



Space for Food Security

*Geodata for Agriculture and Water
(G4AW)*

**Programme closure
G4AW booklet**
2013 - 2023

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List of acronyms

A-CAT	Agri-Credit Assessment Tool
AI	Artificial Intelligence
B2B	Business-to-Business
B2C	Business-to-Consumer
BMGF	Bill and Melinda Gates Foundation
COVID	Coronavirus Disease
DSS	Decision Support System
ECMWF	European Centre of Medium Range Weather Forecasts
EO4SDG	Earth observation for Sustainable Development Goals
ESA	European Space Agency
EUR	Euro
FAW	Fall Army Worm
FDP	Farm Development Plan
FSP	Financial Service Provider
G4AW	Geodata for Agriculture and Water
G4IFF	Geodata for Inclusive Finance and Food
G50	Group of Fifty (community approach in G4AW GAP4A project)
GAP	Good Agricultural Practices
GEO	Group on Earth Observations
GEOGLAM	GEO Global Agricultural Monitoring
GPCA	Golden Paddy Crop Insights
Ha`	Hectare
ICT	Information and Communication Technology
IT	Information Technology
Kg	Kilogram
LAI	Leaf Area Index
M&E	Monitoring and Evaluation
MFI	Micro-Finance Institution
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NDVI	Normalised Difference Vegetation Index
NGO	Non-Governmental Organisation
NpM	Netherlands Platform for Inclusive Finance

NSO	Netherlands Space Office
ODA	Official Development Assistance
PPP	Public Private Partnership
SACCO	Savings and Credit Cooperative Organisation
SAF	Spatial Agribusiness Framework
SBU	Sales Business Unit
SDG	Sustainable Development Goal
SIM	Subscriber Identity Module
SME	Small and Medium Enterprise
SMS	Short Message Service
SNNPR	Southern Nations, Nationalities and People's Region (in Ethiopia)
UN	United Nations
UNSGA	UN Secretary-General's Special Advocate for Inclusive Finance for Development
US	United States
USSD	Unstructured Supplementary Service Data
UAV	Unmanned Aerial Vehicle
UMVA	Universal Method of Value Access
VHR	Very High Resolution
VLSS	Village Link Satellite Service
VSLA	Village Savings and Loans Association
WaPOR	Water Productivity through Open-Access of Remotely Sensed Derived Data



Preface

As space agency of the Netherlands we contribute to building a global space infrastructure that supports sustainable transitions. Satellites offer us a bird's eye view of planet Earth, allowing us to monitor our planet and help in finding solutions to societal issues. But this view is not available to everyone, especially not for a group that might need it most: smallholder farmers and pastoralists in developing countries. Farmers who can significantly improve their livelihoods with the help of Earth observation data, but lack the technical skills to get access, interpret and use this data in day-to-day practices. Data that could help food producers to adapt to changing climate conditions, be more resilient to unforeseen pests and diseases, or become more financially sustainable.

The space community in the Netherlands has the scientific and technical expertise in Earth observations to support the development of digital advisory and financial services that can be benefit to these remote small-scale farmers. But designing and implementing these advisory services, integrating them in a local context responding to local needs, often proves far more difficult than expected. The smallholder farmer or pastoralist is a new type of beneficiary (or user), and the specific information needs and practices of this group were often not well known to remote sensing specialists. The G4AW programme turned this approach around by involving smallholder farmers and pastoralists in designing and implementing digital advisory services. This was done in public private partnership cooperation often with non-governmental organizations in the liaison and training role engaging with the target group. By exploring together with smallholder farmers and pastoralists the challenges that they face and how space can offer a unique solutions, the twenty-five G4AW partnerships helped to improve the livelihoods of more than a million farmers.

I am thankful for the visionary leadership of the Ministry of Foreign Affairs for their forward thinking-decision to kickstart this initiative showing their commitment to progress and innovation. For us as a Space Agency that really emphasizes that the value of space lies here on earth, we are grateful and proud that we have managed to bring the two worlds of space and small-scale food producers together. At first sight irreconcilable, but through the unique G4AW approach successfully brought together to improve individual livelihoods. This programme booklet will give you an overview of all twenty-five G4AW projects, each of which uses 'space' data to have an impact on the daily lives and livelihoods of smallholder farmers and pastoralists in developing countries.



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Director Netherlands Space Office

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Coordinator G4AW programme



The G4AW programme shows that gap between high-tech and smallholder food producers can be bridged

Food security is a major political concern. Climate change and conflicts are having enormous adverse effects on the global food supply. More than 30% of our food is being produced by smallholder food producers. For these smallholder food producers, life is a bumpy road - literally and figuratively. When is the right time to sow? Should I fertilise my land today or is it better to wait a few more days? If it rains too much, the fertiliser will simply be washed away and I will lose my money. When do I have to irrigate the soil? If I do nothing, my harvest may fail. Can I take out insurance against drought or flooding and if so, is that worth the cost?

It was the ambition of the Government of the Netherlands and Netherlands Space Office to use digitalisation and, specifically, satellite data to alleviate many of the obstacles that smallholder food producers face - or even remove them altogether. Wherever possible, farmers and pastoralists should have access to useful and actionable information. This was an opportunity for the space sector to contribute with solutions for the global food challenge.

In the period 2013 - 2023, the Netherlands Space Office, through the Geodata for Agriculture and Water (G4AW) Programme, has supported twenty-five public-private partnerships across fifteen countries with financial backing and with its network and expertise. In this programme, NSO deliberately focused on the development of revenue models to ensure that the services could continue even after the end of the project phase. All projects have since been completed and the approach was successful for ten projects. Another eight partnerships implemented and continued part of the developed services at minimum cost. Three partnerships stopped their activities and four are looking new partners and funding to continue.

G4AW demonstrated that the gap between high-tech and smallholders absolutely can be bridged. International governments, NGOs, multinationals and local businesses have experienced the myriad benefits of digitalisation and satellite data. Dutch and foreign Earth observation organisations have shown incredible innovative skills and ambition, even faced with the difficult circumstances that smallholders have to operate under.

Digitalisation - even in a development context - is no longer merely a concept for many businesses, but rather a substantial aspect of their business operations and advice towards food producers. NGOs are showing greater interest in the added value of geo-ICT technology and some have adopted it as a key strategic principle in order to achieve greater impact.

All this would undoubtedly have happened eventually - even without G4AW - but the G4AW programme allowed a significant expedition of the development process. The Netherlands plays a guiding role with regard to this theme. Dutch citizens and organisations are well familiar with the high-tech solutions and their position in relation to the development challenges (think of water, food supply, the fight against poverty and awareness of the role digitalisation can play in this).

Innovation within a programme such as G4AW cannot be imposed in a top-down manner. It requires a careful process that food producers are involved in from the very beginning and in which they themselves play an increasingly important role, e.g. as advisers on good agricultural practices, caretakers of demo plots or trainers to other farmers. Farmers indicated that the knowledge provided by the service is not a substitute for their traditional knowledge, but rather offers an

extra reference that can be used to evaluate and further improve their existing knowledge. Younger generations help older farmers understand and effectively use the digital services available to them, while the latter inspire the former to continue their agricultural activities by sharing success stories. Farmers also find it very useful to link with other farmers for exchanging knowledge and experiences.

There are points for improvement as well. One example is working together even more closely with clients to develop the services and continuously asking for feedback on new features and services, using an approach that is as inclusive as possible. Another point

for improvement has to do with making sure that it becomes clear early on in a public-private innovation project who will be responsible for the provision of the services and to leave enough room for entrepreneurial input. Lastly, the revenue model must be discussed and assessed together with clients as soon as possible.



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Digitalisation and geodata applications show potential to contribute to improving the food security of small-scale food producers

Climate change, Covid-19 and the impact of the war in Ukraine (sharp fluctuations in food and fertilizer prices) have serious repercussions on food and nutrition security goals. Particularly in Africa, hunger and malnutrition are again rising sharply and the resilience of smallholder farmers is under serious pressure. Currently, 735 million people are still threatened by hunger and malnutrition, which is one person in nine globally. The Netherlands aims to work with partners to ensure that at least 32 million vulnerable people no longer experience malnutrition by 2030 and that 8 million small-scale food producers have sustainably doubled their incomes and productivity by 2030.

Over the past 10 years, the Netherlands Space Office has worked in 15 countries in Africa and Southeast Asia on the Geodata for Water and Agriculture (G4AW) program. Companies, non-governmental organizations, public organizations and knowledge institutes have set up twenty-five Public Private Partnerships (PPPs) with the commitment that digitalization and geodata contribute to improving the food security of small-scale food producers. It is a field where much has been innovated and realized.

I would like to thank the Netherlands Space Office and the various collaborating actors for implementing the G4AW program, which has promoted digital services for small-scale food producers in many countries and sectors. For instance, digital advisory services providing improved local weather forecasts help smallholder farmers to better plan their sowing or harvesting times, or they provide information to pastoralists to guide their livestock to better grazing areas.

Digitalization is here to stay and has found its way through various programs. Geodata and digitalization have a lot of potential, but there are still many barriers to overcome before end-users can take full advantage of these innovations. It is very important to continue to seek cooperation with local and international partners to share experiences, like the Food Systems Resilience Program of the World Bank or the Africa Adaptation Acceleration Program of the African Development Bank. Finding the right balance of private and/or public service providers and investments remains important to increase the effectiveness and impact of programs for small-scale food producers.



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

Introduction

In 2021 the Netherlands Space Office (NSO) received the Group on Earth Observations (GEO) award in the innovation category for the G4AW programme. The motivation was that G4AW makes it possible for small-scale farmers and herders in developing countries to produce more and more sustainably thanks to the innovative use of satellite and other geodata. Tellingly, in 2021 NSO received the award for “Innovation” from the GEO EO4SDG coordinator Argyro Kavvada, because G4AW of course supports SDG-2 “zero hunger” and also contributes to SDG-1 “no poverty”, SDG-5 “gender equality” and SDG-13 “climate action”.

Now, two years later, the G4AW programme is coming to an end and we want to share the findings and lessons learned. How well did we succeed in helping food producers in developing countries to increase their production and to do it sustainably? And what still needs to be done?

To answer these questions, we first present a summary of the set-up of the G4AW programme and an infographic with the main results of G4AW. We then discuss the main characteristics of the programme: the information service, the use of Earth observation, the business aspects, the successes, the failures and the trends that provides opportunities for expansion of the services and development of new ones.

We then recapitulate the lessons learned and recommendations of the G4AW programme that are extracted from two earlier G4AW publications on the design and development of the services and the business models and scaling aspects. We conclude with a section that contains more details on the services, business models and impact for each of the twenty-five G4AW projects.

Summary of the set-up of the G4AW programme

The Geodata for Agriculture and Water (G4AW) Programme aimed to improve food security in developing and transitioning countries by creating digital advisory and/or financial services based on satellite data to reach and support small-scale food producers (farmers, pastoralists or fisherfolk). The G4AW Programme was a Netherlands Ministry of Foreign Affairs grant programme. It fell under the policy priority of food and nutrition security, which focuses on increasing and enhancing sustainable food production in the Dutch ODA focus countries¹.

The G4AW Programme filled a niche in the current range of instruments by stimulating public-private partnerships using (digital) technologies in the nexus of food security, water productivity and climate change adaptation. G4AW started in 2013, has had three tender rounds (Calls for Proposals) in 2013-2014, 2014-2015 and 2017-2018) with a total investment of EUR 87.5 million, of which EUR 59 million (67.5%) was a grant from the Dutch Ministry of Foreign Affairs and EUR 28.5 million (32.5%) is raised from private sector contributions². The objectives of G4AW were as follows:

Output:

1. Reaching 4.5 million food producers and informing them about the developed services by using modern technologies and media.
2. Educating and training extension officers and food producers.

Outcome (services):

1. Ensuring 2.25 million food producers use and benefit from the service provision.
2. Improving the output of the agricultural, pastoral and fishing sector in 26 partner countries by providing food producers with relevant information, advice or (financial) products.
3. Reaching at least a 10% increase in sustainable food production and/or an improved financial

situation of food producers, by providing them with relevant and timely information services.

4. Helping to achieve a 10% more effective use of inputs for food production (water, seeds, fertiliser, pesticides, etc.).
5. Supporting the opening of new markets for geodata-based product and service providers that contribute to improved food security.

Impact:

1. Improving food security based on increasing food production and increasing sustainability in agriculture, including water use.
2. Improving income security for food producers.
3. Improving support to food producers in adapting to climate change.

The programme was active with 25 projects³ in 15 countries⁴ in Sub-Saharan Africa and Southeast Asia: Angola, Bangladesh, Burkina Faso, Burundi, Cambodia, Ethiopia, Ghana, Indonesia, Kenya, Mali, Myanmar, South Africa, Tanzania, Uganda and Vietnam.

The Netherlands Space Office (NSO), a Dutch governmental agency, was in charge of the implementation, which includes managing the tender process, advising implementation partners, facilitating match-making and knowledge sharing, and monitoring the results at the programme level⁵.

Implementation partners generally consist of local service providers, mobile network operators, geodata/ICT companies, knowledge institutions, NGOs, governmental organisations, financial service providers, farmer organisations and other value chain actors such as agribusinesses. These implementation partners are organised in consortia, consisting of an average of five organisations (at least one local and one Dutch) with one lead partner per partnership.

¹ The Dutch ODA Policy is described here. Please note that the policy and the focus countries have changed since the start of G4AW Facility in 2013. <https://www.government.nl/topics/development-cooperation/the-development-policy-of-the-netherlands>

² Status per 31-12-2019; generally, private investment is shown to grow over time.

³ For a project overview, see Annex 1 and <https://g4aw.spaceoffice.nl/en/g4aw-projects/g4aw-projects>

⁴ G4AW Facility was open for 26 focus countries. In 11 countries no projects were granted mostly due to unfavourable safety and/or market conditions.

⁵ Each partnership operates a monitoring system at project level.





Results G4AW 2023 (end of programme)

The main results of the G4AW programme are visualized in the infographic presented below. More detailed results can be found in the project closure flyers at the end of this document.

NUMBER OF FOOD PRODUCERS

4,901,800

Participating and trained
in using G4AW services



33,4%

Female users



36,9%

Young (<35y) users

1,812,330

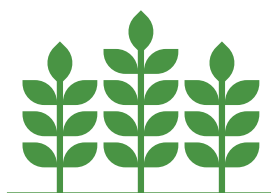
With improved livelihoods

Contributing to:



1,599,200

Users of G4AW services



5,159,500 ha

Land managed by reached farmers

Main characteristics of the G4AW programme

The set-up of the information service

All G4AW projects had to translate predictive analytics into actionable advice. This was done by providing services based on a data infrastructure that used (a selection of) the following data as input: satellite data, in situ data, farm / plot location and size, market data and socio-economic data. Models and data processing transform the data into information, which is made available on a platform and through a user interface. For the target group of smallholder food producers a range of transmission channels were used, depending on the local conditions: apps, websites, USSD messages, call centres, voice messages, text messages and face-to-face meetings. Other dissemination channels, such as television, radio and social media were used more for advocacy and creating awareness about the services.

Demonstration plots and lead farmers were not only instrumental for the calibration and validation process, but also helped to convince more farmers to use the services. Mechanisms for receiving and processing feedback from the target groups were used as input to improve the services, by making adjustments to one or more elements of the data infrastructure. Updating and improving the system for service delivery is a continuous process.

The use of Earth observation for the services

For a long time the application of satellite data for agricultural advice and food security was only feasible for large, commercial farmers, because of the high costs and relatively low resolution of the imagery. Thanks to developments in the areas of mobile connectivity, the availability of new satellites that offer free and open data with a high resolution, new research and innovation findings of research in remote sensing, quicker data processing and programmes, such as G4AW, satellite applications are now also available for smallholder food producers in developing countries.

In the G4AW programme services were developed that make use of Earth observation data for different topics, such as insurance, crop monitoring, crop management advice and early warning for pests and diseases. These services targeted not only smallholder farmers, but also other actors in the agricultural value chain.

An analysis of the use of Earth observation in the G4AW programme shows that quite a number of successful applications have been developed. Examples are the index insurance services and the biomass and water information provision to pastoralists. There is also a clear need for accurate weather forecasts. This concerns daily forecasts, but some projects work with more complicated forecasts for different time periods.

Unfortunately, not all Earth observation-based applications turned out to be equally successful. With innovation there is always a possibility of failure. A number of projects experienced problems with cloud coverage, fragmented landscapes and a limited amount of data for calibration and validation. Sometimes the technical solution worked, but there was no perspective for further action, i.e. the application was not economically feasible.

The extent to which Earth observation was applied successfully was also indicative for the period after the G4AW funding. When Earth observation provided a valuable contribution, the service was continued after the end of the project and/or more functionality was added. When this was not the case no further efforts were made to use Earth observation.

The majority of the projects made use of freely available satellite data. Sentinel-2 data was the most used, followed by Sentinel-1. Both types of satellite data became available during programme implementation (in 2015 and 2014 respectively), which explains the declining use of MODIS (2002) and Landsat data (Landsat 8 was launched in 2013). Other comparable data sources were less often used. MODIS and Landsat data are used when analysis of a longer time series is needed. Commercial very high resolution (VHR) and UAV data are less used, because of the mismatch between costs and benefits in applications for smallholder food producers.

