the end of the project period, most partnerships have developed a proof of concept, but they are still at a stage in which additional financing is needed to further engage with customers and scale to a sustainable level.

By starting in 2013 (just ahead of essential satellite missions such as the Sentinel 1 and 2 missions), G4AW might have started too early. However, it has proven its value of catalyst for early adoption. Since 2018, the rapid maturing market has generated a lot of interest from other donors and impact investors and led to increased competition from other services focused at digitisation of farmers. Later G4AW calls and other donor programs were able to learn from the early steps of G4AW.

Users and services

The importance of users (food producers and other clients) in the design of the services and education was well understood from the programme's start. User involvement was given special attention throughout implementation. There is always some trade-off between rigid planning needed to reach impact in a limited time and the flexibility to engage users. This can mainly be seen at the starting point of the projects: proposals already included the expected 'unique services' and a range of partners that could create these.

The flexibility that partnerships have shown in dealing with rapidly changing user needs (including COVID-19 related challenges), shows the extent to which users are becoming empowered by being a true client of the services. While the food producers' involvement in the initial concept (proposal) might not always have been equally high (this was outside the scope of G4AW), most partnerships have been flexible to adapt their services to the emerging user needs.

Digital inclusion

Ensuring digital inclusion has been a clear objective of G4AW. The involvement of women (SDG 5: Gender Equality) and youth (SDG 8: Decent Work and Economic Growth) have explicitly been monitored. Youth (< 35 years) in particular are well represented with around 45% of reach. This group often leaves rural areas, but now sees the benefits of digital services to increase their skills (useful for other jobs) and the benefit of such services for more business-oriented management of farms. Essential services for a business focus include market information and access to finance/insurance.

According to monitoring and evaluation figures, around 30% of users reached have been women. Getting accurate insights is difficult, as most services only register a primary user, often the owner of the devices used to receive this advice. There is often a gender gap in ownership of these devices in developing countries. As most advice is shared within a household and even within the community, the percentage women reached is expected to be higher.

Coffee farmer in Vietnam ©ICCO/GREENcoffee project

Local embedding and licence-to-operate

Local embedding is a crucial factor in the successful setting up of a business. The involvement of public and private organizations in the G4AW partner countries have ensured services and (new) businesses are well embedded. This includes all licences-to-operate are in place, and the IT infrastructure meets the legal framework for storing and sharing personal data. An increasing focus on data privacy is a new push towards even further embedding of the business. In some countries, specific arrangements with governmental Meteorological Offices were needed to enable operations and disseminate weather data and forecasts. Cooperation with governmental agencies was also required in other countries to provide financial services such as credits and insurance.

Data and service platforms

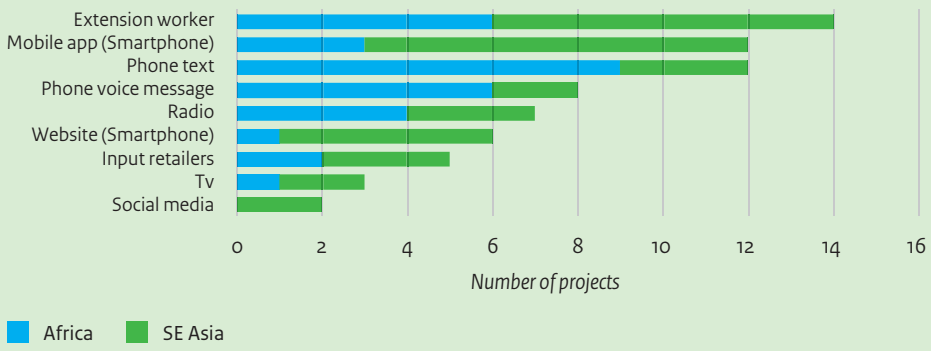
Already half the platform-providers are local. The platforms that are still based in The Netherlands or elsewhere are also considering the setting-up of local servers to ensure the product will continue to be operational, even if more strict data national laws are implemented. These data and service platforms play a crucial role, as these ensure all data is processed, integrated, stored, and made accessible in an understandable format to the users. This is also the level at which maintenance and support are generally provided. These platforms have to be technically advanced, stable, and easily accessible, while at the same time, costs cannot be too high.

