Case Study

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Case Study: Crop Observation, Management & Production Analysis Services System Project March 2021

The project rationale is to develop a system, which is independent of the major agri-businesses, that is transparent and benefits all stakeholders.

COMPASS - Agricultural Innovation in Mexico and Argentina

Executive Summary with Key Insights

The Crop Observation, Management and Production Analysis Services System (COMPASS) uses satellite Earth observation (EO) data to help smallholder farmers manage their sugar cane, maize and wheat agriculture. It helps optimise crop productivity by identifying factors that cause the yield gap between crop potential and actual field performance. It also provides agronomic support to advisory services, agribusiness, farmer co-operatives, crop insurers and governments. The service is offered through a free mobile application for the farmers and a dashboard for the supply chain users.

The system uses Sentinel-2 EO data, with a 10-metre resolution and a five-day revisit period, which makes it ideal for monitoring crop yield. The EO data is combined with 30 site-specific parameters grouped by soil, management, inputs and environment that determine the production efficiency of wheat and sugar cane crops, e.g. soil type, harvest date, disease control and temperature. It assists the wheat, maize and sugarcane farmers to monitor their crop health every week with satellite and crop model data analysis and advises farmers of the potential gap in their crops forecast yield versus maximum potential yield, optimal sowing and irrigation dates.

It also provides a log of crop management activities and reminders from sowing until harvest. The farmers just require a mobile phone or desktop computer plus an internet connection and no other IT infrastructure is required to provide the technology.

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Project Overview

Wheat farming in the Yaqui Valley is at the forefront of new technologies for wheat compared to other parts of the developing world, however, the area was hit by a fungal disease (Karnal bunt), and export profits suffered. The effect from droughts from 1996 to 2004, also contributed to an overall fall in income from agriculture in the Yaqui Valley of 40%. Average wheat yields are currently around 6.2 tonnes per hectare, with considerable variability from year to year. Annual profits from wheat production in the Yaqui Valley varied by 60% per tonne from 2009 to 2017, with a steady rise in the total cost of production over time. Better management practices by smallholder farmers for nitrogen application, irrigation and weeds would help to improve yields and productivity.

The Mexican sugarcane industry currently generates more than 930,000 direct jobs and employs another 2.2 million people indirectly, contributing a total of around US$2.5 billion a year to the Mexican economy. The average yield is currently close to 70 tonnes of cane per hectare however smallholder farmers have below average productivity partly because they have not adopted modern methods of agriculture. They are also threatened by drought (especially because of under-developed irrigation infrastructure), pests, disease and weeds.

During 2019 it was established that the project could be expanded into Argentina for Wheat and Maize and to include Maize in Mexico. The underlying premise for COMPASS remains the same but extending the crop type and location emphasises the ability for COMPASS to eventually have a global audience.

In response to these challenges, Rezatec has launched a free mobile application 'COMPASS' (Crop Observation, Management and Production Analysis Service System) aimed at helping wheat, maize and sugarcane smallholder farmers in Mexico; wheat and maize smallholder farmers in Argentina benefit from using Earth Observation (EO) satellite data within field measurements to manage production costs and support informed management to enhance crop yields. The ultimate aim is to ensure that farmer incomes become more stable, and therefore directly benefit farming families and rural communities, as well as addressing potential environmental issues.

The overall challenge for both the wheat & sugarcane sectors is to transform both traditional extensive as well as modern intensive systems into sustainable systems producing more crop output with better use of resources and this requires better management of the interacting parameters controlling yield.

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COMPASS is an IPP- UK Space Agency funded project started during Dec'16. The UK Space Agency's International Partnership Programme (IPP), funded by the Global Challenges Research Fund (GCRF), aims to deliver a measurable and sustainable economic or societal benefit to those in developing countries, through space-enabled Official Development Assistance (ODA) compliant programmes. Rezatec and the University of Nottingham in the UK, supported by Booker Tate, are working with CIMMYT and COLPOS in Mexico to help smallholder farmers growing sugar cane, wheat and maize to improve crop management and with INTA in Argentina. Farmers in both countries need to improve crop productivity and stabilise their incomes to facilitate rural community economic development. The technology developed by this 4½ -year project will use earth observation satellite data (including data from Sentinel) along with in-situ data captured with the farmers to help them identify factors that cause the yield gap between crop potential and actual field performance. The project will provide customer specific decision support tools to help growers, including smallholders, improve their technical, environmental and financial performance.