This could change in the future, because more VHR and UAV data will become available at lesser cost. The quality of freely available data will also improve. Here much will depend on the continuation and extension of the Sentinel-1 and Sentinel-2 programmes. Promising developments are the increased application of AI and the combined use of Sentinel-1 and Sentinel-2 imagery. This potentially improves the perspective for

Earth observation solution for agricultural monitoring, support to inclusive finance, agroecology and e-extension.

Business aspects of the services

Different business models were applied, the first is business-to-consumer (B2C). In the B2C model revenue is generated through payments for a call to a call centre, subscription to an app or SMS-service or a one-off fee (as in the case of insurance). In most cases, the revenue was not enough to make the business sustainable. In some cases, a governmental subsidy on the premium for insurance was needed. Business-to-business (B2B) was therefore applied as an alternative, although in some projects B2B was already part of the original set-up. B2B had two main forms: one is a loyalty model, where e.g. an agricultural inputs supplier pays for the service to increase farmer customer loyalty, and the other consists of selling intelligence about farmer, farms and/or crops to agri-businesses, financial institutions or other interested parties through a subscription or one-off payments.

The business owner is the entity that is responsible for generating revenue and thus has a major interest to continue providing the services developed in a G4AW project after the end of the funding period. The creation of social enterprises was stimulated in many G4AW projects and such an arrangement was partly successful. Who the business owner would be was not always clear from the start of the project. In some cases the envisaged business owner withdrew from the project or the identified business owner considered the provided services of only marginal value. A more detailed description of experiences with business models and business owners can be found in the project closure flyers at the end of this document.

What worked and what didn't?

A lot of effort went into making the information service work, resulting in an impressive number of innovative and valuable proof-of-concepts, but making the business side work was much more difficult. In most cases business development started relatively late (because first interaction with the target groups had to be established and all the technical arrangements had to be made) and this made it difficult to have a successful business running

in the project period or shortly thereafter. Most of the services are definitely an improvement compared to the original situation of smallholder farmers, although some of the developed services are not cost-effective (yet). The number of smallholder food producers reached (in terms of information provision and awareness raised) is very high, but the number of paying customers (or even registered users) and the generated revenue is much lower.

In the paragraphs below a selection of successful examples is presented.

Earth observation services are an essential and invaluable component in circa half of the G4AW projects. Of these, three projects revolve around offering insurance to farmers in Ethiopia, Indonesia and Uganda. In Uganda, more than 200,000 farmers to date have taken out drought insurance. Scaling is ongoing in Mozambique, Rwanda and Togo. Active governmental support (licence to operate and subsidies on premiums) was essential.

In addition, for two projects in Burkina Faso and Mali a major telecommunication provider has set up a call centre to provide the Garbal navigation service to pastoralists. Garbal provides information about good and accessible grazing sites and local market prices for their livestock. Garbal is characterised by its simplicity and offers tremendous added value for pastoralists. Livestock mortality decreased by 24% and pastoralists earned EUR 160 of extra annual income. Garbal was introduced in Niger in 2021.

Eleven projects offer weather services using data gathered by weather satellites. Farmers provided feedback on how they use weather information and forecasts to make informed decisions. An example is early warning for diseases, which can now be predicted with relative ease well before farmers see the effect on their crops.

In Bangladesh, a text message-based warning service was developed that warns potato farmers about the occurrence of phytophthora. With the help of this service, farmers were able to increase their revenue by EUR 170 per hectare annually. This service is now being scaled up across Bangladesh and in India. Other countries - including Indonesia and Pakistan - have also expressed interest in this service.

What are the trends?

In the G4AW programme, clients often ask for services to be bundled together. Blockchain and artificial intelligence gain prominence as emerging technologies and complement Earth observation. In addition to agricultural services, target groups are also interested in financial and health care services. Continuous support from donors and/or governments is essential in order to fund the introduction costs and keep business risks at an acceptable level.

Parties in the private sector are investing as well. It is a promising development to see larger businesses in the agricultural chain participate in projects - often driven by their corporate social responsibility at first, but later incorporated into their business operations. These businesses - also known as aggregators - are a crucial factor in the process of reaching more food producers and achieving greater impact.

Partnerships are not static, but able to adapt to their changing environment. Collaboration and development are not always easy and require a lot of time and attention. Ambition and patience go hand-in-hand.

G4AW has also contributed to the development of employment opportunities and entrepreneurship. In Indonesia, young people continue with great enthusiasm and dedication with the provision of SMARTseeds and SpiceUp services as part of recently established social enterprises. In Burundi hundreds of jobs were created by the GAP4A partnership implementing their G50 community approach (and using tablets). This approach was later introduced in Burkina Faso and other countries.

It is expected that mobile connectivity coverage and capacity will increase in many developing countries. Digitalisation will also become more mainstream, although most governments will have to take big steps in terms of creating an enabling environment, putting adequate policies and regulations in place, creating a digital infrastructure, increasing digital skills and human capacity and stimulating digital innovation and

entrepreneurship. Digitalisation of agricultural value chains is part of this process. However, conflicts can have a considerable negative effect on the digitalisation process.

The establishment of public-private partnerships (PPPs) is an important element of the G4AW programme. Through increased digitalisation the bottom-up data infrastructure of G4AW can be combined with global and regional satellite-based agricultural monitoring initiatives, such as GEOGLAM⁶. This enables national and local governments to improve their policy formulation, monitoring and evaluation to improve informed decision making. More advocacy and demonstration power is needed to convince governments in developing countries to invest in this.

Finding investment is also a challenge for tackling climate change. Farmers clearly expressed the need to receive information on changing rainfall, temperature, and/or general climate conditions to adapt to climate change. Currently, targeted finance for combating the effects of climate change in developing countries is limited, efforts mainly focus on carbon credits and agroforestry. Although it will take time, more investment in climate-related activities is expected. The Office of UN Special Advocate Queen Maxima recently released a report on inclusive green finance, citing weather/livestock index insurance as one of the instruments to reduce vulnerability⁷.

In the framework of Geodata for Inclusive Finance and Food (G4IFF), an initiative that was inspired by the G4AW programme, three pilots were funded that tested the feasibility of satellite-based service to support inclusive finance. Interesting proof-of-concepts were developed for localisation of farms and assets, credit scoring, historical performance analysis and risk management⁸. It is expected that these will be further developed and become operational in the near future.

The section on G4AW recommendations and lessons learned and the project closure flyers gives more detailed information.

⁶ GEOGLAM is the Group on Earth Observations flagship activity on global agricultural monitoring: <https://cropmonitor.org/>

⁷ UNSGA (2023). Inclusive green finance: A policy and advocacy approach.

https://www.unsga.org/sites/default/files/resources-files/2023-05/UNSGA_Inclusive_Green_Finance_Policy_Note.pdf

⁸ NSO (2021). Space for food security - Stimulating smallholders' access to emerging agtech and fintech markets. Part 1: Users and services (summary report). https://g4aw.spaceoffice.nl/files/files/G4AW/publications/Users%20and%20Services%20_Summary%20Report_Space%20for%20Food%20Security_Publication_NSQ.pdf

What is the exit strategy of the G4AW projects?

One of the planned outcomes of the G4AW programme was to support the opening of new markets for geodata-based product and service providers that contribute to improved food security. This is instrumental to achieve the desired impacts of improving food security based on increasing food production and increasing sustainability in agriculture, including water use, improved food security for food producers and improved support for food producers in adapting to climate change.

What was the exit strategy of the G4AW projects and how well did they perform? A general post-project assessment carried out by Netherlands Space Office gives the following results:

- Five projects continued service delivery and scaled up outside the initial country.
- Another five projects continued the service with paying clients and/or donors, but only in the country where the project was implemented.
- Eight projects continued service delivery at minimal cost, i.e. some income was generated, but not yet enough to make the services financially feasible in the longer term.
- Four projects are waiting for investment and/or a local entrepreneur to continue with service delivery, and
- Three projects had no (plans for) activities after the closure of the project.

Apart from the recommendations and lessons learned that are presented in the next session, there were some factors related to the exit strategy and the pathway to success (or failure). All projects made considerable efforts to create a sustainable business and most achieved a strong technical proof-of-concept. However, the initial strategies did not always work and some projects were able to adapt the strategy and others not. In the paragraphs below, a short overview is given of the factors that affected the exit strategy. A more detailed description is provided in the individual project flyers that are attached to this document.

A good technical concept, a service that makes a difference (and adds value) and addresses a concrete need of smallholders (and reaching impact), a feasible business plan and an innovative approach for interaction with farmers (such as applied in the GAP4A

project in Burundi) are necessary conditions for success. But these elements are not enough. Sufficient revenue has to be generated in a difficult market. Different approaches were developed to achieve this. One of the strategies that worked consisted in cooperating with commercial parties, such as input suppliers. The geodata-based service then becomes part of a bigger portfolio, which increases the chance of adoption and acceptance by the farmer and use can be made of an already existing client base. Increasing revenue and customer loyalty are the main benefits for the commercial partner. The downside of this approach is that the geodata-based service can be dropped from the portfolio when it is not considered (commercially) interesting anymore, and that farmers may be locked in to the input supplier to have access to the information service. Preferably the service provided is non-exclusive. The GEOPOTATO service to warn potato farmers timely to spray against phytophthora (a potato root rot disease) is a good example.

Services often contain a “public good” element, which makes them commercially less feasible. Government support is then a possible option. Satellite-based index insurance, such as sold by local organisations that are part of the AgroConsortium in Uganda (as result of the SUM Africa and MUIIS projects), becomes affordable to farmers because of a 50% subsidy. However, getting the required government support is often a time-consuming and difficult process, as the R4A projects in South Africa discovered with the start-of-rainy season weather advice. Another option here is to make use of the corporate social responsibility dimension of large companies, as the STAMP project in Mali and the MODHEM project in Burkina Faso have done with their service for pastoralists. Other examples of this approach are the SMARTseeds and SpiceUp advisory services for smallholder farmers in Indonesia.

Partnerships sometimes opted for the establishment of a social enterprise. This enables the continuation of service delivery at minimal cost for some period of time and also reduces the risk for the partners involved. The results with G4AW projects have been mixed, depending (also) on the level of commitment of key partners.

The potential for scaling up a service is also a critical factor for success. Not only does scaling generate more opportunities for earning more revenue, it also enables service providers to move operations elsewhere if the situation in a particular country becomes unworkable.



Smallholder community in Burundi explores AgriCoach app ©Auxfin International/G4AW GAP4A project

Some of the projects continued service delivery, but without the geodata component. Often some satellite data elements were maintained, such as determining farm location and size with GPS or the provision of weather forecasts, but sometimes the proposed Earth observation solutions did not deliver what was promised or expected. It also happened that the solutions did work, but were considered too complicated and/or expensive or the envisaged client simply lost interest.

Sometimes the service portfolio was too diverse and/or the business case too optimistic. Different offerings were developed without clear-set priorities. In a sense this is understandable, taking the innovative nature of the programme into account, but in some cases the adjustment process started too late in the project to be effective.

In some projects an essential project partner (Dutch or local) had to terminate operations (not only for the project, but in general) or did not perform satisfactorily. Especially when this concerned the envisaged business owner the continuation of the initiative after the end of the project period was negatively affected.

The security situation in several countries had severe consequences for the continuation of service delivery. The G4AW countries concerned were Myanmar, Ethiopia, Mali and, more recently, Burkina Faso and Niger (introduction of Garbal service developed in STAMP/MODHEM).. Unfortunately, these developments are outside the scope of control of the G4AW programme, only a good scaling strategy to other countries (as indicated above) can mitigate the situation.

G4AW recommendations and lessons learned

Two documents were published on the experiences gained in the G4AW programme, on the design and development of geodata-based services for smallholder farmers and one on business models and scaling. The recommendations and lessons learned from both documents are presented below.

Recommendations and lessons learned on design and development of geo-data based services for smallholder farmers

Based on the experiences gathered during the implementation of the G4AW Programme, lessons learned and recommendations were formulated for consideration by other (grant) organisations when designing a grant programme, and for service development for smallholder food producers in general.

- 1 User-centred approach:** For a new grant programme, consider adapting the project setup to a two-stage approach, such as a one-year plus three-year structure, in which the first year is used for assessment of user needs, exploring possible solutions with the users, and attracting the necessary additional (service and/or technology) partners. This provides a better understanding of the user needs.
- 2 Digital inclusion:** It is important to develop a good understanding of the current uptake of digital advisory services. The information is often shared within households and local communities. Monitoring from the project is often mainly focused on the primary (registered) user. This distorts the picture of the actual use of the information. To monitor and evaluate digital inclusion a framework is needed that focusses on the actual reach rather than on registrations.
- 3 Weather:** Food producers need local, accurate and affordable weather information and forecasts. Many agro-advisory services and even financial services make use of by weather data and/or forecasts. Free satellite and ground weather data are a necessity. WMO SOFF⁹ may help to provide access to national data, and also to procure low-cost ground stations to provide accurate and localized weather information that can be shared with agro-met service providers and their beneficiaries.
- 4 Crops:** The G4AW projects have mainly focused on well-researched staple crops (e.g. rice, maize) and cash crops (e.g. coffee, cocoa). This is because the projects did not include a research component and thus services had to be developed based on existing research. It is expected that further research will increase the diversity of crops that are covered by geodata-based advisory services.
- 5 Soils:** Many G4AW projects focussed on providing soil nutrient advice, using soil samples. Many different approaches were used. Combining soil data, existing nutrient models and (commercial) satellite imagery is the best way to provide relevant fertiliser advice.
- 6 Water:** Recent initiatives, such as FAO WaPOR¹⁰, provide useful information regarding water productivity and related parameters in Africa, the Middle East and since October 2023 even at a global scale¹¹. This enables the development and delivery of new advisory services, not only on water productivity, but also on land degradation caused by salinisation and the application of water-saving methods (e.g. alternate wetting and drying for rice).
- 7 Climate:** In G4AW the focus was mainly on climate adaptation, by enabling farmers to take out insurance or to select more suitable crops/varieties. Adding services that cover the full extent of climate-smart agriculture, including climate mitigation will improve the impact of digital services. Payments to smallholders for ecosystem services, such as carbon sequestration, fall outside the scope of most traditional (agri-) markets, but are likely to become more popular in the future.

⁹ <https://www.un-soff.org/>

¹⁰ <https://data.apps.fao.org/wapor/>

¹¹ Launched October 4, 2023: <https://www.fao.org/in-action/remote-sensing-for-water-productivity/news-and-events/events/events-detail/wapor-global-database-version-3.0-will-be-launched-during-the-rome-water-dialogue/en>

8 Insurance: A promising approach is to bundle insurance with the provision of other agro-services, such as seed or nutrient supply. When income security increases thanks to the reduced risk, food producers will be able to make more investments in new products and technologies that enable them to make the switch to climate-smart practices.

9 Bundling: As indicated above, bundling of services provides significant benefits to food producers. Such bundles can cover different relevant to smallholders; such as advice, finance and market information. Bundling of services also makes it easier to retain client loyalty, as relevant information is provided throughout the year and not only during the growing season.

10 Service delivery: Services should be developed in such a way that they can easily be maintained and expanded. The design should be flexible enough to adapt new platforms and different transmission channels. Where possible, services should be available for offline use.

11 Data: The availability of free satellite data (such as those from the Copernicus programme) and the rapid development of machine learning, make the provision of digital advisory services more attractive and affordable. It is important that the data are properly stored, curated and shared to facilitate this process.

The training data collected in the projects is one of the most valuable sources of information, and can be shared with other projects to increase the availability of data for different users. This training data should be well-structured, documented and stored, in line with its value. 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.

12 COVID-19: The provision of digital advisory services to farmers had additional benefits during the COVID-19 period, when face-to-face contact was impossible. These benefits can be exploited further for application in situations where farmers are difficult to reach (new pandemics, conflicts, etc.).

Recommendations and lessons learned on business models and scaling for geo-data based services for smallholder farmers

1 Creating a balanced and involved partnership: In a successful partnership each partner contributes to and benefits from the creation of shared value. The roles, responsibilities and arrangements (e.g.

intellectual property and business ownership) need to be clear and formalised to ensure a transparent cooperation process. A partnership needs to be flexible and able to adapt to changing conditions.

2 Ensuring sufficient entrepreneurial leadership:

Entrepreneurial leadership is one of the most important preconditions for successful commercialisation and scaling of services. This entrepreneurial leadership has varied throughout the G4AW calls (limited in early calls, high in the latest call). There was generally less entrepreneurial leadership in the G4AW projects in Africa than in Asia. The entrepreneurial lead should preferably be located in the targeted country, or have its own business associates in targeted countries. Clear roles and agreements for project lead and entrepreneurial leadership are essential (see previous recommendation).

Many G4AW partnerships envisaged the establishment of social enterprises, and a few have established those. It is important that the partners begin this process early on in the project, to ensure that there is no (time and financial) gap after the project ends.

3 Understanding smallholder needs: Smallholder food producers, whether they be farmers or (agro) pastoralists, are the end users and beneficiaries of the services. In order for them to use the service, it has to be clear what challenges they face and what options they have to solve these. It is important to understand the different user segments (e.g. gender, age, finance, specific needs). It is also important to understand what actions farmers are willing and able to take (user stories), and what products are available on the market (market study), to ensure that the information or advice provided is actionable.

4 Optimising services: Meeting the needs of many users (smallholder segments and businesses) can be done by bundling services, and by having a dynamic and easy-to-use front-end (e.g. an app for smallholders or a dashboard for businesses). Reducing costs can be done by collaborating with other partners, using cheaper or open data, and replacing international staff with local staff.