Delivery channels

Actual delivery of data and information from these platforms to the users has been very different between Southeast Asia and Africa. This is due to the difference in existing ICT and mobile networks and (smart)phone ownership and a rapidly changing market. For example, Myanmar developed from having less than 10% to having over 120% mobile connections between 2013 and 2020: over 20 million users consume an average more than three gigabytes of data per month. This development is based on opening up of the telecommunications sector to foreign competition in 2014. This leapfrog resulted in significant changes to the enabling framework required for certain G4AW services after the second call. G4AW partnerships in Southeast Asia use mobile apps and websites mainly for service delivery and use social media for user engagement, training, and marketing. G4AW partnerships in Africa focus more on basic text and voice messages. In both continents, call centres, radio and television are also being used as delivery channels by partnerships (see Figure 1).

Advanced smartphone apps provide clear benefits, as these can provide a wider range of information, and can include more components of the 'climate-smart', but also `corona-smart` agriculture, such as the embedding of videos and map viewers, creation of chat boxes and addition of an online market-place where farmers can buy and sell products. Smartphones and the use of USSD messaging service technology improve the ability to have easy two-way communication, which can provide clear benefits to both the food producers and the service providers. On both continents, most partnerships still use traditional methods to reach farmers, such as extension workers and radio advertisements.

Figure 1 Service delivery methods in different regions



[3] A Quick Glance over Telecoms - Myanmar Insider

Insurance services

In the first G4AW call for proposals (2013), three out of four projects focused on providing (index-based) crop insurance. To comply with the overall objectives of the G4AW Facility, it was decided that projects in the subsequent calls could no longer apply with projects focused solely on insurance: bundling with other services such as Good Agricultural Practices was required. This ensured that farmers could adapt to the increased risks of climate change by adopting smart farming practices and cultivated crops.

In the four targeted countries, a different approach was followed. The G4INDO project developed a service to support Jasindo insurance company to assess the eligibility of a claim. In Ethiopia, the GIACIS project worked with Kifiya and the Ethiopian government to develop a crop index insurance coupled to a credit provision for smallholder farmers. In Uganda, the Sum-Africa project successfully cooperated with ACI (insurance broker), NUCAFE (coffee grower association) and the Ugandan government. The government provides a 50% subsidy to the crop index insurance premium to be paid by farmers. The introduction of crop index insurance in Mali was halted, mainly because of a lack of awareness of risk management and an improper business model.

Decision supporting services for (agro-) pastoralists

The services for pastoralists that were developed in STAMP (Mali) and for (agro-) pastoralists in MODHEM (Burkina Faso) projects provided clear societal benefits and are highly appreciated by all stakeholders. Orange Mali and Orange Burkina Faso and local service providers, supported by the NGO SNV and satellite service providers, operate the Garbal service that can be reached via a call centre. These have successfully reached large groups of (agro-)pastoralists in high-conflict areas and are successfully continued and scaled after project ending with support from other donors.

Pastoralist, herding cattle in Mali ©SNV Mali - STAMP

Decision supporting services for farmers

Of the services created within G4AW, ***weather information and forecasts*** have become the most appreciated services (see Figure 2). Accurate weather forecasts using data from meteorological satellites and local stations are highly appreciated by users, indicating a lack of reliability (or existence) of open alternatives. Weather forecasts are created as a stand-alone service and provide a crucial link to other services focused on farm management: nutrient management, pest and disease early warning, and timing of activities such as sowing, weeding and harvesting. The main challenge for weather forecasts has been to create sustainable business models, as the data can easily be shared between food producers, and many food producers see provisioning of weather information as a public task.