The project also aims to provide commercial information support, following trials, to advisory services, agribusiness, farmer co-operatives, crop insurers and irrigation bodies on water resources management.

For example, crop management in relation to global climate change is identified to be a major concern. One of the negative environmental impacts from unsustainable farming practises include wasteful water consumption. The COMPASS system aims to manage the water resources better for the farmers in the Yaqui Valley where the climatic change has been inconsistent, and availability of water resources are limited during the crop cycles where the farmers are only allowed to access 3 or 4 irrigation cycles irrespective of the demand raised in the Yaqui Valley, Northwest of Mexico.

Another example is that of sugarcane farmers where sugarcane is a perennial crop and is harvested and the plant allowed to create a new shoot or sprout from the base of the plant; this is called ratooning. However, each ratoon weakens the plant and the yield reduces. Understanding the reduction in potential yield against new planting will help the farmer calculate the benefit of re-planting after a number of ratoons. It is hoped that by providing this information, the farmers will be able to justify raising capital against future harvests.

The overall challenge for all crops is to transform both traditional extensive as well as modern intensive systems into sustainable systems producing more crop output with better use of resources. This requires better management of the interacting parameters controlling yield. There are about 30 site-specific parameters grouped by soil, management, inputs and environment that can determine the production efficiency of crops e.g. soil type, harvest date, disease control and temperature. The theoretical effect of these parameters on production is understood. However, there were no practical, evidence based, management decision tools that support smallholders and larger growers by targeting production efficiency per specific field.

Providing a management decision support tool, informed by satellite and other data sources that is both practical and affordable for smallholders with low levels of formal education, will help them make better crop decisions and thus benefit their incomes and farm development. COMPASS aims to provide this solution.

Earth Observation can be best applied to improve crop yield and farming efficiency by using the normalized difference vegetation index (NDVI) to monitor crop health. NDVI can be used to calibrate yield estimates, as well as to identify where crops may need farmers' attention due to crop stress.

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While a crop growth model can be used to predict the assumed growth of a crop based on the changing input variables, the actual growth, and potential yield, for any field may vary with time depending on the changing conditions impacting growth. Therefore, there may be a deviation in actual yield as opposed to estimated potential yield based on the crop-growth model. By inputting new time-series information into the crop growth during the growing cycle, this model can be used as a monitoring tool to observe the changing condition (health) of the crop, and therefore its potential yield.

Some earth observation datasets provide data highly suited to regular monitoring activities such as this, with revisit periods of less than a week (e.g. Sentinel 2). By regularly and dynamically updating the prediction of the crop growth model for each field with each new data acquisition that becomes available, the model can output an updated and more accurate crop yield estimate. By comparing the assumed growth (under normal conditions) and the actual growth, deviations between the two can be quantified. The spatial element of the earth-observation data would also allow for this to be conducted on a per-pixel basis, allowing the user to evaluate the changing spatial behaviour of the crop, showing field(s) where the deviation is occurring, potentially allowing for mitigation activities and an active monitoring procedure.

COMPASS targets to support Mexican Wheat, Maize & Sugarcane farmers and Wheat and Maize farmers in Argentina with crop management practise targeting the below UN SDG (Sustainability Development Goals):

Primary UN SDG targeted:

Secondary UN SDG targeted:

Project Partners

Rezatec and the University of Nottingham, supported by international partner Booker Tate, in the UK work with CIMMYT and COLPOS in Mexico and with INTA in Argentina helping smallholder farmers growing sugar cane, maize and wheat to improve crop management.

Lead Partner –
Rezatec Limited (UK)

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www.rezatec.com

Rezatec is an award winning and now well-established satellite data systems company specialising in earth observation to assist land managers, governments and insurance companies. For example, it combines satellite ground observation data with weather information by applying agro-meteorological and biophysical modelling to accurately forecast and optimise crop yields. Rezatec is developing a crop production management tool to address the biggest challenge in agriculture: producing more food sustainably with less resource. It provides analytical data products and decision support through a web-based platform designed to improve the technical, economic and environmental efficiency of production systems per crop, per field and per grower.