It is also important that the partnerships do not overestimate the (rate of increase in) network coverage and smartphone access. In several projects, significant additional expenses had to be incurred to add more offline features than originally envisaged, as farmers could not access the online advice.

An additional challenge in the optimisation of services was that the number of growing seasons for testing was limited in most projects, as the minimum viable product was generally only ready in the third year of the project. Another constraint was that the organisations that were identified as potential users or (re-)sellers of the services were sometimes not ready for embedding digital solutions in their operational processes.

5 Financial services: The objective of financial services is to provide farmers with affordable credit and/or insurance that enable them to invest more in their farming activities and to increase their production and income. While geodata has been proven beneficial for supporting financial services through e.g. credit scoring, the revenues were still relatively low and require sufficient scale to be sustainable. Bundling financial services with agricultural advice and/or risk management is advisable. Bundling financial services with those of suppliers of agricultural inputs is also an option.

6 Understanding the value of client and crop data: The G4AW partnerships have collected a lot of data. This includes, amongst others, the registration of farmers (and pastoralists), plot delineation and crop types. During project implementation, many of the partnerships started to understand the value of this data. Farmer registration, for example, is of interest to financial service providers and agribusinesses. The data related to plot delineation and crop types is also of interest to businesses, but is also useful for research. It is important to appreciate the value of the data and to ensure that the data is complete and validated. Metadata should be well documented ownership of data is recognised and privacy regulations are complied with.

7 Understanding the willingness to pay: The willingness to pay for each customer (B2C, B2B) has to be investigated. In the projects that assessed this through surveys, it was found that there is generally a certain willingness on the part of smallholders to pay for the proposed service. In some of these projects, however, smallholders – for numerous reasons – did not pay once the service became available. This means that understanding the willingness to pay not only requires a survey of smallholders, but

also a broader understanding of the (potential) market and an assessment of alternatives that may compete with the services offered.

8 Retaining users: A successful and economically sustainable service benefits from a stable user base. This requires that the services provided are highly relevant throughout the year, and easy to use. In order to make them relevant throughout the year, features can be included that are also relevant outside of the growing season (e.g., market information, financial planning, health information). To reduce complexity for the user, the service should be designed together with farmers and have sufficient offline features (as there is often less connectivity than anticipated). In any case, frequent user satisfaction surveys are an important tool for understanding the degree to which the service is appreciated by all user segments and how it can be improved.

9 Planning for scaling of services: Scaling is required to generate sufficient revenue. In their business plans, many of the G4AW partnerships were strongly focussed on adding new products or expanding to other countries. In many cases, scaling is achieved easier by strengthening the existing products in the original country (higher market penetration) and/or cooperating with other actors in the value chain. Often, this is also more cost-effective.

10 Accessing additional capital: Partners need to focus first and foremost on service optimisation, financial modelling, entrepreneurial competence building, and partnership brokering, before looking for additional capital. An investor will not invest in a business if the business case is not solid and the business owner is not yet well established. Additional funding from public sources or grant programmes can help with de-risking the business case and provide support to the introduction of the services in new regions or countries, e.g. via outreach and training programmes together with local partners and/or NGO's. Sustainable business development should receive sufficient attention from the start of a project.



Introduction project leaflets

In the next section an overview of all 25 G4AW projects is presented in the form of two-page leaflets, in alphabetical order. Each leaflet starts with general information: where the project took place and when, what the project was about, who were the actors involved and which crops (if applicable) were targeted by the project.

Then a description of the provided services is given: what where they, how were they developed, what technology was used and in what way were they delivered to whom. Then the business model is discussed: which business model was adopted, did it work and was it changed during the course of (or after) the project.

The impact section provides information on how and if the results of the project were made sustainable and further developed after the end of the project. What happened to service delivery after the end of the project and what the effect was on the target group (and how they perceived the service and its delivery) are important aspects related to impact that are discussed. In some cases this concerns only an interesting proof-of-concept, in other cases real business maturity was achieved.

At the end of each leaflet key figures are presented that are characteristic for each project. Although the same parameters were used by the Netherlands Space Office for monitoring and evaluation of all projects, a selection of figures is made that highlights best the achievements of each particular project.



AngkorSALAD

Geodata for sustainable vegetable farming in Cambodia

2018 - 2022



The aim of AngkorSALAD was to provide geodata-based information services that support vegetable farmers in Cambodia and helps them to increase their production, income, food security and reduce their inputs of water, fertiliser and pesticides. The services are also extended to the cultivation of cashew nuts.

In addition, services in the form of intelligence about the vegetable farmers and their production are provided to commercial clients.

The project was implemented by ICCO South East Asia (a Dutch development organisation, now part of Cordaid) as the lead partner, supported by Cambodian partners Angkor Green (an agricultural investment and development company, the Cambodian General Directorate of Agriculture, the Cambodian representation of the World Vegetable Centre (a research and development organisation for vegetables), and Dutch partners Nelen & Schuurmans (a geo-IT company, specialised in water management), VanderSat (a satellite data and services company, now part of Planet) and Akvo (a foundation specialised in data-driven development).

Provided Services

AngkorSALAD delivers five services for smallholder vegetable farmers: irrigation advice, fertiliser advice, information on good agricultural practices, market information and pests and diseases information and advice. The services are delivered through a platform that contains soil fertility maps, geodata on soils, weather information, crop calendars, crop decision trees, market information and good agricultural practices guidelines. Satellite-derived rootzone soil moisture maps are uploaded to the platform daily.

The fertiliser service is based on soil and plant characteristics, combined with a fertiliser application schedule. To make this effective, a soil sampling campaign was carried out. For optimal results this should be repeated each year, but this turned out to be too ambitious.

The services are delivered to the farmers through the AngkorSALAD mobile app. The services were promoted through television, radio, extension workers and input sellers. As digital literacy of farmers is a potential bottleneck, a lot of effort went into organising face-to-face meetings and training. In addition to the workshops, meetings and field trips, demonstration farms were

established in the 16 target provinces to test the services. During the project, the visuals and readability of the app were improved to ensure that people interpreted the information and advice correctly.

Apart from the services for smallholder farmers, a business-to-business AngkorSALAD dashboard product was launched to provide intelligence for agri-businesses, financial institutions, NGOs and insurance companies.

Satellite information was used for estimating soil moisture in the rootzone on a continuous basis, as input for irrigation advice. In the end, this approach was not cost-effective enough to serve the target group.

Business Model

Smallholder farmers expressed a willingness to pay a small amount for the services of about €3 per year. However, this is not enough to make the services financially sustainable. AngkorSALAD therefore opted for engaging business clients to generate sufficient revenue for continuation of the services. These businesses then pay a subscription fee for intelligence from AngkorSALAD. Advertising and sales of data and insights provide additional income.

Several meetings were held with potential business clients. It is evident that, if AngkorSALAD reaches sufficient scale, this will make it more attractive for potential business client to subscribe to the service.

The AngkorSALAD social enterprise was established to give the initiative a further boost and bundling with new services is foreseen to make the package more attractive to paying clients. The local partner Angkor Green is currently maintaining the information services.



Impact

The project successfully created an application for farmers to access recommendations that cater to the specific needs of cultivating vegetable crops. This will give the farmers an edge in the highly competitive vegetable market, and it will also enable business clients to enter the market of vegetable farmers with e.g. provision of financial products.

The information provided by the AngkorSALAD app is certainly relevant, but the way it is being transferred could be further improved to reach the less privileged and less digitally literate target groups. Especially the older farmers need more time and training to adjust to the new technology. Limited connectivity is also identified as a constraint for onboarding. On the supply side, some features, such as the irrigation advice and advice the use of fertilisers and pesticides, need further improvement in accuracy.

On the positive side, a survey showed that farmers, especially the young ones, are able to adopt the new technology despite difficulties in downloading the app. They reported an increase in knowledge about vegetable farming and improvements in production and reductions in the use of fertiliser and labour. The extension of the services to cashew nuts and the obtainment of the associated innovation funding is also a positive development.

>400,000
farmers
reached
(informed
about
the service)

>5,000
active users
of the service

>50% reported an
increase in revenue after
using the AngkorSALAD app

Almost **7,000**
farmers trained in
face-to-face events

>65% of users are
committed to use the app
for the next 4 years

**Numbers are approximations based on M&E results.*



CommonSense

Weather and agro-advisory services

2015 - 2018



The CommonSense project targeted smallholder farmers in four regions of Ethiopia. Sesame and sorghum are important crops for these farmers. The farmers were reached directly or through actors across the agricultural value chain, such as unions, cooperatives, and micro-finance institutions (MFIs). CommonSense provided them with actionable information based on geodata and satellite information. The services were provided through a platform with dedicated dashboards and including monitoring current and predicting future crop conditions, weather forecasts, crop suitability assessment and risk analysis based on historical satellite and weather data. The goal was to increase income and to reduce risk for Ethiopian farmers supporting them directly or through their intermediaries in the relevant value chains.

Provided Services

The CommonSense partnership developed an aggregators app for farmer unions and agro-processors called TERRA, provided by CommonSense partner Apposit (an information technology solution provider). This was bundled with an eVoucher system that enables farmer unions and agro-processors to organise, monitor

and serve their farmer members more efficiently. In addition an agri-credit assessment tool (A-CAT) for inclusive finance was developed by Wageningen Environmental Research, that is marketed by Cordaid (an NGO) and Gebeya (an IT & marketing company).

Two services for farmers complete the portfolio, developed in collaboration with the Ethiopian Ministry of Agriculture and Livestock Resources (MoALR) and the National Meteorological Agency (NMA): an SMS-service with short and medium weather forecasts, provided by Weather Impact (a weather products service provider), Apposit and the Sesame Business Network and an agro-meteo advisory service at Woreda (district) level, developed by Wageningen Environmental Research. This service supports the work of extension officers.

Satellite information provided added value to the services (seasonal crop monitoring, weather forecasts, historical analysis).

Business Model

CommonSense developed very good relations with government agencies, enabling the embedding of the developed services in the Ethiopian context. This was a

necessary condition for obtaining a “licence-to-operate” in Ethiopia, but also contributed to achieving mutual cooperation and the formation of partnerships. CommonSense developed two types of services, depending on the client: commercial and government-oriented. This had consequences for the business model: the first type of services was, by definition, self-supporting while for the second type the government was the main client and public or donor funding was necessary.

The commercial services were paid either through a subscription in the form of an annual fee or based on the number of transactions. Integrating the services with other services, e.g. the eVoucher system or services of inclusive finance providers.

For the government applications CommonSense has been exploring other solutions, that are compatible with the Ethiopian regulatory framework. These include both public and donor funding.

Impact

During the project period the CommonSense partnership managed to reach 366,000 farmers indirectly through TERRA, owned by Apposit, and through collaboration with eight Ethiopian farmer unions. This indirect reach included 76,000 women (20%) and 35,500 young farmers (10%).

At the end of the project a total of 8,500 farmers had subscribed to the CommonSense services: 3,000 to the SMS weather service, 3,500 to the farm management app and 2,000 to the agri-credit assessment tool.



COVID and the conflict that affected the project focus regions of Tigray and northern Amhara had a negative effect on the continuity of the services, except for the weather forecasts. In 2020 an MoU was signed between CommonSense partners and the NMA to continue the weather information service, paid for by the Sesame Business Network. The number of farmers using the service increased to 5,000.

Even though follow-up funding was secured through the Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems (RAISE-FS) project, funded by the Dutch Embassy, the continuation of the conflict led to the cessation of services at the end of 2020. Prospects for a resumption of the same service are conditioned by the restoration of security conditions in the affected areas. Of course, it will also be necessary to consider the changed conditions on the part of service providers, who have in the meantime focussed on other markets and geographies.



**Numbers are approximations based on M&E results.*



CROPMON

Crop Monitoring Service

2015 - 2019



The CROPMON (CROP MONitoring) project developed a crop monitoring service that provides smallholder and medium-sized farmers in Kenya with location-specific and timely information about the actual status of their crops and (weather) alert messages. Additionally, possible causes for yield reduction are identified and advice on the application of corrective measures is provided to the farmers.

The advice concerns the following crops: maize, coffee, wheat, sugarcane, potatoes, soybeans and grass (for dairy cattle). The project was carried out by a partnership of Dutch and Kenyan partners with expertise on soils, weather, earth observation, digital platforms, agronomy and extension services.

Provided Services

Two different service levels were made available to the farmers. The first one is a basic service that provides weather forecasts by SMS-messaging. The second one is a full service that includes crop monitoring, advice on good agricultural practices, soil fertility improvement and weather forecasts. Alert messages on the spread of

the fall army worm (FAW) in maize with advice on how to deal with the pest, is an example.

Registration of farmers includes contact information, collection of agronomical data and determination of plot boundaries with global positioning systems (GPS). To ensure successful delivery of the services, extension officers and lead farmers were trained by using demonstration sites to showcase best practices.

Currently (that is: after the end of the project), farmers receive a localised weather update twice a week directly on their phone through SMS. The first message of the month also contains a seasonal outlook with the forecasted weather conditions for the next three months.

Satellite information provides added value for weather forecasting and crop monitoring.

Business Model

During the project, both the basic (or light) service level and the full service level were provided to registered farmers free of charge. The users of the service gave valuable feedback on its performance, which was used to improve and validate the service further.

CROPMON faced difficulties in developing a viable business case and in identifying a business owner for the services. The envisaged business owner, Equity Bank, expressed interest, but a transfer of operations did not take place in the project time frame.

During project implementation it became more and more clear that the initial business model based on a business-to-consumer (B2C) model would not be successful. The focus shifted to a business-to-business (B2B) model. Targeted B2B clients, such as input providers, cooperatives, advisory service providers, financial institutions and governmental bodies were approached, but no real commitments were made. As a result, different elements from the service portfolio were marketed worldwide separately by consortium partners after the end of the project.

Impact

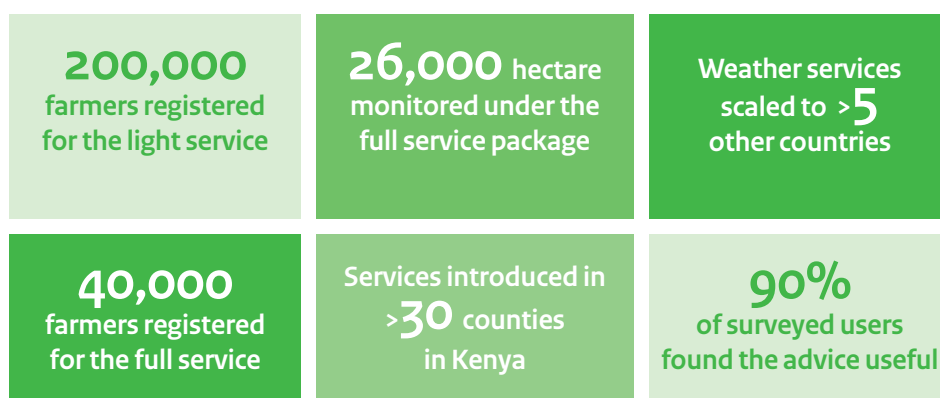
CROPMON established a strong and innovative proof-of-concept for delivering weather information and agricultural advice. However, problems that led to the termination of operations of the project coordinator (and therefore in fact eliminated the soil-related component from the service portfolio) and the absence of an identified and committed business owner (right from the start of the project) hampered successful service delivery.

With the support of the local partners, a large group of farmers registered to light and premium services. A comparison of average yields between begin and end of project indicated an increase in yields for all crops grown under CROPMON, except for coffee and grass. Wheat



farmers had the highest gains in average yields. Increase efficiency on the usage of inputs was reported seeds (20%), fertilizer = 35% and pesticides = 340%.

The consortium partner Weather Impact took the initiative to continue the weather forecast SMS-service. First through its own investment for two years and since 2022 with the support from the Bill & Melinda Gates Foundation (BMGF). This BMGF project was led by Equity Foundation (linked to Equity Bank), which provides new opportunities for service continuation. This includes the development of a Weather4Farmers app that delivers weather information to farmers with a smartphone, and enhancing the agricultural advice component with support from service provider NEO. Continuation of these services is only for the farmers linked to Equity and not for all the farmers originally targeted by CROPMON.



**Numbers are approximations based on M&E results.*



G4INDO

Geodata for upgrading smallholders' farming systems

2014 - 2017



The Indonesian Government has developed a crop insurance policy to assist farmers and to boost food security. The G4INDO consortium developed an IT platform for the Indonesian Jasindo insurance company to assess claims using processed satellite data. The objective was to provide this insurance service, combined with crop suitability advice, to at least 200,000 smallholder rice farmers, with an average of one or two hectares of land. The project was implemented on Java, Indonesia.

Provided Services

With the help of the G4INDO platform crop growth can be determined by calculating a parameter called the leaf area index (LAI) using radar and optical satellite imagery (Sentinel 1 and 2). Crop development is monitored over a growing season to detect anomalies. It is possible to distinguish between crops that are healthy, damaged by flooding or under drought stress. To enable a proper assessment of insurance claims, a satellite-derived crop mask and information on administrative boundaries are developed.

Every Jasindo branch office on Java, where claims are verified, has access to the G4INDO-platform. Jasindo claim assessors use the platform to assess crop damage and to process claims. 73% of all damage claims that farmers submit can be verified remotely with the help of this platform.

Business Model

The G4INDO service is closely linked to the national insurance programme of the Indonesian government. In 2013, insurance provider Jasindo was entrusted by the Government of Indonesia through the Ministry of Agriculture with the implementation of this programme. Establishing an insurance scheme for smallholder rice farmers was one of the first priorities.