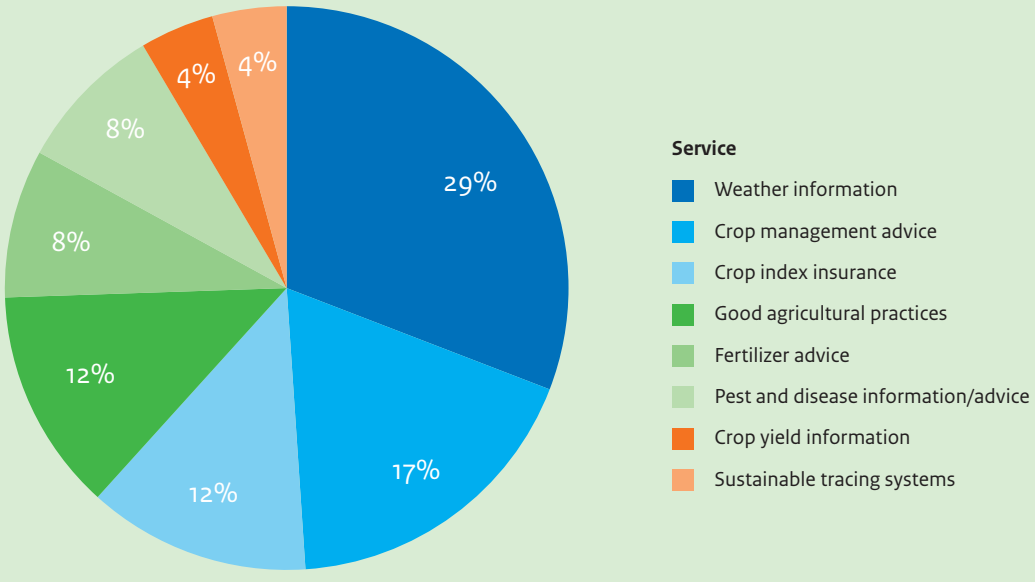
Good Agricultural Practices provide farmers with advice on how to increase their yields sustainably, by improving the understanding of when and how to perform certain actions (e.g. application of pesticides and nutrients). This is the service that comes closest to the objectives of G4AW: improving food security while also increasing input efficiency. Satellite data can provide complementary services to good agricultural practices (GAP). Similar to weather forecasts, GAP is often not specific to a plot, but more to a certain crop and soil type. This also makes GAP easily shareable as it does not require plot-level insights.

For GAP, many farmers still focus on 'seeing is believing', which requires the involvement of extension workers. Some projects enabled farmers to directly contact the extension workers they know (and are familiar with their local conditions) by chat to verify accuracy of advice. In this way, uptake of GAP could still be promoted under restrictions placed by COVID-19.

Other services that focused on ***crop management*** (irrigation advice, crop monitoring, pest- and disease warning, and nutrient advice) generally require a more specific focus on plot-level conditions. Understanding the current growing stage is important in assessing water and nutrient needs and the risk of pests and diseases. In some G4AW projects, these services were provided as part of a bundle, and the provided advice was more generalized (similar to GAP).

Some projects (e.g. Geodatics, Kenya) have provided nutrient advice and pest- and disease warning/advice as key-selling services. To successfully sell this to other businesses or farmers as stand-alone services, accuracy and actionability have to be high. This means only a limited number of crops and pests or diseases can be covered in detail. In some cases, this has been successful. Some other projects faced challenges related to market availability of products; even if services are highly valued, the enabling framework is not always ready.

Figure 2 Key selling point of the created products



Plot-level advice remains challenging

In general, providing plot-level advice has remained challenging. Successful plot-level advice often requires satellite data that is of higher resolution than what is currently freely available. Also, diversity within fields can be high, and reliable farmer input is required to understand the context. Plot-level crop monitoring requires that research on the relationship between satellite-derived information and the crop context is already done (research has not been part of G4AW projects). This results in a focus on well-researched crops cultivated in relatively large plots, such as rice, maize and potatoes. Cash crops (coffee, cacao, and spices) are also covered in many projects. This is partly because the value chain is more advanced (active multinational organizations). Because farmers cultivate cash crops, they are more likely to pay for digital services, as they have more income and the benefit-cost ratio is better.