Particular areas of knowledge and expertise of Rezatec on this project include:

- Analysing earth observation data and combining this with other data sources through its platform to support management decision making
- Tailoring the user interface to different end users e.g. growers; processors; retailers; traders; advice, input and equipment providers; and government, so that the information provide to each meets their specific needs.

Partner – Booker Tate Ltd. (UK)

Booker Tate
Your reliable partner in a changing world

www.booker-tate.co.uk

Booker Tate has unrivalled international experience in the provision of Development, Management and Technical Services to sugar, ethanol, bioenergy and other agribusiness projects, having successfully completed 1,500 assignments in more than 100 countries over 50 years. In addition, TSB, Booker Tate's parent company, produces over 600,000 tonnes of sugar per year at its three sugar mills in South Africa. Booker Tate is dedicated to be a global leader in the provision of services to the sugar sector and agribusiness.

Booker-Tate's role in the project include:

- Capacity building, training & development
- Benchmarking and performance improvement
- Management and technical services: technical management, operational management, corporate management, client's representative
- Irrigation services: water resource and irrigation development
- Reconnaissance visits: pre-feasibility & feasibility development plans, strategic planning
- Due diligence studies for investors

Partner – University of Nottingham (UK)

The University of Nottingham

www.nottingham.ac.uk

The University of Nottingham has a research portfolio of over £300m, over 2,300 research projects and is 7th in the UK for research power and renowned for strong industry links. Research relevant to food security is UoN's priority and it has particular strengths in agriculture and crop science. UoN will lead the development, application and evaluation of crop models required in the project and participate in their integration into the COMPASS platform.

Particular areas of knowledge and expertise relevant to this proposal are:

- Crop physiology and sustainable agriculture
- Crop resource capture and use
- Modelling the growth of crops in response to their environment

Mexican Lead Partner – CIMMYT (Mexico)

CIMMYT
International Maize and Wheat Improvement Center

www.cimmyt.org/en/

The International Wheat and Maize Improvement Center (CIMMYT) prioritises research relevant to ensure global food security and decrease poverty through the use of new technologies and management knowledge to sustainably increase the food productivity.

The role of the international lead partner, CIMMYT are:

- Wheat Component Data Collection
- Maize Component Data Collection
- UAV imagery from Sugarcane component Data Collection
- Assist University of Nottingham on Crop Performance Gap Analysis
- Farmer Support Programme: organize workshops and seminars to wheat and maize growers aiming to disseminate the tool developed by the project

The contribution of CIMMYT to the project include:

- Leadership of the activities and management of the Wheat and Maize component of the project through the provision of staff time and resources
- Access free of charge to past experiments' database that may be useful to the project objectives

Partner – COLPOS (Mexico)

www.colpos.mx/wb/

The Colegio de Postgraduados is a Mexican public institution of higher education with international recognition that prepares students for a globally competitive world in which knowledge is the most important asset. It specialises in the generation, promotion and application of knowledge for the sustainable management of natural resources, production of nutritious and safe food and improving the quality of life of society.

Particular areas of knowledge and expertise relevant to this proposal are:

- Education, research and liaison with the business community
- Performing relevant knowledge-generating research for sustainable management of natural resources and the production of nutritious and safe food
- Improving the quality of life of society and providing input to academic activities through dissemination in the community

The role of COLPOS, Mexico:

- Data collection from sugarcane component
- Farmer Support Programme: supporting Booker Tate on the organization of workshops and seminars to sugarcane growers and mills to disseminate the tool.

Both CIMMYT and COLPOS have very close links to farming organisations, grower groups and sugar mills (COLPOS) in Mexico, which are used to recruit and engage farmers, smallholders and agribusinesses in the project.

Argentinian Lead Partner – INTA (Argentina)

www.inta.gob.ar

INTA contribute to the sustainable development of the agricultural, agri-food and agro-industrial sector through research and extension. They promote innovation and knowledge transfer for the growth of the country.