The ownership of the G4INDO service and products resides with the Dutch service providers. The Indonesian government partners are responsible for the continuous provision of satellite data. Jasindo received a free license to operate. It proved difficult, if not impossible, for Indonesian government organisations to work on a commercial basis with foreign companies. This complicated the development of a successful business

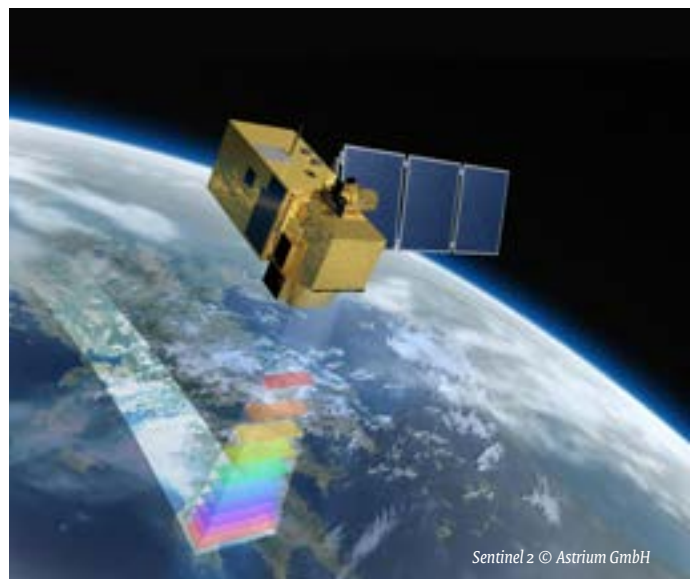
model. An alternative approach is now explored, where services derived from the platform are sold to Indonesian agribusinesses.

Impact

The potential impact of the project depends on the progress made by the Indonesian government on the national insurance plan. As the completion of this national plan was delayed the G4INDO services could only start insuring rice farmers in 2018. In addition, Jasindo needed a licence- to-operate to make use of the G4INDO service. Another complicating factor was that on-site inspections were still a condition imposed by the Government for the granting of claims.

As a result, project activities were mainly carried out in pilot form. However, these pilots showed very promising results, in terms of speeding up processing time and reduction in personnel input needed.

TerraSphere (one of the Dutch private sector partners) signed a memorandum of understanding with the Indonesian agricultural technology company HARA in 2018. This collaboration makes it possible to transfer the G4INDO service to a commercial setting by incorporating the services in the existing HARA app targeted at farmers. TerraSphere opened an office in Indonesia in 2020 and have started the introduction of GEOPOTATO (resulting from another G4AW project) that provides early warning for late blight disease in potatoes that started in Bangladesh and has since been expanded to India as well.



1,200,000
farmers onboarded

73%
of damage claims
can be verified
remotely

Almost **100%**
increase in claim
processing speed

240,000
farmers submitted
damage claims

67%
reduction in
personnel input for
claim assessment

1,8 million USD
can be saved
per growing season

**Numbers are approximations based on M&E results.*



GAP4A

Good Agricultural Practices for All - digitizing agriculture in Burundi

2018 - 2021



In Burundi, one of the poorest countries in Africa, farmers are not reached sufficiently by extension workers to have access to fertilisers, improved seeds or good agricultural practices. The population is young and knowledge about both modern and traditional farming is limited. There is a clear need for timely, accurate and location-specific agricultural advice and information about the changing climate. The Good Agricultural Practices for All (GAP4A) project addressed this need by building a digital highway consisting of groups of farmers organised around a tablet supported by activators, called the G50 approach.

The GAP4A project was implemented by a consortium led by the social enterprise AUXFIN International with headquarters in the Netherlands and branch offices in Burundi and Nepal.

Provided Services

The agricultural services developed in GAP4A are provided through a mobile app called AgriCoach. The AgriCoach supports the farmer in the decisions: What to grow? When to grow? and How to grow?

The CropSelector provides information on which crops are suited for the specific location based on climate data and crop models. In addition it provides information about the nutritional value, the use, varieties, cultivation practice, information on common pests and diseases, and the cropping calendar.

The second service is the ActivityCalendar, which shows when to carry out the different cultivation activities for the selected crops during the growing season. The farmer can use the WeatherCenter to further optimise their timing. The WeatherCenter provides a nine-day weather forecast, based on satellite data and weather models, with a spatial resolution of 9x9 km. In addition, the SeasonalOutlook shows the expected rainfall in the coming months and the start and end of the rainy season.

The third service is Good Agricultural Practices information. GAP information is provided for 43 crops, including wheat, maize, sorghum, rice, cassava, yam, potato, soybean, groundnut, coffee and different types of fruits and vegetables. For 23 crops these best practices are provided by videos in the local language and the video database is still growing.

The farmers are organised in so-called G50 groups, where 50 neighbouring households join a group to get access to the services.

The G50 groups often start a demo plot to have a shared learning with the AgriCoach and to test the new techniques before using them on their own fields. There is dissemination of AgriCoach information outside of the G50 group, usually varying from five to ten people per weekly meeting. G50 groups have access to AgriCoach via tablets.

GAP4A used an extension approach with so-called activators, consisting of field agents, G50 group leaders and G50 group members. These AUXFIN activators make sure that the digital applications are understood by the group and its leaders and encourage the groups to start with their self-development. AgriCoach runs largely offline as part of the UMVA (Universal Method of Value Access), which is the basis of all AUXFIN applications. The GAP4A project also developed UMVA GEO. This internet application serves policy makers and value chain operators, companies and NGOs by visualising data from the UMVA platform in an aggregated and anonymised manner about the G50 groups, crops, livestock, land cover, erosion risk, availability of education and healthcare centres, the presence of diseases, land conflicts. The purpose of the tool is to inform farmer supporting organisations in the form of maps. Farmers also have the opportunity to provide feedback.

Suitability maps are created on the basis of using climate data series and crop models. All G50 group data in UMVA is localised.

Business Model

AUXFIN is a social enterprise and the business owner of the services developed in GAP4A. Smallholder farmers pay a fixed subscription fee per time period for using the service. Additional revenue is generated by the facilitation of sales of agricultural inputs and other products from local entrepreneurs.

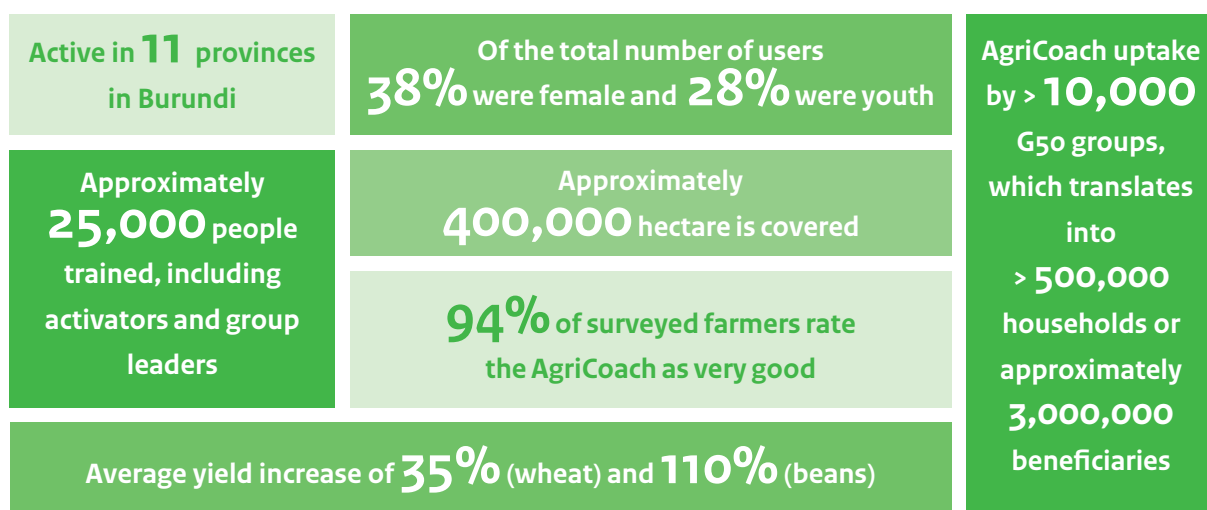
The AgriCoach and G50 approach can be scaled as an agro-advisory solution. There is potential to offer this solution to other partners and projects. Bundling of services with those of other organisations is also an option.

The approach is currently scaled by Auxfin International to Uganda and Burkina Faso opening new branch offices with local partners and thereby also contributing to youth employment and economic development.

Impact

The AgriCoach of GAP4A is embedded in the holistic G50 approach. Besides from agricultural information there is a need for access to finance, inputs, access to markets and good health. The G50 approach provides a solution to that complexity, while paving the way to the farmers in the remote rural areas for other organisations.

Evaluation of the AgriCoach shows an increase in good agricultural practices and yields. Farmers appreciate the AgriCoach app as if it is their personal extension officer. The model of self-help groups for social and financial inclusion supported by a tablet and a key activator is feasible. AUXFIN Burundi has expanded to almost 800 people providing quality employment in the rural areas. The network does not only support farmers, but also local entrepreneurs.



*Numbers are approximations based on M&E results.



GEOBIS

Geodata-based information for smallholders in Bangladesh

2015 - 2018



The GEOBIS (GEOdata-based Information Services for small farmers) project developed and implemented information and advisory services for smallholder farmers in Bangladesh (starting in Rangpur province). The aim of GEOBIS was to improve agricultural productivity, yield and farmer income and to increase resilience to weather-related extreme events.

The services focusses on good agricultural practices and weather alerts. The services are linked to the operational practices of Lal Teer Seed Ltd., a provider of agricultural inputs. Lal Teer led the GEOBIS consortium that consisted of six Bangladeshi and Dutch partners.

The services are delivered for 12 crops: maize, tomato, potato, radish, pumpkin, chilli, okra, cucumber, bottle gourd, bitter gourd, rice and eggplant.

Provided Services

The services concern the following topics for each of the 12 crops: seed variety and quantity, seed bed preparation and land preparation, sowing and

transplanting (timing, how to), irrigation and application of fertilisers and agrochemicals (timing, quantity, type). In addition, weather forecasts and alerts are provided. Farmers can also buy insurance through Lal Teer.

The services are delivered through text messages, interactive voice response (IVR) and a call centre. The farmers choose one or more of the options, subscribe to the system and provide information on location, crop and sowing date to receive the appropriate advice.

Lal Teer makes use of the phone number “3333” to facilitate access to the services and to respond to queries. This phone number is displayed on the seed sachets it sells.

The existing monitoring system of Lal Teer was used as basis for project implementation. New functionalities were designed and added to accommodate the GEOBIS services.

Earth observation has a supporting role in GEOBIS. The resolution of the satellite data that was too coarse to provide relevant advice to individual farmers, although advice at the level of clusters of farms may have added value.

Business Model

GEOBIS changed its selling strategy from a subscription fee approach to the offering of three bundled packages. Lal Teer negotiated a rate reduction (~50%) with mobile network operators for farmers receiving GEOBIS SMS messages or voice messaging.

The difference between the “basic”, “premium” and “gold” packages is determined by the limit on amount of minutes for contact with a call centre or voice response interaction and the number of text messages. All packages allow access to Krishi Radio (which delivers news and information updates on farming) and the premium and gold packages also include a certain amount of internet access. Insurance is part of the gold package through a separate arrangement with an insurance company. Buying a SIM-card offered by a certain network operator in combination with the premium package further reduces the price with an additional 20%. Farmers also have the option to pay for just a one-time query. Buying the SMS-message service in combination with a sachet of improved seeds is also a possibility.

Lal Teer is the business owner of the GEOBIS services. Lal Teer has taken care that all packages are vetted and approved by the Bangladesh Telecom Regulatory Authority, which is a requirement for mobile network operators. Lal Teer also has licences for the phone number “3333” with four major mobile network operators in Bangladesh. Service level agreements were signed with the GEOBIS partners to continue development and delivery of the services.

Impact

During the first years of the project Lal Teer invested in creating awareness and proving the relevance of the



service. To this end 35,000 basic packages and 50,000 seed packages were distributed among farmers for free. Face-to-face advice delivered by Lal Teer extension workers was also not charged for. After the start-up phase, the payment model was introduced. By the end of the project, the GEOBIS service had generated close to € 100,000 in revenue.

The smallholder farmers appreciate the quick response and the ease of accessing the call centre. They also were very positive about the effectiveness of the SMS messages. Advice on the use of pesticides and seed management was rated highest.

Lal Teer’s distribution network and large farmer database have facilitated awareness raising and marketing. New offices were opened, employees trained and many events were held to introduce farmers to the services. The use of distributors and lead farmers was instrumental for scaling up.

The continued offering of the GEOBIS services after the end of the project depends on the revenue that Lal Teer generates from the bundled packages and the sales of its associated products, such as seeds.

More than
300,000 farmers
received technical assistance

Approximately
10,000 events
and community meetings held

881,000
farmers registered

More than
2,000 project-related staff
were trained

**Numbers are approximations based on M&E results.*



GEODATICS

Innovative advisory services to smallholder farmers

2015 - 2018



GEODATICS offered smallholder maize farmers in Kenya and Tanzania advice on the use of fertiliser and crop nutrient requirements. The aim was to increase yields and farmer's income. The project was carried out by a consortium led by the social enterprise Agrics, with branches in both Kenya and Tanzania.

In addition to G4AW funding, GEODATICS also benefitted from winning a prize in the "Geodata for inclusive finance and food" innovator's challenge G4IFF, organised by the Netherlands platform for inclusive finance (NpM).

Provided Services

The target groups of GEODATICS are smallholder farmers and agri-businesses. GEODATICS provides agricultural input loans and advice on fertiliser, crop management and good agricultural practices. To do this effectively first a database with farmer profile information was created.

A variety of communication channels was used to reach the farmers, such as radio, phone text messages and phone voice messages, combined with outreach through extension workers, farmers' and pastoralists'

organisations and ministries.

Demonstration plots for maize farming were used to show the benefits of the GEODATICS approach. Unfortunately, the spread of the fall armyworm and dry spells affected validation in the first years of the project, but the in last project year considerable gains in maize production were achieved, compared to conventional methods.

In addition experiments were carried out to use the GEODATICS model for soybeans and sorghum. Also weather forecasts and remote sensing-based crop monitoring were added to the service portfolio.

Business Model

The business owner was the social enterprise Agrics. Agrics provided agricultural input loans and sold agricultural inputs. The farmers received advice through a subscription model.

Although the GEODATICS services were operational at the end of the project, the farmers experienced the provided advice as too complicated. This resulted in the service not being profitable in the short term. A cooperation within the G4IFF challenge with Agri-Wallet



and Rabobank (both providers of inclusive finance) to add financial services and strengthen the business case did not create enough momentum towards a sustainable business case.

If sufficient scale could have been reached, e.g. through cooperation with a large input producer, then perhaps the business model could have worked. Several factors affected the sustainable service provision negatively. One was government disrupting the business by subsidising fertiliser. Another was the outbreak of fall army worm and drought. In addition, the optimum blend of fertiliser that was advised was not available in the market. But maybe the most important factor was that, although the use of the GEODATICS service is demonstrably a profitable investment, potential clients considered the service to be too expensive.

Impact

In total approximately 15,000 farmers were profiled and registered. However, many of these farmers defaulted on their payments. There was also a difference between

the two countries: the uptake in Kenya was much better than the uptake in Tanzania.

Agrics focussed purely on supplying smallholder farmers with inputs such as seeds and fertilizers via micro-credits. It turned out that this business proposition was not feasible enough, as the income generated via the small margin on top of the sold blends of fertiliser did not cover costs. As there was no viable business case, the GEODATICS team was dismantled and Agrics had to terminate its operations due to financial difficulties.

Still, GEODATICS developed a viable and proven technical model to provide farmers with solid nutritional advice that leads to higher yields. This proof-of-concept could be shared with others to provide added value to their business.

200,000
smallholder farmers reached

1% paid uptake
of advice by farmers

15,000
farmers profiled and registered

56% of the
participating farmers were female

**Numbers are approximations based on M&E results.*



GEOPOTATO

Geodata to control potato late blight in Bangladesh

2016 - 2019



The aim of the project “Geodata to control late blight fungal disease in potato in Bangladesh (GEOPOTATO)” was to sustainably improve resource use efficiencies and profits in potato production in Bangladesh by providing a decision-support service (DSS) to smallholder farmers to control the late blight (*Phytophthora infestans*) fungal disease.

Late blight is globally the most important, highly destructive, fungal disease in potato crops. Annual yield losses due to late blight in Bangladesh have been estimated at 25-57%. Late blight can be controlled by frequent and costly applications of fungicides. The resulting level of control heavily depends on the timing of the fungicide application and the use of fungicides in relation to local weather conditions, crop development and disease pressure. The efficiency of late blight control in potatoes can be considerably improved through informing farmers timely about the predicted infection periods and effectiveness of past spray applications.

The DSS is provided to potato farmers in three districts of Bangladesh: Munshiganj, Rangpur, and six upazillas (sub-unit of a district) in the Dinajpur district.

The GEOPOTATO consortium consisted of Wageningen Plant Research (lead partner from the Netherlands), Agriculture Information Service (government institution from Bangladesh for dissemination of modern agricultural information and technology), the Bangladesh Centre for Advanced Studies (research and policy NGO), CORDAID (Bangladesh branch of a Dutch development NGO), mPower (social enterprise from Bangladesh specialised in ICT for development) and TerraSphere (Dutch company specialised in satellite crop analytics).