The key-services in projects focusing on cash crops have been different from the focus on food crops. This included tracing, mapping forest clearance, market insights, suitability mapping, and more. In general, satellite data have played less of a central role, but the provided services in these projects are still very well appreciated by the farmers.

Inclusive Finance services

In 2017, the benefits of geodata for financial access also quickly became clear, resulting in active involvement of other organizations. NpM (Netherlands Platform for Inclusive Finance) focused on the benefits of geodata for inclusive finance by starting and coordinating the Geodata for Inclusive Finance and Food Security (G4IFF). This initiative is supported by Bill & Melinda Gates Foundation and the Dutch FMO, Rabobank Foundation and ICCO. Parallel to G4AW a G4IFF challenge was organized in 2018. An evaluation of G4IFF and three G4AW projects with inclusive finance services will be reported separately. A summary of the key findings will be summarized in the second G4AW Lessons Learned Series report.

Corona-smart agriculture services

In 2020 COVID-19 confronted the G4AW projects with big challenges. The most direct implication has been the restriction on movements between and within countries. This has limited the ability of partners to go to countries and meet possible business partners (face-to-face meetings are still seen as highly important to build trust), but also the ability to conduct meetings in the field. This includes farmer surveying, education and training, validation campaigns and also soil sampling campaigns. The main challenges for the farmers themselves, have been related to lack of access to health information and support, disrupted local markets (for selling and buying), and limited contact with extension officers. This has resulted in a clear demand for new services for farmers.

To deal with disruptions to the normal marketing process, farmers have requested tools to get into contact with local buyers to strengthen the local value chain. Online marketplaces have been implemented in several G4AW projects. To overcome restrictions on the agronomic extension system, partnerships have added videos with crop-specific information on Good Agricultural Practices. These videos reached over a million views in Myanmar. Some partnerships have also enabled farmers to directly contact the extension officers they are already familiar with, to verify the advice with someone who is aware of their local conditions. In addition to farming support, these digital tools can also help in providing COVID-19 related updates. In this way, digitalization of farmers has become a key-aspect of 'corona-smart' agriculture.

Use of satellite data

NASA MODIS (250 meter resolution) has been operating since 1999 and USGS Landsat programme has been operational since 1972. Availability of free high-resolution satellite data (resolution <50 metres) has drastically increased during the course of the G4AW Facility. Missions such as EC/ESA Sentinel 1 and 2, and USGS Landsat 8, were all launched shortly after the start of the G4AW programme and offer High-Resolution Data (HR). This has enabled the partnerships to use free data starting at 10 metres for the services. The most used satellite data has been derived from weather satellites, however a clear overview of the satellites used is difficult to create due to the integration of different satellites, official ground stations, models and personal weather stations.

The second and third most used sensors are EC/ESA Sentinel 2 and NASA MODIS (see Table 1). While the resolution of MODIS is lower than that of comparable (Sentinel 2 and Landsat 8) missions, the main benefits here are the longer time series (already well established in research and useful for index-based insurance) and the more frequent overpass (every 1 or 2 days). For index-based crop insurance services, long time-series satellite data (preferably longer than 15 years) is essential. GIACIS (Ethiopia) uses SPOT-VGT 1/2 (first launched in 1998) and the successor Proba-V, while SUM-Africa (Uganda) uses weather data provided by Meteosat (>30 years data archive). G4INDO uses Sentinel 1/2 in support of claim management by Jasindo.

Sentinel 2 ©ESA/ATG medialab

Sentinel-1 has been a clear game-changer in the use of satellite data. This satellite provides high-resolution radar (SAR) data that has the ability to see through clouds and during the night. Applications are rapidly increasing, and have been especially useful for monitoring of rice crops, flooding and deforestation. Sentinel-2 has been used in more G4AW projects than Landsat-8 (30x30 meter pixel). This satellite provides a higher resolution (10x10 meter pixel) that is more in line with smallholders' plots' size.