The role of the international lead partner, INTA is:

- Wheat Component Data Collection
- Maize Component Data Collection
- Assist University of Nottingham on Crop Performance Gap Analysis
- Farmer Support Programme: organize workshops and seminars to wheat and maize growers aiming to disseminate the tool developed by the project

Solution Development

Assessing user needs

As part of the Baseline evaluation study during the project's early stage, various farmers have been engaged on formal and informal interview to understand the real needs where COMPASS's objectives were identified. These interviews were held in various regions in Mexico where Sugarcane and Wheat is grown and closer to our International partners facilities. The questionnaires were related to current crop management activities, the technologies being used, in particular related to yield improvement/ resource input optimisation (fertiliser, water etc.)

In Argentina, the discovery phase of the project comprised interviews held very early on, and later via zoom (owing to Covid-19) with INTA and other local experts who had in-depth knowledge of the needs of the farmers. Argentinian farmers rely more on agronomists who support a number of farmers through unions with decisions, and the COMPASS tool was seen to be of greater use to the agronomists who would ultimately enter the data for the farmers and support implementation of the recommendations.

Design, build and testing of the solution, and iterating the design

The user needs have been collected through informal interviews via the farmers' association and through the network of international partners. The user needs interview was conducted by the international partners with the local farmers, such interviews, surveys and online (WhatsApp) group information gathered has helped the consortium to review the technical requirements necessary to adapt to the farmer's needs. The pilot farmers/ end users' feedback is collected periodically. For example, we have introduced an attractive and sophisticated user interface design on the initial versions of the mobile app and allowed the farmers to use and provide feedback during the follow up interviews during which most of the farmers with little digital literacy have found the app design as 'difficult to use'. This has helped our design teams to build a more robust, very user-friendly version 2.0 after approximately 6 iterations. The new version 2.0 also has a help section in every page of the app with some animation to assist any farmer with low digital literacy or poor education to understand and use the app effectively. We have capturedend users' feedback from a wide audience across the Yaqui Valley to further improve the app to suit a wider audience.

Further discussion during 2020 in fact led to a final app version 3.1 which was yet again enhanced to be easier to use and follow and included extra features which had not originally been planned.

Figure 1: COMPASS App. V2.0 with easy instructions on setting up field boundary

Figure 2: Help Section with a question mark symbol on every screen, to easily navigate through all options and features

Launch and Marketing

The app and its subsequent version releases are usually launched during Rezatec visits with farmers meetings organised at our partners facilities. One of our important version releases was V1.6 which was built with new improved features such as NDVI map of farmers' fields updated weekly using Sentinel 2 data, and availability of the app on the Android Google Play store. V1.6 was very popular amongst the Sugarcane and Wheat pilot farmers in Mexico and was launched at ForoGlobal Agroalimetario, the largest agro food tech forum held in Latin America every year attracting 40-50k visitors. The COMPASS Mobile App was originally launched in October 2018 in Puebla at an event where the President of Mexico was present. The presentation drew attention from a variety of potential stakeholders and the project was covered in the Mexican press which really helped to raise awareness of the COMPASS project.

The next step was to launch Version 2.0 of the app to 100+ farmers in Obregon, the irrigation District of Yaqui Valley and where the largest wheat farmers association, AOASS, has volunteered to support us organising the event with CIMMYT.

Due to Covid-19 all in country visits were stopped and a new solution had to be found. In October 2020 the first webinar was held which was supported not just in Mexico and Argentina but had a more global attendance, including New Zealand and the United States of America. The webinar was recorded and distributed to farmers via USB sticks through the in-country partners.

A further webinar was also hosted by the Mexican Government's National Committee for the Sustainable Development of Sugar Cane (CONADESUCA) which is a decentralized public body of the Federal Public Administration, the objective of CONADESUCA is to coordinate and carry out all activities provided for in the "Sustainable Development Law of the Sugar Cane "related to the sugar cane agribusiness. www.gob.mx/conadesuca. This webinar focussed on the "ingenios" (sugarcane refinery) managers. 40 managers took part, and a follow up post formal closure of the project is proposed in order to increase understanding of mill refinery requirements in the hope of finding a commercial user for the data.

Figure 3 LHS: A sugarcane farmer from Tabasco with COMPASS app v1.6. RHS: COMPASS presented to 5000+ audience at Global Agri-Food tech forum (FGA), the largest forum held in Latin America during Oct'18 at Puebla Mexico attracting 40,000 visitors around the globe.