Provided Services

The core of the GEOPOTATO DSS is an epidemiological late blight model using temperature and relative humidity as drivers to predict infection events. Crop development since the last fungicide application is an important indicator of the need for a new protective

fungicide application. GEOPOTATO uses satellite data to keep track of crop development by monitoring the increase of the leaf area index (LAI). To do this Sentinel 2 and Landsat images are used. A crop growth model runs in the background for situations where actual LAI measurements are lacking because of cloudy conditions.

The DSS integrates the weather and satellite-based information and issues a spray advice to farmers when necessary. An infection risk calendar based on a historical weather analysis is used to replace forecasted weather data which were found too unreliable for the purposes of this project. Satellite crop reflectance is used to derive crop growth since the last spray event. Spray advice is issued three days prior to the predicted infection event. When a farmer uses a common fungicide the potato crop is protected for five subsequent infection events. A spray advice can be triggered by excess foliar growth since the last spray or when more than five infection events have occurred since the last spray. The minimum spray interval is set at five days. Thus, the GEOPOTATO system prevents under-spraying as well as over-spraying.

The potato farmers can subscribe to the GEOPOTATO service through interactive voice response (IVR) or through local extension officers. The farmers mobile phone number, upazilla and planting date are then registered in the GEOPOTATO database.

The communication channels are phone text messages, phone voice messages and contacts with extension workers.

Business Model

Smallholder farmers are the direct beneficiaries.

Paying clients for the provided services could be potato

processors or agro-input suppliers. Provision of the service is relatively expensive because farmers must renew their subscription prior to each new potato growing season (November – March). The service is not active outside this period when commonly rice is grown in the same fields. This means that sufficient scale is needed to make operations profitable.

After project ending, Bayer has adopted the service and pays the service owner mPower for the service provision during the potato growing season. Service level agreements have been reached with WUR and TerraSphere.

Impact

GEOPOTATO provides added value to farmers' potato cultivation. Most surveyed farmers considered the service reliable and followed recommendations. The farmers that followed the recommendations reported higher yields.

Bayer's cooperation with GEOPOTATO proved beneficial, as the GEOPOTATO service increased sales and brand recognition for the input supplier.

Still, bundling with other services (e.g., for rice cultivation) is recommended, as dependency on ground weather stations and a limited potato growing season increases service costs. The limited mobile phone coverage in rural areas is also a bottleneck. Taking this into account, through cooperation with partners, such as Bayer, there are opportunities to scale up to the whole of Bangladesh and to expand to other countries. Currently, Bayer has expanded the service area to West Bengal and Uttar Pradesh in India since 2021.

13% more yield
in demonstration plots

Financial gains of
€ 173 per hectare
per growing season

>50,000 farmers
subscribed to the service

>50,000
hectare covered

**Numbers are approximations based on M&E results.*



GIACIS

Geodata for innovative agricultural credit insurance

2014 - 2018



The objective of the GIACIS (Geodata for Innovative Agricultural Credit Insurance Schemes) was to enable smallholder farmers to cope with and manage weather-related risks. GIACIS targeted Ethiopian smallholder farmers in four key-regions of Ethiopia: Oromia, the Southern Nations, Nationalities, and Peoples' Region (SNNPR), Amhara and Tigray, cultivating teff, wheat, barley, maize and sorghum.

In the Ethiopian highlands the poorest farmers are in need of microcredit to buy seeds and fertiliser. In the case of crop failure, which happens often, farmers have no income and still have to pay back the loan. To help tackle this problem, GIACIS offers farmers affordable insurance based on satellite data.

The GIACIS partnership consisted of Faculty for Geo-Information Science and Earth Observation (ITC) at the University of Twente in the Netherlands as lead partner and the Ethiopian organisations Agricultural Transformation Agency ATA (as technology partner), Kifiya Financial Technology (as credit and insurance provider) and the National Meteorological Agency NMA (as information provider).

Provided Services

GIACIS has developed and implemented a single-peril drought insurance product named "VICI" that is based on vegetation indexes. The VICI toolbox is used to derive a greenness indicator, called the Normalised Difference Vegetation Index (NDVI) from the Copernicus NDVI-product disseminated through the EUMETCAST system, currently using the Sentinel-3 Ocean and Land Colour Instrument (OLCI) on a 10-day basis. The toolbox facilitates import, aggregation, pre-processing and temporal filtering routines (incorporating future NDVI 10-day climatology time steps). The results are transformed to a table to be ingested in the insurance scheme by the Ethiopian partners. A time series of satellite datasets that goes back more than 20 years is used for historical analysis and simulation.

Farmers can purchase this insurance product to insure their agricultural inputs against crop loss caused by drought events. Drought maps of each season are made and translated into pay-out maps to determine pay-out per insured farmer according to their geolocation on the map. In principle this product is applicable to any arable crop.

Business Model

The product is sold through direct sales of insurance policies via brokers. In 2016 the product became the first official insurance product approved by the National Bank of Ethiopia, and put under management of a national public-private partnership (PPP) consisting of the Ethiopian partners mentioned above. This coupling of the insurance service with microcredits provided by the Ethiopian government was done to increase the uptake of the insurance service, to reach scale of economies and reduce insurance charges for farmers. However, the introduction and scale up got delayed several times due to the unstable political situation in the country.

The roles for the ownership and continuation of the services have been decided on and approved by the partners: ATA is the product owner and Kifiya has an executive role and implements and maintains the service. Both organisations attracted a new partner called Global Green Growth Institute (GGGI) to establish an agricultural facility fund that will contribute to scaling up of the product by providing a premium subsidy to farmers and financial support to insurance companies in the case of losses beyond their capacity. Satellite processing activities are at present fully embedded into the NMA daily operations as information provider to Kifiya. NMA is assisted by Mekelle University for validation and maintenance of VICI drought insurance product (and by VITO, the Flemish technology research institute, during the conflict period).

Kifiya reported that face-to-face interaction is the best method to reach non-literate communities. The objective of the insurance companies in the project is

not to generate profit, but to test whether the product and the ecosystem in general are working.

Impact

GIACIS made an important step towards scaling up of crop insurance in Ethiopia by getting the national government on board to adopt the product as their national crop insurance programme, which provided a licence-to-operate and opportunities for growth.

Scaling up of the service was substantially hampered due to local unrest (the state of emergency was proclaimed twice during the project) and changing political priorities. In addition, the operation of the agent network proved to be not optimal, the premium to be paid was considered unaffordable and reinsurance was difficult. All these problems were tackled during and after the end of the project.

Although there were some good growing seasons, during the 2015/16 and the 2016/17 seasons, different regions of Ethiopia experienced severe droughts.

When the project closed in 2018 a total of 7,735 farmers had bought a drought insurance policy. An estimated 2 million farmers in 40 districts of Ethiopia have been reached and informed. Activities continued with support of the European Commission and the Japanese development agency JICA. This resulted in a continuing expansion of operations. In 2020 a partnership was established with Wasasa, a large microfinance institution, and in 2022 with the Oromia Insurance Company.

96%
of pay-outs in line with
farmers' expectations

98%
correlation between field
verification and indemnity paid

2 million
were reached and informed
about VICI

12,000
small farmers bought policies
(until 2021) and 5,300 received
pay-outs

**Numbers are approximations based on M&E results.*



GREENcoffee

Information services for coffee farmers in Vietnam

2016 - 2020

Vietnam
(Central Highlands)



GREENcoffee is one of the earliest, if not the first, ICT-based information services for coffee farmers in (the Central Highlands of) Vietnam. During the four year project, this public-private partnership launched the GREENcoffee application. Together with local partners the social enterprise OmiHubs was established in Vietnam to continue service provision to coffee farmers in the Central Highlands of Vietnam after the end of the project. Through the development of a location-specific advisory service, GREENcoffee succeeded in offering farmers the critical information and advice they need to face climate-related challenges in coffee farming.

Provided Services

The GREENcoffee app provides weather, rain, and humidity forecasts, information on daily coffee prices, advice on farming techniques, including how to diagnose and manage pests and diseases, and early warning for extreme weather events. The GREENcoffee app is available in the Google Play store.

Farmers, who do not have smartphones, can still get information and advice from key farmers, or other

farmer-users in their coffee cooperative. Members of the same household, who often have a preference for the different features of the app, e.g. male farmers usually access good agricultural practices (GAP), while female members of the household, use the app to get market information, can use the same account in the GREENcoffee app. Government agricultural extension staff, NGOs, field staff of input companies, and buyers who subscribe to the GREENcoffee service, can provide customised and more comprehensive advice to coffee farmers. GREENcoffee app users consider weather information the most valuable service that makes use of remote sensing data.

Business Model

Services were initially provided to coffee farmers for free, to generate a significant customer base. Revenues are generated through subscription fees from business-to-consumer (B2C) users, supplemented by grants from the Vietnamese government and other donors. At the same time GREENcoffee is pursuing business-to-business (B2B) revenue streams to ensure the financial sustainability of the provided services, while maintaining affordability for smallholder farmers. To



this end, the partnership is licencing the services to coffee buyers and input providers at a price based on the number of farmers they are affiliated with.

Impact

GREENcoffee overcame the huge cost, logistical challenges, and limited resources of extension offices, in providing technical services to farmers in remote rural areas. The GREENcoffee services can be expanded beyond Vietnam, to support coffee farmers in other Asian countries, and those from Africa and Latin America.

Client feedback surveys show that farmers highly value the weather information and the market information on coffee prices that the app provides. This applies

to female farmers in particular. In the past few years, farmers have been discouraged by the low coffee prices being offered to them, reaching points where prices did not even cover production costs. Farmers can now use the market information that the app provides, to decide where, and to whom, to sell their coffee at a fair price.

In 2020, a collaboration by GREENcoffee lead partner ICCO (now part of Cordaid), and Dutch coffee trading company KoffieDirect (now Farmers Direct) was set up, to further improve and boost GREENcoffee service delivery to farmers and supply chain actors.

Around **5,000**
farmers trained

Direct reach of around
25,000 farmers

14%
more efficient use
of pesticides

72%
of farmers
improved income
on average by 11%

Around **13,000**
subscriptions
(of which 33% female)

32%
of farmers
improved productivity
on average by 8%

**Numbers are approximations based on M&E results.*



IDSS

Intelligent Decision Support System for farmers

2015 - 2019



The objective of the Intelligent Decision Support System (IDSS) project was to give reliable and timely advice to farmers in Bangladesh. This improves the farmer's decision making for the entire production cycle, de-risks farming operations and improves profitability. The IDSS service is made available through a mobile application called Fosholi.

IDSS focusses on the following crops: maize, potato, rice, vegetables (including tomato) and wheat.

The IDSS partners are ACI Limited (a Bangladeshi agricultural input and trade company and the lead partner), SNV Bangladesh (a development organisation), the Department of Agricultural Extension, Ministry of Agriculture of Bangladesh, Nelen & Schuurmans (a Dutch IT company, specialised in water management) and SarVision (a Dutch remote sensing company, specialised in radar).

Provided Services

IDSS provides a platform for the farming community with services related to advice, agricultural inputs and buying and selling. The types of services are agricultural input loans, crop management advice, crop selection advice, crop yield information, fertiliser advice, flood mitigation advice, good agricultural practices, market information, pest and disease information and advice, weather information, connection the nearest government agricultural extension officers and information on dealers. Weather information is the service most appreciated by farmers. Farmers, who use Fosholi, spread weather alerts to their neighbours, thereby benefitting the whole community.

The platform and the associated mobile app are called Fosholi. The app is developed for the Android operating system and is supported by the government of Bangladesh. Behind the app is a service architecture that makes use of the Lizard database of Nelen & Schuurmans. The data is combined with expert agricultural knowledge to provide advice on e.g. crop suitability and pest and diseases.

Satellite images, such as MODIS and Sentinel-1, are downloaded, processed, and classified for the whole country to map land cover, crop growth stage and detect pest and disease outbreaks. Time series of imagery and scenarios of flood hazards are also available for the whole country. ACI regularly collects field data through a smartphone app to improve the quality of the information provision.



Business Model

The IDSS partnership provides services for three types of customers: the ACI Sales Business Units (SBUs), other companies and farmers. Four services are provided to the SBUs of ACI and charged for: sales leads of agricultural inputs, instant messaging, app content subscription and management fees, and remote sensing and GIS. IDSS charges the SBUs per service and/or report and expects to generate a revenue of € 3,5 million by 2025.

App-based campaigns and promotions, remote sensing and GIS data analytics services, and traceability and anti-counterfeit detection are the services provided to other companies. Farmers can take a subscription, which entitles them to receiving agronomic expert advice around the clock. Until now the advisory services focussed on mass circulation, targeting all crop farmers, with emphasis on rice. Commercial farmers of cash crops need very specific and one-on-one advice and this could be an interesting target group for future revenue generation.

Funding of the business is still a constraint, service provision is now mainly own investment. As indicated above, new models are therefore explored, including

a freemium model and generating income from advertising and selling data and insights.

ACI is the owner of the IDSS services and software. ACI is maintaining and updating the digital platform of IDSS gateway to disseminate the services.

Impact

The goals of the project have been achieved with significant impact among the farmers. Crop yields (for rice) of the beneficiaries were reportedly increased by 9% to 16% in the two growing seasons of 2018. A user survey showed that farmers are positive about the provided services and the Fosholi app. They indicated that they made decisions based on the information provided by the app. Training and feedback continues to improve service delivery.

ACI works closely with the Ministry of Agriculture and local NGOs to scale up the services. To make the services feasible, new client groups need to be added, such as commercial farmers. At this point there is insufficient support for inclusion and further development of the remote sensing based services.

300,000 farmers
subscribed to the services

66,770
hectare covered

4,200 farmers
club events organised

300 awareness shows
at schools organised

>1,700 project-related
staff trained

100,00 farmers
(unique users) received direct
training and technical support

**Numbers are approximations based on M&E results.*



Mavo Diami

Accelerating agribusiness performance in Angola for smallholders

2019 - 2022



The project was called Mavo Diami, which means 'my land' in an Angolan local language. The aim of Mavo Diami was to increase sustainable food production and help provide income security for smallholder farmers in Angola, by improving their agribusiness performance through informed decisions supported by the Mavo Diami services for weather, soils, and crops. The important decisions for an individual farmer relate to what to plant, when to plant, and when to harvest and keep track of farming results.

Another important goal of Mavo Diami was strengthened resilience of smallholder farmers with respect to the effects of climate change.

The main crops that are cultivated by the users are maize, beans, potatoes, tomatoes, onions, soybean and cabbage.

The project was carried out by World Vision (a development organisation from the Netherlands), with the Angolan partners Ministry of Agriculture and AgroLider (business owner attracted at the start of the project) and Dutch partners

Aquaetor Groen + Ruimte (an agricultural and environmental consultancy), eLEAF (a remote sensing company), FutureWater (a water consultancy), Weather Impact (a weather consultancy).

Provided Services

The services that Mavo Diami provides are crop management advice, crop selection advice, fertiliser advice, advice on good agricultural practices and weather information. Currently the services include localised weather forecasts for 2 days and 9 days, advice on what to plant and when to plant, in-season planning and tracking of activities and visual soil assessment guidance.

The services are delivered through KresBot, which is a personal dashboard that consists of a ChatBot for smart phone users and an interactive voice messaging service (VoiceBot) for the many farmers, who do not have smartphones or internet access. The services are promoted in face-to-face meetings and through radio broadcasts.

Satellite data are used for the weather forecasts (Meteosat, CHIRPS) and for monitoring water use (based on the FAO Water Productivity Open-access portal (WaPOR).

Business Model

The services are not yet paid for by clients, but a subscription model is foreseen to generate revenue. Users expressed a willingness to pay around € 2 per month for the ChatBot (on top of the cost of regular internet access of approximately € 4 per month) and around € 1.7 per month for the VoiceBot.

A development pyramid is envisaged with a chatbot service that is available to all farmers at the bottom of the pyramid, development programmes as incubators for sustainable smallholder inclusion in the middle, and farmers as agri-entrepreneurs that are joined in agribusiness clusters at the top. Depending on the stage of development, different types of fees can be charged to these categories.

After withdrawal of Agrolider as business owner a partnership of Angolan businesses, consisting of SEIVA (an agricultural value adder), Roque Online (a marketplace operator) and CADA (an agricultural development company) was established to continue the Mavo Diami activities in Angola. The providers of the satellite-based services, established a social enterprise called Kres Network BV, to support this from the Dutch side.

Bundling of the Mavo Diami services with other goods and services is seen as the way forward to become financially sustainable. Contacts were established with providers of agricultural inputs to realise this. Keeping the costs of the services low to stay in the affordability



range of the target groups is another paradigm for further development of KRES.

Impact

By improving the provision of agro-weather and crop management information Mavo Diami succeeded in de-risking farming operations, which creates the conditions for successful long-term agricultural development. The Kres approach is an instrumental part of the strategy to improve agricultural practices.

Although it is too early to give concrete results in terms of impact, surveyed farmers indicated increased production and sales, savings on inputs, a more diverse cropping approach and less need to buy additional food for the family.

On the negative side, farmers reported that accessing the services was sometimes difficult, because of limited connectivity and phone capacity, and lack of electrical power. The droughts and high inflation of recent years, as well as the COVID pandemic had additional negative effects.

The Mavo Diami partnership is looking for additional funding to continue developing the services and to make service provision sustainable.