Sensor type	Sensor name	Number in proposal	Number in operational service
Optical	Sentinel 2	14	14
Optical	MODIS	16	12
Radar	Sentinel 1	14	11
Optical	Landsat 7/8	14	5
Optical	VHR	4	3
Optical	PROBA-V	4	2
Radar	SMAP	3	2
Radar	AMSR	2	2
Radar	SMOS	2	2
Radar	TerraSAR-X	3	1
Optical	VIIRS	2	1
Radar	ALOS PALSAR	2	-
Various	Sentinel 3	2	-
Various	Envisat	1	-

Use of commercial Very High Resolution (VHR) data is still limited. It has been used in parts of the projects to better understand the local situation (plot delineation, creation of base maps, and more) and support product validation. In some projects it is also used in the data-processing chain, especially when mapping changes to individual features, such as trees. Costs are still a challenge, especially considering the current stage of the businesses, in which the operational costs have to be reduced to ensure sustainability of the business. Many projects see a future use of VHR data once the business has reached a sustainable scale.

Knowledge sharing

Projects in the last call (2017) have clearly benefited from lessons from the earlier calls. G4AW is active in sharing information and lessons through social media (LinkedIn, Twitter), meetings, webinars and the G4AW website. Many (Dutch) partners have also been involved in more than one project, which enabled them to share their experience. Still, a lot has depended on the local context and the partners involved. Working with public-private with an average of five partners per consortia (working under time-stress) requires a strong internal balance and willingness/ ability to move through difficult times. This has often been a challenging but satisfactory process for all partners involved.

Sustainability: Finding an adequate business model

There is no one-size-fits-all approach to creating successful digital agriculture advisory services. There have been unlikely successes and projects that have not reached the anticipated targets. Projects in Africa and Southeast Asia have had similar success in providing highly valued services to food producers, which indicates service delivery methods are not limiting to the success. The main difference is in how partnerships develop and adopt the business model to service uptake. Their commercialization readiness is correlated with the local context and entrepreneurship. Insecurity (Mali, Burkina Faso, Ethiopia) leads to travel restrictions and on access to the internet. The presence of a large agro-business, insurer, bank or telecom in the partnership creates favourable conditions for reaching food producers and bundling with other services. Generally, conditions for entrepreneurship and investments are more favourable in Southeast Asia than in Africa. The second report of this G4AW: Lessons Learned series will focus on these business aspects.

Scaling

Scaling can be a strategy to reach the organizational and financial sustainability of a G4AW service provision. There are hundreds of million food producers that still lack access to financial products and agro-advisory services. An important target is to digitally connect them to these services to reach scale and create a big impact. That goal has been set forth by the Global Commission on Adaptation under their Action Track 2 "Food Security and Rural Livelihoods". The potential of digital services (with satellite data) is very high.

The services developed within G4AW Facility and similar programs are satisfactory for food producers. These initiatives need scaling and further development. Government and other donors may provide grants, but private equity will be needed to reach the hundred-plus million scale. G4AW, as an early adaptor, has clearly demonstrated proof-of-concept and has set the first steps to global scaling.

© NSO/Photo by Makmende Media Bangladesh

Recommendations for service development

The G4AW Facility started in 2013 with a vision of how new technologies (increased capacity and continuity in satellite monitoring and mobile connectivity) could support bottom-of-the-pyramid food producers. Based on stakeholder consultation the G4AW grant programme was designed to ensure that during project execution, the focus of the activities became business oriented, ultimately leading to financially sustainable service provision. In the next publication of this lessons learned series, we will dive deeper into partnerships and entrepreneurship. Based on our learnings in G4AW Facility we come to several recommendations that could be considered by other (grant) organisations upon the design of a grant programme, and for service development for smallholder food producers in general.