>400 agents were certified to represent Mavo Diami (20% female), of which almost 200 started onboarding farmers

15 million communications registered annually

Almost **25,000** farmers onboarded the Mavo Diami service

On average each Kresbot user shared the information with **11** other persons

Approximately **90%** of surveyed farmers report an improvement of their livelihoods

**Numbers are approximations based on M&E results.*



MODHEM

Mobile Data for Moving Herd Management

2015 - 2019

Burkina Faso

MODHEM stands for mobile data for moving herd management and better incomes. The MODHEM project aimed at improving the food security situation of pastoralists' and farmers' households in Burkina Faso. By using satellite data, the pastoralists and farmers are informed on the best locations for pastures and water areas via a call centre. They also have access to accurate information about weather forecasts and market prices. This leads to improved herd and crop management and conflict avoidance.

The service for pastoralists and agro-pastoralists is based on the Garbal solution that was designed in the framework of the G4AW project STAMP in Mali. The call centre for this service is run and funded by the telecom company ORANGE Burkina Faso.

Other participants in the project were SNV Netherlands Development Organisation (Burkina Faso office and project lead), Agrhymet / CILSS (an international organisation supporting agricultural development in the Sahel region with headquarters in Niger), the Ministry of Animal

Resources of Burkina Faso and Satelligence (a Dutch remote sensing company). Another Dutch remote sensing company, Hoefsloot Spatial Solutions, also active in the STAMP project, was contracted for specific services.

Provided Services

Under the brand name Garbal, services are provided through a call centre. Communication with the callers takes place in French and in different local languages, such as Mooré and Dioula. The services consist of market prices, weather forecasts, information on biomass and livestock corridors, information on water availability and water points, agro-meteorological advice (sowing / planting, rainfall information) and on-demand response to specific requests.

The services are based on satellite data that are analysed and processed and made available via an analytical framework, a transmission protocol and a web viewer to enable the call centre operators to provide correct and up-to-date information to the end users. A field data collection campaign supported the validation and quality control of the output of the

information that was derived from the satellite data. Local market and biomass data were also provided. The field extension system of the Ministry of Livestock and Fisheries supported the service development in collaboration with six producer organizations that represent farmers and pastoralists.

An intensive marketing campaign was carried out for Garbal. This was supported by end users mobilisation by farmers' and pastoralists' organisations. The actions in the field had to be carefully planned, because of the deteriorating security situation in Burkina Faso.

The use of satellite data for MODHEM is essential. Data from the Sentinel-1, MODIS and Proba-V satellites are used for the detection of biomass and the assessment of water availability. Data from the Meteosat satellites are used for the weather forecasts.

Business Model

ORANGE Burkina Faso is the business owner. The goal of ORANGE Burkina Faso is to use Garbal as leverage for reaching rural populations. There are plans to add financial products Garbal. Garbal helps to create a loyalty base for ORANGE Burkina Faso, as you must have an ORANGE number to access the service. Garbal therefore helps to increase the awareness about the ORANGE brand among local communities.

Although some revenue is generated, the service would not be financially feasible without the support from ORANGE. Inbound calls are charged at € 0.457 per minute, with a "profit" margin of almost 7 eurocent per minute. The loyalty approach of ORANGE for onboarding and retaining customers is therefore crucial for MODHEM's success.



Impact

To measure impact, the value of animal loss was used as a proxy for income, and this showed that pastoralists, who used the call centre, reduced the value of animal loss by € 582, the equivalent of increasing their income by 39%. Farmer households that used the service almost doubled their income.

A point of concern is that the security situation deteriorated in some of the project regions. This situation affects service promotion and enrolment of users. Pastoralists also tend to reduce their herds in uncertain times, which has a negative effect on the impact of Garbal. Limited connectivity due to conflict also hampers onboarding.

Thanks to funding of the Royal Netherlands Embassy the project continues in the form of MODHEM+, enabling partners to further develop and expand the services.

An important achievement is that MODHEM is one of the very first projects in Burkina Faso that created innovative digital services on a large scale for pastoralists and farmers. Providing services to both agro-pastoralists and farmers is also new.

Approximately **110,000**
users registered for the service

> **65,000** pastoralists
reached with the service

Approximately **72,000** calls
processed during a 9 month period

Of which **12%** female users

**Numbers are approximations based on M&E results.*



MUIIS

Market-led User-owned ICT4AG Enabled Information Service

2015 - 2019



The aim of the Market-led User-owned ICT4AG-enabled Information Service (MUIIS) was to establish a demand-driven, market-led, and user-owned approach to provide satellite based information services related to weather forecasting, crop management and insurance to farmers in Uganda.

The value proposition focusses on bundled mobile services and index-based crop insurance. Subscribers pay for this information via the mobile network operator. The service builds on already existing customer relationships and previous experiences and makes use of an existing network of agents on the ground. The crops covered are maize, beans, soy and sesame.

The main actors in the MUIIS consortium were: CTA (an international institute specialised in agricultural development, now part of Wageningen University), Ensibuuko (a Ugandan fintech company) and eLEAF (a provider of satellite-based insurance).

Provided Services

MUIIS provides advisory and insurance services in the form of agricultural input loans, crop index insurance, crop management advice, advice on good agricultural practices, and weather information. To do this effectively more than 270,000 farmers were profiled with detailed information on each farmer, including the GPS coordinates of their fields.

Agents were contracted, the so-called MUIIS Service Agents (MSAs), who were trained and involved in marketing and selling of the services to the farmers. The farmers received the advice through SMS-text messages and the MSAs.

MUIIS developed a database and dashboard for service delivery, which has been revamped, cleaned and decentralised for access directly by the farmer organisations and/or cooperatives and other clients, based on feedback from the field.

Crop insurance is perceived as the most valuable service. This is the only service of which Earth observation is an essential component. The MUIIS insurance service uses the same technology and method as the G4AW SUM Africa project.

Business Model

Revenue is generated by charging a percentage of the loans that farmers take, charging for services bought by Savings and Credit Cooperative Organisations (SACCOs) and by recovering the government subsidy on insurance. Although the number of farmers who have taken out subscriptions is gradually increasing, it remained well below the profit threshold. The project therefore aimed to solidify the value of the MUIIS products and services and to explore and identify business partners, such as farmers' organisations, agent networks and agribusinesses. The aim is that these entities pay some or all the subscription on behalf of the farmers.

Ensibuukoo was identified as the partner organisation that could best perform the function as business owner. Ensibuuko offers a cloud-based microfinance management platform and data infrastructure called MOBIS with the aim to make the operations of SACCOs and finance providers digital. This includes savings and loans, internet and mobile banking, mobile money (transactions and information per SMS). Ensibuuko partners with a number of banks to do this. They provide intelligence reports on clients to banks. Savings groups are a special type of customers for Ensibuuko. Currently over 100 SACCOs and lenders are served by Ensibuuko.

As a result of the MUIIS G4AW project, insurance is now successfully integrated in the Ensibuuko portfolio. The price of UGX 30,000 (about US\$ 8) per acre (about 0.4 hectare) is considered very acceptable. The G4AW support made the inclusion of the insurance part possible and facilitated scaling up.

Impact

The farmers that did receive MUIIS service bundle were generally satisfied by MUIIS services; and reported applying improved farming practices regarding soil fertility and water management, use of improved seeds



and fertilisers. These farmers also reported increased yields over the project period and an increased awareness about climate smart-agriculture.

Still, the total number of subscribers to the service bundle remained too low to be profitable. By focussing on business-to-business contracts and a more limited service portfolio (insurance) Ensibuuko tries to address this issue.

Valuable lessons were learned during project implementation, which include the importance of identifying a business owner from the start, giving sufficient attention to marketing and business sustainability and provision of training at farm level. Challenges related to the operation of the MUIIS system and the services portfolio were also addressed. These concerned the infrequent and late sending of advisory messages and the fact that the provided advisory and weather information was not geographically specific enough. In addition there were some more general constraints, related to absence of mobile network coverage in some areas and difficulties surrounding delivery of the messages in local languages.

The low uptake during the project period notwithstanding, MUIIS succeeded in establishing a strong proof-of-concept, invested heavily in capacity building and provides continued services through Ensibuuko.



**Numbers are approximations based on M&E results.*



MYVAS4AGRI

Connecting smallholder farmers and agriculture professionals

2018- 2022



The Myanmar Mobile Value Adding Service for Agriculture project (MYVAS4AGRI) aimed to provide agricultural services to farmers and to connect farmers to other stakeholders in the agricultural value chain. Farmers receive information and advice through various channels, including a mobile app called Htwet Toe. The service is available in all regions of Myanmar. Village Link is the entity responsible for the delivery of these services. Village Link also caters to commercial clients, who are interested in using farmer data and getting farmer insights.

The services are provided for a large number of crops, including (four varieties of) rice, maize, pulses, groundnut, onion, potato, chili, pulses and sesame.

The project lead is the Myanma Awba Group, a manufacturer and distributor of agricultural inputs and technology. Together with project partner Miaki Myanmar the Awba Group established Village Link, an agtech specialised in connecting farmers with digital technology. The Department of Agriculture of the Ministry of Agriculture, Livestock and Irrigation is the project partner from

the government side, while the Dutch companies Weather Impact, Terrasphere and SarVision provide technical input.

Provided Services

MYVAS4AGRI provides the following services to farmers: crop guidance and advice on good agricultural practices related to seed selection, land preparation, fertiliser and pests and diseases management, irrigation and post-harvest management. In addition weather advisory services, daily market information and farming financial management advice are provided.

As indicated above the services are delivered through the Htwet Toe mobile phone app and the Htwet Toe Call Centre. The weather service, for example, consists of a five-day weather forecast, a forecast of the onset of the monsoon, a seasonal forecast and alert services for heavy rains.

Crop monitoring and land monitoring analytics is offered mostly to business partners. The information provided covers features such as crop extent, crop type, crop phenology, crop damage, crop health and flood monitoring.

Several accompanying measures are implemented to increase the loyalty of the farmer. Digital farmer communities are created and location-specific information, such as local news, is added to the Htwet Toe app. Promotion is done through radio broadcasts, digital marketing, extension workers, agricultural fairs and village leaders.

The backbone of MYVAS4AGRI is the Village Link Satellite Service (VLSS), which consists of a data infrastructure, where the three technical data and service providers (Weather Impact, TerraSphere and SarVision) store and process their data and transfer the data to the frontend of the platform. Paying clients can access crop monitoring and land monitoring analytics through the business-to-business (B2B) side of the VLSS platform, while farmers can access weather data for free through the business-to-consumer (B2C) part of the VLSS platform, the app, the website or the Htwet Toe Facebook page.

A combination of optical and radar satellite data is used. A first data category deals with weather analysis, forecasting, monitoring and historical time series, the second data set consists of meteorological and remote sensing data that is transformed into quantitative crop, water and climate parameters. For weather monitoring, Weather Impact uses several satellite data-sources and the model of the European Centre of Medium Range Weather Forecast (ECMWF). This is complemented by other data sources, such as topographic maps and weather station data. SarVision attempted to use Sentinel-1 radar satellite data to produce cropland extent maps, crop type extent maps and crop growth stage maps, but this turned out to be too complicated. Classification based on Sentinel-2 data yielded better results, TerraSphere uses these to map crop extent and crop health status.

Business Model

The business model is a combination of various types, whereby information services are free-of-charge for farmers and commercial clients pay for information about farmers performance and operations. For Myanmar Awba and potential other value-adders, offering services as those developed by MYVAS4AGRI, this free-of-charge approach creates loyalty towards the other products and services it sells.

Village Link is the business owner responsible for monetising the data infrastructure and delivering the business-to-business services to interested clients. A number of pilots have already been carried out and discussions are going on with other potential clients. Bundling with other services or other service providers is also an option. There are, however, some bottlenecks related to government tightening regulations for weather and geodata services and disappointing revenue generation from advertising.

Impact

MYVAS4AGRI has succeeded in onboarding many farmers through the provision of relevant services. More than 800,000 farmers installed the Htwet Toe app. Over 90% of surveyed farmers indicated that the information they received was useful. Considerable increases in yield (8% for rice and 28% for maize) and income were also reported (36% for rice and 73% for maize).

The COVID-19 pandemic and the security situation affected MYVAS4AGRI negatively, although it was appreciated that Village Link was one of the few organisations that continued the delivery of services to farmers during these difficult times. The highly valued MYVAS4AGRI cyclone warnings are a good example of this.

85% of > 2,000 interviewed customers
rated the Htwet Toe service as (highly) satisfactory

> **800,000**
smallholder farmers subscribed to the Htwet Toe app

73% of the subscribers
are under the age of 35

25%
of the subscribers are women

> **2,400**
face-to-face
trainings were
carried out to
almost 120,000
farmers

**Numbers are approximations based on M&E results.*



Rain4Africa

Rain for Africa - agricultural advice based on weather information

2015- 2019



The goal of the Rain for Africa (R4A) project was to compose the best available historical, actual and forecast weather data and make it easily accessible for each food producer, weather service, added value provider and governmental organisation in Africa, at an affordable price. From these data, different services for food producers were derived, such as advice on when to plant and when to spray both herbicides and pesticides. The project was implemented in South Africa and initially focussed on two main crops: maize (in summer) and wheat (in winter).

The development of R4A was carried out by a consortium of 10 organisations. The main activities were carried out by the Agricultural Research Council (ARC, South Africa), the South African Weather Service (SAWS, the South African National MetOffice), Hydrologic (a water consultancy firm in the Netherlands) and Weather Impact (a weather consultancy in the Netherlands).

Provided Services

The services provided are location based weather information assisting in crop management, crop

selection, and good agricultural practices. The service also provides significant advice for the management of pest and disease. Similarly the same information can also be adopted to aid in pasture and water management in livestock farming.

To reach the smallholder farmers and other clients a platform with an associated Android app, called AgriCloud, was developed. AgriCloud is an online weather based agricultural advisory system that enriches weather and climate data with agricultural information and data. This is combined with local knowledge and models (via knowledge engines that are a set of research equations or statements forming the basis of the programme, software and/or application) to generate real-time personalised advisories. Via the AgriCloud App advisories (smartphone and USSD) are accessible to extension officers and small-scale farmers. The information is delivered in all eleven recognised South African languages.

The AgriCloud platform facilitates rapid development and integration of additional services. During the lifetime of the project services were developed for maize, wheat and knowledge engines for potatoes, tomatoes, pepper, eggplant, onion, garlic, sweet

potatoes, soy beans, groundnuts, sunflower, bees and beef cattle. Specific products were developed on water demand monitoring and for viticulture.

The AgriCloud advisories are accessible through different AgriCloud products: AgriCloud Mobile for extension services and farmers, desktop AgriCloud Services for value-added service providers and AgriCloud Portal providing reports for agribusinesses, commodity traders, governmental organisations and media.

HydroLogic is the provider of the AgriCloud platform which uses the HydroNET decision support platform for data integration. The use of HydroNET has the advantage that new applications can be built on an already existing data infrastructure. ARC is responsible for the communication with extension officers and smallholders farmers. In addition, radio- and TV media were used to generate interest in the services. The AgriCloud app also facilitates the reception of feedback from farmers via a crowd-sourcing function.

Earth observation is used for the provision of weather-related advisories.

Business Model

Service provision is free for smallholder farmers, but other customers pay a subscription fee for the services. These customers can be large farmers, energy and water companies and/or the (local) government. ARC, SAWS and Hydrologic signed a memorandum of agreement in 2021 to continue R4A service delivery.

SAWS and ARC are responsible for reaching paying customers. Scaling up is done by bundling with new

services developed by the consortium and by bundling with services developed by other companies (e.g. through APIs). Licencing the R4A services to others is also an option. Efforts have been undertaken to scale into new countries (Zimbabwe, Eswatini, Burkina Faso).

Impact

The R4A project is a good example of public-private-partnership. Institutional, research and business organisations cooperated to achieve common goals in a defined project period. The partnership targeted different customer segments ranging from smallholder farmers (R4A's primary target group) to commercial farmers, service providers (e.g. using weather information), agribusinesses, commodity firms, other economic sectors (e.g. energy, water), and governmental organizations (including other African meteorological organisations).

Financial sustainability by generating sufficient revenue is an ongoing challenge. Strong points are that ARC, SAWS and Hydrologic can operate the R4A / AgriCloud services at relatively low cost and that organisational and service agreements are in place.

The R4A experience with the introduction of innovative agtech services in South Africa resulted in recommendations to prioritise translating knowledge into applications; to improve institutional contract governance; to strengthen institutional data policies with respect to data sharing; to generate sufficient capacity for marketing at an early stage, and to aim at cost containment and efficiency.

Estimated approximately **463,000** smallholder farmers
were reached (of which 50% female and 20% youth)

2,100 registered users
and many more second-hand
unregistered users

1,100 people trained,
including 695 extension officers

**Numbers are approximations based on M&E results.*



SAM

Smart Agriculture Myanmar multicrop advisory system

2018- 2022



The Smart Agriculture Myanmar (SAM) project utilised and strengthened existing information service; the Golden Paddy platform and app. The platform provides farmers with knowledge on good agricultural practices, product information, pest and water risk indicators, market information and financial inclusion. This information is customised and relates to characteristics of the registered user, such as location and crops grown. The service caters to the value chains of maize, rice, sugarcane and mung beans. As a result of a market and competitor analysis, maize was given priority over paddy rice.

The SAM consortium consisted of Impact Terra (an agri-tech company based in Myanmar and lead partner) Financial Access (a Dutch financial services company), Satelligence (a Dutch Earth observation services provider), the Centre for Economic and Social Development (CESD) (an organisation supporting evidence-based policy making based in Myanmar) and Wageningen University (WUR) contributing with knowledge on good agricultural practices and agronomical services. The Myanmar Ministry of Agriculture,

Livestock and Irrigation (MoALI) joined for local embedding and the provision of the licence-to-operate.

Provided Services

Golden Paddy's platform consists of two services directed at two different user groups. The Golden Paddy Android App (GP) provides services to farmers, the Golden Paddy Crop Insights web-portal (GPCI) to governments and businesses.

The Golden Paddy App provides crop calendars for different varieties of maize and paddy rice, and also for sugar cane and mung beans. Good agricultural practices related to planting, weeding, fertiliser application, detection of pests and diseases, harvesting, etc., are sent to extension workers and to the farmers via the ShawTheeNan mobile app and via Facebook. This information is also available offline. The farmers are also provided with weather forecasts and market information.

The Golden Paddy Crop Insights (GPCI) portal contains information on historical droughts and drought

predictions (weekly and daily), on historical floods and flood predictions (weekly and daily), crop performance (weekly), extreme weather alerts and forecasts, and pest and disease alerts. The platform's services are to a large extent automated.

For crop monitoring a combined, multi-sensor crop growth index was applied that makes use of Sentinel 2, Landsat and MODIS imagery to account for local differences in land cover, mixed cropping and non-uniform soil conditions and topography.

The flood risk data product uses land cover, a digital elevation model, historical precipitation, and historical satellite inundation observations as input. In the dry season the Sentinel-2 satellite is used because of its more stable water detection algorithm, while in the wet season the Sentinel-1 radar satellite is used because it can look through clouds.

The drought risk data product is provided at 1km spatial resolution on a daily basis and with a tested accuracy of 90%.

Business Model

The services of the Golden Paddy App are provided to farmers for free. The services of the Golden Paddy Crop Insight portal are sold to (non-)government institutions and businesses, such as food processors, input and food retailers, insurance companies and financial institutions. The clients pay a licence fee for the use of the platform. The more specific the insights, the higher the fee.

Impact Terra is the business owner of Golden Paddy. Agreements with Satelligence (satellite-based services) and WUR (pests and diseases risk prediction) were reached on maintenance, quality assurance and updating of data provision and service delivery. These three organisations committed themselves to continuation of the services after the end of the project.



Impact

The SAM project succeeded in reaching approximately 2.5 million smallholder farmers with low-cost solutions through marketing activities and social media (Facebook). Farmers reported that thanks to the advice they increased the diversity in crops grown, increase yields and that they could grow more crops in a year. Maize farmers were also better prepared for fall army worm (FAW) infestations.

Operational costs have been downsized to a bare minimum, which increases the probability of achieving a successful business case. However, due to COVID and the deteriorating situation in Myanmar the continuation of SAM became more and more difficult and operations had to be stopped in 2021.

Scaling up to other countries in South and South East Asia is envisaged as a possibility to capitalise on the demonstrated proof-of-concept, particularly with the easier scalable GPCI solution.

2.5 million
smallholder farmers
reached

30% less
use of pesticides
for maize reported

40% savings
in applied fertiliser
for maize reported

**Numbers are approximations based on M&E results.*



Sat4Business

Advisory and financial services for smallholders in Ghana

2019- 2022



Sat4Business aimed to test and validate a portfolio of services, ranging from advice on better agricultural practices to financial services. These services are critical for de-risking smallholder farmers through access to digital finance and the elimination of information asymmetry.

The primary target group for Sat4Business services are smallholder cocoa and oil palm farmers in seven regions (Eastern, Central, Western, Western North, Ashanti, Bono and Ahafo) of Ghana. The secondary target groups are service providers (SMEs) and financial services providers (FSPs). Sat4Business focusses especially on young and female farmers. Youth plays a key role in the future of cocoa, especially because over 55% of Ghanaian cocoa farmers are older than 50 years.

The Sat4Business partners were Solidaridad Europe (a global network organisation with main office in the Netherlands – lead partner), Akvo (a Dutch data services and tech solutions provider), Esoko (a technology and deployment company with a branch in Ghana), Financial Access (a rural agri-finance company based in the Netherlands),

the Ghanaian Ministry of Food and Agriculture (MOFA), Satelligence (a Dutch remote sensing company) and Solidaridad West Africa (Ghana).

Provided Services

Sat4Business offers advisory services and financial services. The advisory services consist of crop management advice, fertiliser advice, good agricultural practices, location information (on pastures and water), market information, pest and disease information and advice, weather information, and crowdsourcing for input dealers and financial service providers. Advice on good agricultural practices is (until now) rated as the most important service by farmers. The financial services relate to credit scoring and provision of loans.

The services are provided to the farmers through radio broadcasts, phone text messages (SMS), voice messages (IVR) and a call centre operated by Esoko. Capacity building and face-to-face meetings are also important communication elements.

Three different IT-platforms are in use to provide the services, by Solidaridad, Financial Access and Esoko.



The aim is to integrate them into one Sat4Business platform. Satelligence already integrated an agricultural insights bundle, based on satellite information, and a web viewer into the Solidaridad platform.

Business Model

The business model focuses on the monetisation of all the Sat4Business activities. This includes the leveraging of satellite, farmer-level and value chain data to provide actionable (marketing and credit risk) insights to businesses active in the cocoa and palm oil value chains as well as to financial service providers (FSPs) in the smallholder farmers segment.

The business model is a combination of subscription by farmers and a revenue model for financial service providers and agribusiness that is a combination of a subscription and freemium model, supplemented by advertising. To support the creation of a successful business case a social enterprise, called Green Cred Limited, was established.

The initial projections are that the business case could be feasible in the future, but that sufficient scale is needed with more than one million subscribers to make the business profitable. This can be realised by expanding activities to at least five countries in West Africa.

Impact

Financial Access is currently developing an input financing scheme together with Advans Ghana, a financial service provider, and Solidaridad WAF in the palm oil sector. New services can be added to the Sat4Business portfolio and a combination with services provided by others can be made to add new customer segments.

The main impact is in the improvement of access for people living at the bottom of the economic pyramid. At least 45,000 food producers have made use of the Sat4Business services during the project period. Special attention has been given to women and youth, e.g. by working with village savings and loan associations (VSLAs).

140,00 smallholder farmers reached with radio broadcasts and advertisements

A lending pilot with **7,500** smallholder farmers implemented (ongoing)

>50,000 cocoa and oil palm farmers identified and profiled

>50,000 hectare covered

**Numbers are approximations based on M&E results.*



Sat4Farming

Information services for sustainable cocoa farm management in Ghana

2018 - 2021



The main objective of Sat4Farming (Satellites for Farming) was to assist smallholder cocoa farmers in Ghana with Farm Development Plans (FDPs) aiming at 10-40% increase in yields, income and more effective use of inputs. Sat4Farming operates a business-to-business (B2B) model with aggregators (cocoa traders/cooperatives) as customers. Field agents from aggregators are the users of the service and the beneficiaries of the service are smallholder cocoa farmers and their families.

Sat4Farming provides precision agriculture services supported by a technology platform, where first the pre-FDP farm condition is assessed (physical features, land classification, soil condition, plant condition), then an FDP is formulated (application of good agricultural practices (GAPs), soil management, replanting), followed by the monitoring of changes in the condition of the farm (changes in soil condition, changes in tree architecture/health, changes in farm yield, changes in input efficiency).

Sat4Farming was carried out by a consortium,

consisting of Rainforest Alliance (an NGO with representation in Ghana and main office in the Netherlands), Grameen Foundation (an NGO with representation in Ghana and main office in the US), Touton S.A. (a commodity trader based in Ghana and main office in France), the University of Ghana and Satellintelligence and Auxfin (both based in the Netherlands and providers of geodata-based services).

Provided Services

The core of the service developed under the Sat4Farming project is called FarmGrow. FarmGrow is a Farm Development Plan (FDP), which is an intense multi-year plan established per farm which benefits the farm household and combines advice with one-on-one coaching of farmers by extension workers that increases the cocoa yield from 450 kg per hectare to 1,500 kg per hectare over time.

Touton S.A. acted as a pilot customer of the service. Touton provided farmer lists from which farmers were selected and profiled that were eligible to receive the FarmGrow service. The selection criteria concerned

the capacity and commitment of the farmer to follow the recommendations, the history of the farm and the (possible) certification of the cocoa from the farm. These criteria were also applied to new customers, such as Cargill and Beyond Beans.

The field staff visited the communities of selected farmers to raise awareness with respect to FarmGrow. The FarmGrow process starts with household and farm profiles, an outline of the plan and a profit and loss calculation. Once farmers agree with the plan, the coaching trajectory formally starts. After every coaching session, the adoption observations of the plan are scored again, and recommendations will be given to farmers. All this is filed and monitored electronically.

The FDP process is very labour intensive, therefore also a light version exists for farmers, who are unable to afford the investment in replanting and/or fertiliser. Several applications based on geodata were developed to support FarmGrow, such as a deforestation and canopy alert service, a drone-based cocoa monitoring service, a black pod disease alert model, a cocoa yield estimation model and a soil moisture input credit insurance scheme, but none of them resulted in a viable business case (although this may happen at a later stage in a different environment).

Business Model

Rainforest Alliance is the business owner of FarmGrow. Commodity traders and food processors are the envisaged clients, while the cocoa smallholder farmers are the beneficiaries. The revenue model is a combination of pay-per-use and subscription options. The estimated price is US\$ 5 per farmer.

Although new customers were onboarded, the returns do not cover the costs. FarmGrow is projected to play a role in Resource Alliance's certification programme, by integrating it into its Farm Intelligence application. Adding of financial services is considered.

Scaling up of FarmGrow is the main challenge.

Impact

Sat4Farming resulted in improved income for farmers, increased loyalty from farmers to trader and more volume capture (more cocoa to trade). However, as the FDPs require investment by farmers which affect income negatively in the first years, the achievements measured within the project period are not a clear indication of long-term success.

The biggest achievement, however, is the strong traction generated around FarmGrow, the internal buy-in at Rainforest Alliance and the onboarding of new customers.

The emphasis of Sat4Farming was on the more professional farmers that are ready and motivated to work towards replanting. This is the 'top of the pyramid' which makes up 10% of all cocoa farmers (about 450,000 farmers maximum). Rainforest Alliance will further develop and enhance FarmGrow by offering a light version to farmers, who cannot afford to make the necessary investments. There are also plans to expand to the coffee and tea sector.

17,000 farmers
pilot farmers selected

Yield increase from **350** kg/ha
to **390** kg/ha cocoa reported

3 clients
onboarded across Ghana

7,000 FarmGrow plans
being implemented

>18,000
hectares covered

36% improvement in pest,
disease and sanitation practices

**Numbers are approximations based on M&E results.*



Sat4Rice

Financially sustainable information services for rice crop management

2015- 2018

Vietnam
(Mekong Delta)



The Mekong Delta in Vietnam is one of the largest rice producing regions in the world. Rice producers in this region, mostly smallholder farmers, struggle to maintain a sustainable rice production due to different factors, including climate change. This affects both the quality and quantity of rice harvests. The Sat4Rice (Satellite data for Rice) project aimed to improve rice production in the Mekong Delta, by providing satellite data driven information services. These information services increase the effectiveness of extension services to smallholder rice farmers.

Extension workers of the Loc Troi Group (LTG), so-called “Farmer Friends”, are provided with near real-time data on production, inputs and environmental factors. Satellite data and field observations are integrated in a geodata platform and are accessible through a browser-based smartphone app. The extension workers transfer the information and knowledge to the farmers to raise awareness, build resilience of local communities and improve the efficiency of inputs for rice production in the Mekong Delta, such as water, fertiliser and pesticides.

The project was carried by a consortium with Loi Troi Group (a Vietnamese agricultural input and trade company), Can Tho University, local public partners, Nelen & Schuurmans (a Dutch geo-IT company, specialised in water management) and SarVision (a Dutch remote sensing company, specialised in radar).

Provided Services

The key users of Sat4Rice services are the Loc Troi Farmer Friends. They connect with contract farmers on a weekly basis and provide training on agricultural practices. In the Sat4Rice project they advise the rice farmers in the Mekong Delta, using a smartphone application that connects to geodata platform based on satellite data. This smartphone compatible web app is also used to collect field data and upload it to the platform to improve the quality of the information.

The services offered relate to the determination of general field characteristics, monitoring of rice growth status and monitoring of pest and diseases.

The project went through a thorough design trajectory based on user requirements and feedback, optimisation of data flows and the selection of hardware infrastructure (provided by Nelen & Schuurmans and SarVision). One of the aims was to minimise technical and organisational complexity, which led to the use of existing technologies and organisational structures, i.e. the Farmer Friends of Loc Troi, who were already familiar with the use of smartphones. A downside of this approach is that of interaction with farmers is limited to the visits of the extension agents.

The role of Earth observation changed throughout the project and shifted towards crop monitoring and pests and diseases monitoring, which are mainly based on the use of Sentinel data. The originally envisaged service on early warning for pests and diseases and early warning for floods had to be abandoned because insufficient data was available or data acquisition was too expensive.

Business Model

The Sat4Rice business case uses an inclusive business model, i.e. Loc Troi Group is paying for service provision based on an internal business case. This arrangement makes Loc Troi the client and Nelen & Schuurmans and SarVision the business owners.

In addition business-to-consumer (B2C) and/or business-to-business (B2B) models can be applied to other customers. There are three distinct types of value propositions: optimisation of the rice production chain, pest control and rice quality control. The overview of rice production over time offers additional benefits to LTG for logistics and financial planning.

Impact

A system was set up with innovative services for rice crop monitoring and pests and diseases monitoring,



embedded in a local organisation (Loc Troi). Through this arrangement contract farmers and extension officers, including those of the Vietnamese Department of Agriculture and Rural Development, could be reached and trained.

To capitalise on this, the continued support of Loc Troi is a necessary condition for success and further expansion in Vietnam, but this stopped in 2019. Initiatives with potential clients in Vietnam have not led (yet) to concrete results. Outside Vietnam, a pilot with Sat4Rice services was conducted in Pakistan, but did not receive a follow-up. The dependence on extension officers may have been a strong point of Sat4Rice as a project, but could be a less appropriate model when trying to develop Sat4Rice as a business.

The project showed that the creation of a data infrastructure and information on crop monitoring provides more added value for policy development and extension planning than it benefits individual small farmers. The options are therefore to focus on government organisations as potential clients and/or add more functionalities, e.g. early warning and weather forecasts, to make it more interesting for agribusinesses and to reach farmers more directly.



**Numbers are approximations based on M&E results.*



SIKIA

SAGCOT Integrated Knowledge and Information for Agriculture

2016- 2020



The SAGCOT Integrated Knowledge and Information for Agriculture project (SIKIA) aimed at improving the livelihoods of smallholder farmers in the rice value chain in the SAGCOT area. SAGCOT stands for the Southern Agricultural Growth Corridor of Tanzania. Radio broadcasts inform smallholder farmers about weather conditions, while giving them the opportunity to register for reception of more specific services. These services range from growth stage-specific weather forecasts to agricultural advice. Agribusinesses can subscribe to SIKIA's Spatiotemporal Agribusiness Framework (SAF) to market their services to farmers and to receive information on farms and their operations.

The project was carried out by TechForce Innovations (a consultancy firm from the Netherlands and the project lead), the Alliance for Green Revolution in Africa (AGRA, with headquarters in Kenya), Kilimo Trust (an NGO with a branch in Tanzania), and Milan Innovincy (a agricultural consultancy from the Netherlands). Kadaster International provided insights on measuring plots with GPS.

For the development of several technical elements of the services different specialised companies were contracted.

Provided Services

Three services are offered by SIKIA: plot-specific crop advice, agribusiness support and agronomic advice. Plot-specific crop advice makes use of a combination of plot maps, processed and analysed radar satellite data and information on planting dates. The agribusiness support service links agribusinesses to the registered farmers in the SAF-platform and allows them to see the crop growth status and the weather forecasts of their areas of interest. The agronomic advice service sends weather forecasts twice a week to the registered farmers. The services were developed by making use of demonstration plots.

The SAF-platform is the core of the service provision. Farmers register themselves to the platform. This enables them to get different types of crop advice for free, e.g. the weather forecasts. Those that sign up for the extended service receive more detailed weather information, advice on good agricultural practices

and crop management, and market information. The agribusinesses that are connected to the platform are also paying customers. To serve these businesses a product was developed that gives near real-time information on the growth cycle of rice (every six days) and a prediction of crop growth in the next three weeks. This information is based on an analysis of different types of satellite data. Satellite data is also used as input for the weather forecasts.

The information is transmitted through phone text messages, but also by extension workers.

Business Model

The revenue model is based on farmers, who pay for detailed advice, and agribusinesses that pay for access to information and intelligence. This model has not yet delivered the desired results in terms of revenue generation. Milan Innovincy is the business owner and aims to license the use of the service to other providers. To attract more agribusinesses as clients, a cooperation with an organisation called Mbeya Rice Group was established.

Impact

SIKIA has developed a sound technical concept to support farmers in developing countries with digital advice. After the end of the project SIKIA continued to attract more Tanzanian rice farmers to its services. SIKIA also plans to add other services, such as the provision



of micro-credits. There are plans to expand to Kenya (avocado) and Mozambique (cashew).

Business development remains a weak point for SIKIA. The number of farmers that make use of the services is lower than the target. It must be noted that the COVID-pandemic affected the results negatively. Still, it can be concluded that finding a sustainable business model should have been given more priority from the start of the project.