1. ***User-centred approach***: For a new grant programme, consider to adapt the project setup to a two-stage approach, such as a one-year plus three-year construction, in which the first year is used for assessment of user needs, discussion of possible solutions with the users and attracting the necessary additional (service and/or technology) partners.

2. ***Digital inclusion***: An important aspect of digital inclusion is creating a better understanding of the current uptake of digital advisory services. A lot of data is shared within households and the local communities, while monitoring is often mainly focused on the primary (registered) user. Strategies to promote digital inclusion should be based on a monitoring and evaluation framework based on actual reach and use rather than on registrations.

3. ***Weather***: Food producers need local, accurate and affordable weather information and forecasts. Secondly, many agro-advisory services and even financial services are fuelled with weather data and forecasts. In many countries the capacity of Meteorological Offices can be strengthened and is often the topic of donor-funded projects (grant or loan). In the design and inception of such projects the need for free or affordable localised weather data and forecasts for smallholder food producers should be taken into account.

4. ***Crops***: Focus of G4AW projects has mainly been on well-researched staple crops and cash crops. Ensuring an adequate focus on the different crops that provide farmers and agroecosystems with the required diversity means that research on remote-sensing for more agro-biodiverse systems has to be improved. Supporting the creation of an adequate research base will provide partnerships with a lower level of entry into providing services for other crops than the standard staple and cash crops.

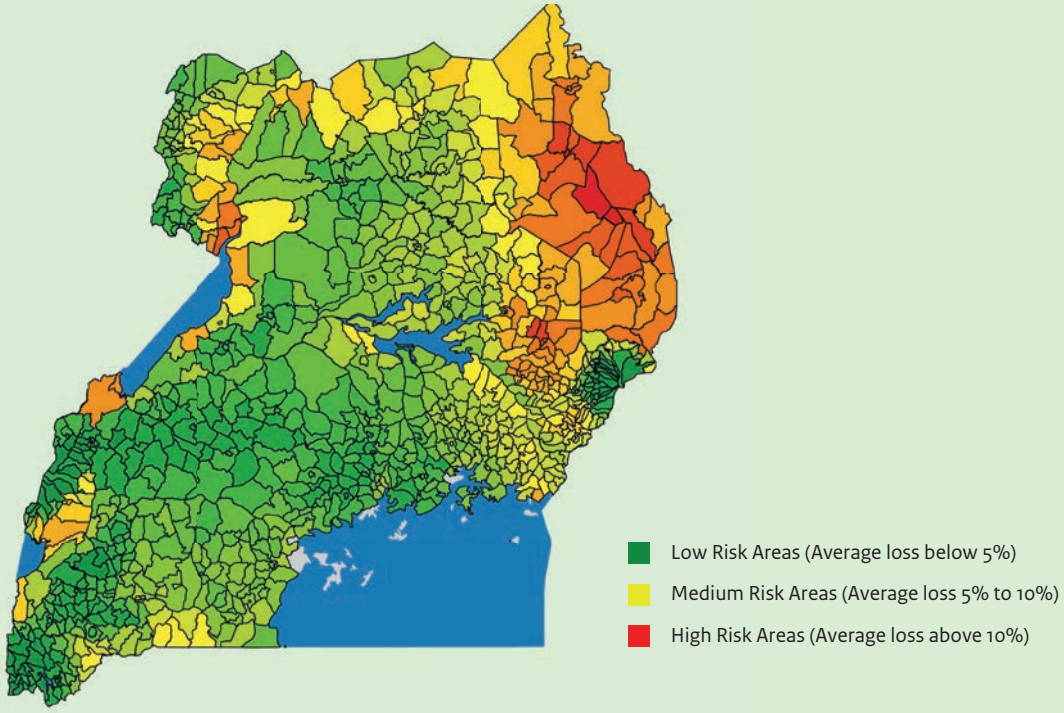
5. ***Soils***: Many G4AW projects have focused on providing nutrient advice and have often used soil samples as a basis. The approaches have been very different. Promoting a more harmonised use of soil data in such innovations, and focusing on using remote-sensing data to create a proxy for the nutrient status of soils, can result in an improved use of satellite data as basis for fertilizer recommendations. A trade off with expected procurement costs for the use of VHR satellite data should be part of the analysis.