As SIKIA offers novel and innovative agricultural advisory services to farmers and agribusinesses with a clear added value, there are possibilities to create a sustainable business. A closer cooperation with the Tanzanian government in the framework of supporting national agricultural policy is one of the options.

35% of the trained farmers were female

60% of the trained farmers are estimated to have improved their farm operations

Approximately **32,000** farmers are registered to the service and receive weather information

> 400 agri-businesses are registered in the Spatiotemporal Agribusiness Framework system and linked to farmers

5,000 farmers were trained on good agricultural practices, post-harvest handling and farmers' business

**Numbers are approximations based on M&E results.*



SMARTseeds

Improving production, income and food security of vegetable farmers in Indonesia 2016- 2020



The objective of SMARTseeds (information services for sustainable vegetable farm management) was to implement a financially sustainable information service that supports vegetable farmers to increase productivity, income, food security, and optimise the inputs of water, fertiliser, and pesticides. Utilising geodata and remote sensing technology, SMARTseeds provides location-specific information to farmers delivered via mobile app. Geodata is also an essential component of business-to-business services via the SMARTseeds geodata intelligence dashboard.

The services are provided for chilli, tomato and cucumber in the Indonesian provinces East Java, Central Java and Lampung. After the project ended, the services expanded to new regions, such as Sumatra and Eastern Indonesia, and new crops, such as onions and potatoes.

The project lead was ICCO Cooperation South East Asia, now part of Cordaid (Netherlands), supported by Indonesian partners Bogor Agricultural University (IPB), PT East West Seeds Indonesia (EWINDO), and Dutch partners Akvo, a data

solutions organisation, Nelen & Schuurmans, an IT company, and the Faculty ITC of the University of Twente.

Provided Services

The location-specific information services that SMARTseeds provide are: soil and fertiliser advice, weather forecasts, farm profiles, digital information on good agricultural practices, and pests and diseases advice. In addition, SMARTseeds offers a digital marketplace for vegetables, daily information on prices and the opportunity for online consultation with agricultural experts. In addition, an irrigation advice feature helps farmers to use water more efficiently.

The services are delivered through a mobile app called SIPINDO.

The SMARTseeds Geodata Intelligence Dashboard provides businesses with vegetable maps based on satellite imagery, weather and forecast maps, soil profiles maps, regional daily vegetables price information, farm and farmer profiles and road access maps. These services run on the Lizard platform of Nelen

& Schuurmans. Earth observation is used for vegetable mapping and, to a lesser extent, for the weather forecasts.

Business Model

SMARTseeds operates a freemium business model for farmers. Most of the services provided in the SIPINDO app are free, while some features, such as chatting with experts, are made premium. Free users can subscribe to a premium membership for € 10 per year or € 1 per month.

For businesses an inclusive and loyalty business model is used: vegetable buyers, agri-input suppliers and distributors, micro-finance institutions (MFIs) and fintech providers, the government, NGOs, and education and/or research institutions have access to the digital infrastructure for use by the farmers in their networks. SMARTseeds charges a fee for every farmer member that uses the app and receives the information services. The dashboard is currently on a trial period with the first paying customer, the EWINDO commercial team. The SMARTseeds information service is owned and operated by a spin-off social enterprise named SIPINDO of which ICCO, EWINDO, IPB, and Nelen & Schuurmans are the founding partners. EWINDO is responsible for marketing and reaching out to paying customers. Although there is a willingness to pay, meeting the quality level expected by potential customers is still a challenge.

Impact

The biggest achievement of SMARTseeds is giving farmers easy access to reliable information, which

normally would be difficult to get for them. The demonstration farms show clear positive results, but the services need to be improved and made easier for farmers to understand to really make an impact. To achieve this the digital services need to be supported by stimulating farmers' communities of practice and to work on continuous improvement of the services and communication with the farmers.

For example, users expressed that the SMARTseeds fertiliser advice was useful but is only applicable under ideal conditions (i.e. with ideal soil conditions, ideal seedlings, and in ideal areas that are relatively free from pests and diseases).

On the positive side, the SMARTseeds endline survey showed that by following the advice from the SMARTseeds information services, farmers have seen an average increase in productivity and an increase in efficiency of water use. Moreover, by having access to the weather forecasts of SMARTseeds, farmers are able to better plan their planting and mitigate the risks of harvest failure. This has led to increased resilience and food security in the communities.

SIPINDO develops new services, such as fertiliser recommendations for rice and maize and expands to new areas. SIPINDO improves the design and display of the app and the pests and diseases database. SIPINDO engages with more than 50 organisations and companies in Indonesia, e.g. cooperation with third parties to use machine learning for detecting pests and diseases with image recognition.



**Numbers are approximations based on M&E results.*



SpiceUp

Improving productivity of Indonesian pepper farmers

2018- 2022



SpiceUp (Geodata for Sustainable Pepper Farming in Indonesia) aimed to create a commercially sustainable information service (mobile app) that helps pepper farmers boost their productivity, revenue, and food security, while optimising their water, fertiliser and pesticide inputs by the use of geodata. In addition to the mobile app, SpiceUp also developed a business-to-business (B2B) information management tool to improve transparency in the supply chain, reduce environmental impact and to support all stakeholders with data for their decision-making.

The project was carried out in the Indonesian provinces Bangka Belitung, Lampung and West Kalimantan.

The project lead, Verstegen Spices & Sauces BV from the Netherlands, owns and hosts the service with support from public-private Dutch and Indonesian partners.

Provided Services

SpiceUp comprises the following services with farmer specific information: weather information, soil moisture

information, market information (on current pepper prices), crop calendar tasks, a fertiliser calculator, extreme weather early warning (on drought and heavy rains), and pests and diseases early warning.

The weather information, soil moisture information, and market information in the application are directly sampled for each of the farmers individually from the sources in the data infrastructure (called Lizard). The crop calendar tasks and warning-based tasks related to geospatial data are derived from specific algorithms. These algorithms use data sources in the data infrastructure, sampled on a farmer's location, and taking predefined variables as input. Based on these samples, Lizard calculates and defines which task should be given to the farmer and communicates this through an API.

The weather information, soil moisture information, and market information give the farmer insight into the current situation of their farm. The fertiliser calculator helps the farmer to quantify the suitable amount of fertiliser for their crop. The crop calendar tasks and warning-based tasks (both derived from geospatial data and reporting) give the farmer concrete advice on which actions they need to perform. When a farmer reports

a pest or a disease, the data is stored and processed to issue warnings (pest/disease hotspot) to other farmers in the neighbourhood. Farmers also use the app to receive regular advice on good agricultural practices and to receive information on pepper market prices.

As a business-to-business service, SpiceUp designed a traceability system for pepper processors and pepper buyers, to tag every spice with detailed information on its journey from farm to table. In addition, SpiceUp provides management information for businesses to track farmer transactions, use of agricultural inputs, reported pests and diseases, and climatological risks.

Apart from the mobile app, SpiceUp also makes use of extension workers and social media as communication channels.

Demonstration plots of 0.2 hectare were established on farms owned by selected pepper farmers to apply the advice from the SpiceUp app and show the added value.

Although geodata plays a substantial role in SpiceUp, the use of Earth observation is limited. The soil moisture service that is based on satellite data turned out to be too costly for the intended use and the target farmers.

Business Model

SpiceUp is still exploring the options for generating revenue and the optimal business models. For farmers a subscription or freemium model seems the most appropriate and other revenue can be generated

through advertising and selling data and insights to food processors, dealers, NGOs, etc.

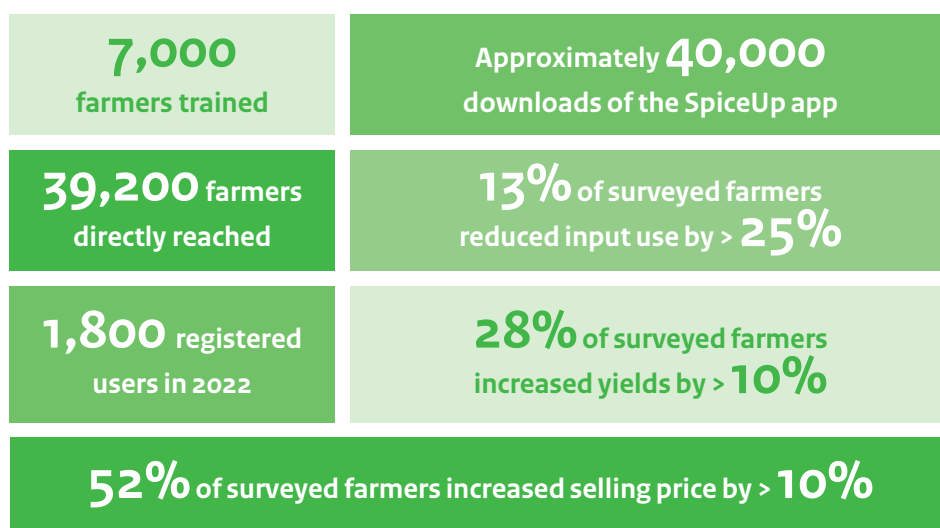
With Verstegen there is a business owner with a strong commitment to continue with service delivery, currently paying for maintenance of the service. Verstegen has an excellent brand name, a good corporate social responsibility practice and a strong local network. Other core partners of the consortium, such as ICCO (now Cordaid), Nelen & Schuurmans and IPB (Bogor Agricultural University) have expressed their support as well.

Impact

SpiceUp engaged in numerous outreach activities, including a television appearance, roadshows and webinars. Partnerships with ministries, local government and agribusinesses are established. SpiceUp has contributed significantly to awareness raising about the adoption of agricultural technology through digital marketing.

Although farmer retention is moderate, those who kept the app reported positive results. SpiceUp worked hard on making the app less complicated and introducing less features simultaneously to make the services more attractive. The need for direct personal advice and limited connectivity are still constraints.

Expanding to other crops and bundling with other services or existing services are identified as possible avenues to increase the impact of SpiceUp.



**Numbers are approximations based on M&E results.*



STAMP

Sustainable Technology Adaptation for Mali's Pastoralists

2015- 2019



The STAMP (Sustainable Technology Adaptation for Mali's Pastoralists) project aims to improve resilience among pastoralists affected by climate change, through access to and use of data derived from satellites. The result is a service that is tailor-made for pastoralists' information- and decision making needs, giving them a predictive analytics tool for guiding their movements. Subscribers receive the information via a call centre.

The project was carried out by SNV Netherlands Development Organisation (Mali), Action Against Hunger (an NGO from Spain), Institut d'Economie Rurale (Mali), ORANGE Mali (a telecom provider), Tassaght (an NGO from Mali), Project Concern International (a development organisation with headquarters in the US) and Hoefsloot Spatial Solutions (a remote sensing company based in the Netherlands).

Provided Services

The idea behind the service is that a combination of indigenous knowledge and remote sensing data is a critical input for pastoralist's migration decisions. The service package has the brand name Garbal and offers

information on biomass availability, biomass quality (based on the satellite derived normalised difference vegetation index NDVI), surface water availability, herd concentration, and market prices for livestock and staple grains along the different transhumance routes.

The algorithms for Garbal process satellite and field data into advisory information. The satellite data used are Meteosat, Proba-V and Sentinel-2. During the project the resolution of the biomass and surface water data was increased to 10 metres by 10 metres. The data was enriched with participatory mapping carried out in cooperation with the communities, to exclude the cultivated zones in the grazing areas. This helps to avoid conflicts between pastoralists and sedentary farmers. The in situ data collection is a time-consuming exercise, which has to be repeated every season.

An application with a web viewer was made available to the call centre operators. ORANGE Mali developed an application for collecting data by pastoralists. In addition, methodologies were designed to enrich this application with indigenous knowledge of the pastoralists. The combination and quality control of the various data ensure an 98% accuracy, according to the users surveyed.

The pastoralists can access the Garbal services with simple cell phones through the call centre or they can send USSD requests. They then instantly obtain decision-making support information in their local language of choice. The STAMP project contracted data collectors, trained call operators and sales agents, and developed training material for data collection, validation and use to make the Garbal service operational and of good quality. Face-to-face meetings, word-of-mouth, social media and campaigns of another agricultural service of ORANGE Mali, called M-Agri, were used to raise awareness about the service.



Business Model

ORANGE Mali is the business owner of the Garbal service. Together with other partners service provision is continued in combination with a strategy to mobilise sufficient revenue. The conditions in Mali are currently not favourable for operating the service on a commercial basis. Still, it was convincingly demonstrated that the service provides a high societal value and that the business model of charging for calls in combination with a call centre operated by a mobile network operator is sound. Without the funding of the G4AW Facility this could not have been realised, because the risks involved are too high.

Thanks to this societal relevance, STAMP received support from the Netherlands Embassy in Mali to continue and improve the service after the end of the project and to scale up to other regions in Mali. There are plans to expand the service further to other pastoralist regions in sub-Saharan Africa.

Mali and reduced connectivity due to conflict, 95% of users find Garbal easy to use and more than 90% reported to have made different decisions based on the information received via Garbal.

The involvement of local leaders as service ambassadors during the awareness sessions contributed greatly to the credibility of Garbal and showed the importance of word-of-mouth promotion. Addition of information on market prices helps the delivery of services throughout the year and reduces the seasonality effect of having demand only when the dry season progresses and having interest waning off during the rest of the year.

Through an excellent communication campaign STAMP got attention from international organisations and governments in the Sahel region (Benin, Cameroon, Togo, Senegal, Niger, Chad and Mauritania). The cooperation with ORANGE Mali also provides opportunities of expansion. A good example is the introduction of the Garbal service in Burkina Faso through the G4AW-project MODHEM.

Impact

Garbal has demonstrated to be a useful service for pastoralists. Despite the limited network coverage in

> **55,000** active users
of the Garbal service

> **7,000** people trained (of
which 11% were women)

Approximately **288,000**
food producers reached

User satisfaction was **95%**
(from an evaluation
conducted with 400 people)

**Numbers are approximations based on M&E results.*



SUM Africa

Transforming Africa's food system through insurance products

2014- 2018



Drought and excessive rainfall are the two largest causes of crop loss in Africa, keeping farmers stuck in poverty. Insurance can help farmers to escape this poverty trap. Insurance coverage can also enable farmers to obtain access to credit and invest in agricultural inputs, which leads to higher production and income. The SUM Africa (Scaling Up Micro-insurance in Africa) project aimed at scaling up low-cost and large-scale index insurance against drought and excessive precipitation. The project was carried out by a consortium led by the Dutch remote sensing company EARS, which was later acquired by eLEAF. The activities took place in two African countries: Uganda and Mali.

The services were offered for different crops. In Uganda, for example, farmers had access to insurance for coffee, maize, and beans, as well as a generic drought index insurance.

Provided Services

The services are based on the processing of Meteosat visible and thermal infrared hourly satellite data to daily actual, potential and relative evapotranspiration (RE). Time series of the RE data, as well as from the CHIRPS semi-global precipitation dataset, are then extracted

for the target countries and serve as the basis for the drought and excessive precipitation index coverage. The next step is the design of the index structure, which includes the phasing of the growing season and the determination of the start of season trigger and pay-out conditions. Then a historic simulation is done of the pay-out for all locations as a function of the various index insurance settings and parameters, leading to a burning cost and risk premium. After that, the design of the product is presented to the partners and the re-insurer for evaluation and pricing and a finetuning based on field information and the needs of the local partners. The use of satellite data is essential for the initiative's success.

An online platform for operators is available, where index time series as well as current season values can be viewed. The design and monitoring process are automated as much as possible.

Business Model

The SUM-Africa project succeeded in creating a sustainable business case in Uganda, with continued operations after the end of the project. In Mali it proved much harder to develop a viable business case due to lack of government support and safety issues.

eLEAF provides their services as business-to-business (B2B) to local insurance companies, agribusinesses, farmers' organizations, and financial institutions, who deliver the insurance products to farmers in a business-to-consumer (B2C) model. In this way the local insurance partners are the business owners, while eLEAF provides the index design and monitoring services that make it possible for the insurers to offer insurance policies and manage an agricultural insurance portfolio.

Impact

The SUM Africa project has proven that when the right conditions are created, i.e. government support and a safe operating environment, there is a market for drought and excessive rainfall index insurance products based on satellite data.

In Uganda, more than 70,000 insurance policies were sold in the last year of the project and sales have continued to scale up since the project end. In 2022 alone around 250,000 weather index insurance policies were sold, protecting well over a million farmers in rural parts of Uganda. The Ugandan Government subsidises the insurance policies with 50% for smallholder farmers and even up to 80% in high-risk areas.

The years 2021 and 2022 have seen a lot of pay-outs due to extreme weather conditions. The multi-year loss ratio of the AgroConsortium is currently around 40%, which means that on average around 80% of all premiums paid by the farmers have been used to compensate farmers who experienced crop losses.

In Mali activities were unfortunately discontinued, because there was insufficient interest in uptake of



the insurance based on the activities developed during the project period. However, there have been various spin-off activities developed in several countries during and following the project period, including Burkina Faso, Senegal, Cameroon and Mozambique. Ultimately, eLEAF and its SUM Africa partners have managed to operationalise and commercialise a highly impact oriented business, protecting an increasing number of farmers in Africa today and tomorrow.

67.000 policies
sold in 2019

250,000 policies
sold in 2022

Commercial spin-offs in
5 African countries

80%
of farmer-paid premium used
for pay-outs

**Numbers are approximations based on M&E results.*

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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.

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G4AW

GEODATA FOR AGRICULTURE AND WATER

Netherlands
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Netherlands