6. ***Water***: The FAO WaPOR initiative has provided a wealth of useful information related to water productivity and related parameters in Africa and the Middle East. New developments in WaPOR could potentially increase the use of the data in advisory services. Use of satellite data, including WaPOR, should also be considered in mapping soil salinization in developing countries; this is becoming an important driver of land degradation.

7. ***Climate***: The focus on climate change has mainly been on adaptation, by providing farmers with the ability to insure themselves, or find more suitable crops/varieties. Promoting a focus on the full extent of climate-smart agriculture, including mitigation (such as carbon sequestration) can improve the impact of digital services on reducing the impact of climate change and could strengthen the business case.

8. ***Service delivery***: Ensure services are created in a way in which they can easily be maintained and expanded. This will ensure the sustainability of products. Partnerships should anticipate future developments and ensure that they can easily switch the delivery of services to new platforms. This includes smartphones and use of social media.

Developing crop insurance: Uganda Risk Areas © eLEAF/Sum-Africa project



9. ***Insurance***: Risk aversive behaviour is one of the critical reasons for farmers not to invest in new technologies and inputs. Education is a likely key success factor here. A recent and most promising approach is to bundle insurance with the provision of other agro-services, e.g. seed or nutrient supply. When income security increases, food producers are more likely to invest in new products such as agricultural equipment and inputs, which can improve uptake of climate-smart practices. Preferably, agro-advisory services are provided in combination with crop insurance to minimise the risk of reduced agricultural yields. This can create a win-win situation for smallholders and insurers.

10. ***Bundling***: A bundle of services can provide significant benefits to food producers, as food producers generally require more than advice to change their practices. Bundles should cover the main areas that are relevant to smallholders; access to (1) agro/pastoralist-advisory, (2) access to finance and insurance, and (3) information on markets. Understanding what a customer desires and how the customer is actually using services will allow for a better assessment of bundling potential.

11. ***COVID-19***: Digitalisation of farmers has shown to provide essential benefits to deal with the impact of COVID-19. Summarizing the lessons from different projects and creating a new bundle of '3C-smart' agriculture (climate, corona, conflicts) can provide farmers with an important safety net for situations that result in similar restrictions on travelling and marketing in the future (new pandemics, conflicts, etc.). This also applies to pastoralists.

12. ***Data***: Projects have already benefited a lot from developments in digital platforms and maturing of the EC Copernicus Programme. It is important to continue and find ways to capitalise on more recent developments, such as the increased application of machine learning to benefit smallholders, and better access to (affordable) VHR satellite data. It is also important to consider global trends in data protection, as legal frameworks focused on data protection could become limiting to the way data is currently shared.

Colofon
This study was carried out in the framework of the Geodata for Agriculture and Water Programme by the Netherlands Space Office.

This is a publication of
The Netherlands Space Office
Prinses Beatrixlaan 2
2595 AL | The Hague
PO Box 93144 |2509 AC The Hague
Tel. +31 (0)88 0424500
E. info@spaceoffice.nl
www.spaceoffice.nl

The Geodata for Agriculture and Water (G4AW) programme stimulates sustainable food production, a more efficient use of water in developing countries, and aims to alleviate poverty by enhancement of sustainable economic growth and self-reliance in the G4AW partner countries. G4AW provides a platform for partnerships of private and public organisations. Together they provide food producers with relevant information, advice and financial products.

G4AW is a programme by the Dutch Ministry of Foreign Affairs within the policy priorities for food security and water, which is executed by the Netherlands Space Office (NSO).

G4AW
GEODATA FOR AGRICULTURE AND WATER

Netherlands Space Office

Ministry of Foreign Affairs of the Netherlands