Technical solution

The overall challenge for both all crops in both countries is to transform both traditional extensive as well as modern intensive systems into sustainable systems producing more crop output with better use of resources. This requires better management of the interacting parameters controlling yield. There are about 30 site-specific parameters grouped by soil, management, inputs and environment that can determine the production efficiency of crops e.g. soil type, harvest date, disease control and temperature. The theoretical effect of these parameters on production is understood. However, there are no practical, evidence based, management decision tools that support smallholders and larger growers by targeting production efficiency per specific field.

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Project innovations

The overall challenge for both the wheat, maize & sugarcane sectors is to transform both traditional extensive as well as modern intensive systems into sustainable systems producing more crop output with better use of resources and this requires better management of the interacting parameters controlling yield. In response to these challenges, Rezatec aims to launch a free mobile application aimed at helping wheat and sugarcane smallholder farmers in Mexico and wheat and maize farmers in Argentina, benefit from using Earth Observation (EO) satellite data within field measurements to reduce production costs and increase crop yields. The ultimate aim is to ensure that farmer incomes become more stable, and therefore directly benefit farming families and rural communities, as well as addressing potential environmental issues.

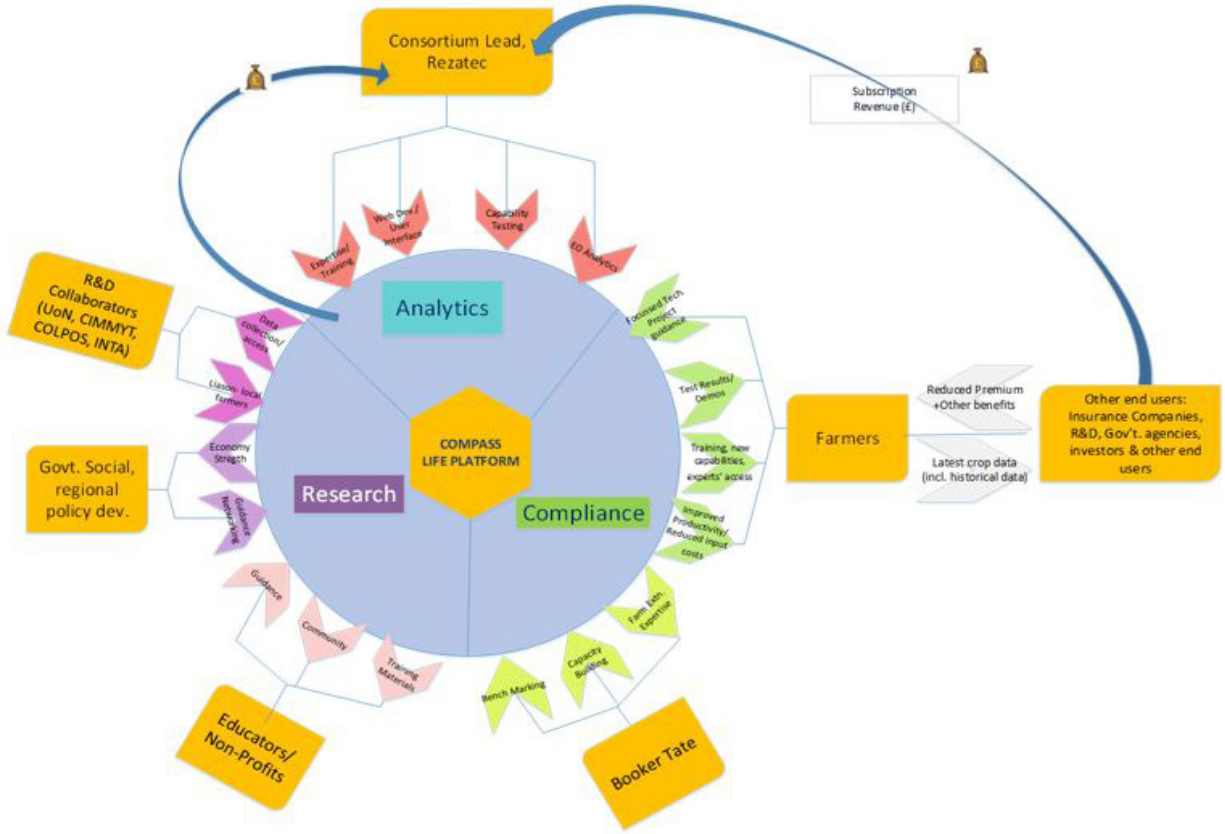

Figure 4: Projected value streams for the COMPASS project

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Sustainability Model

Users:

The main target users and customers of the COMPASS application included to realise the benefits are listed below with priorities:

1. Growers and farm extension services
- Crop productivity – improving smallholder and farmer crop management
- Environmental impact – reducing the negative impacts of crop production, targeted at both smallholders/farmers and government agencies

2. Supply chain users and growers
- Optimisation – improving coordination of harvesting and logistics by scheduling crops at the optimum development stage, targeted at both growers (to increase their incomes) and processors/logistics companies

3. Government bodies/Food Security Agencies/ Crop advisory services
- Crop monitoring at regional/national level – improving market function so that net producer prices increase, and the supply chain operates more effectively

4. Irrigation Bodies
- Irrigation district in Yaqui Valley- improving the supply/demand optimisation for wheat farmers within Yaqui valley. Water a valuable resource within this region and need for COMPASS app in managing the supply/demand between the irrigation district and the farmers (end users) is well acknowledged

5. Crop insurance companies
- Enabling insurers to target insurance payments at those farmers most affected by factors beyond their control (e.g. extreme weather) and thus reduce the premiums paid by farmers by securing supply chain and government support

6. Investment companies
- Helping the equipment and agribusiness sectors target their investments and hedge their risks

Commercial Model

Our commercial model for sustainability is based on deriving subscription revenue from Rezatec's Life Platform commercial service and its associated data products.

Life Platform is a software platform that allows Rezatec's customers to better respond to challenges presented to their land assets by environmental and climate change. It does this by collating data sourced from multiple satellites, incorporating ground-based data and other ancillary datasets, and processes the data against scientific models and algorithms to deliver commercial Earth Information data products, analysed and visualised using Geographic Information Tools, for non-science users.

Our commercial revenue streams are focussed on the following:

- A fee-based subscription model whereby commercial companies, government agencies and crop insurance providers pay for access to enhanced datasets, aggregated data and more detailed analysis than the basic free data which is made available to smallholders.
- The deployment of this business model to other developing countries growing wheat, maize and sugar cane to increase the viability and returns from using earth observation data to support smallholder farmers.
- Upon successful project implementation for wheat, maize and sugar cane crops, the extension of the COMPASS platform value proposition to cover additional areas and crops, such as soya bean and coffee in the adjacent territories e.g., Columbia and Mercosur countries (Argentina, Brazil, Paraguay).
- We have made the assumption that revenues delivered through usage of the COMPASS platform will increase progressively due to more data users accessing the platform, the availability of historic data and the utility of Life Platform specific decision-making tools.

- Revenue is also expected to derive from licensing fees from appointed distributors as the international expansion program rolls out. This network of distributors comprises of other data providers, precision agriculture consultants etc.

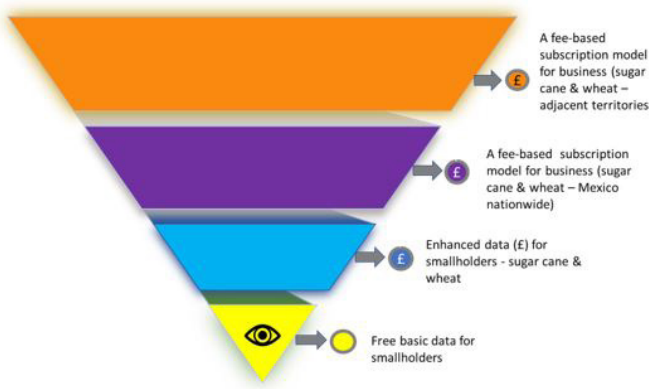

Figure 5: Rezatec COMPASS platform Revenue Pyramid

Commercial Model

Capacity building and training is critical to ensure on-going maintenance and evolution of the product.

Rezatec will develop and manage its own network of partners that will provide the personnel and services required in a software platform implementation. This approach will allow Rezatec to select the best partner for each role and function of an implementation. The involvement of internal managers, executives, and other internal personnel working closely with the selected partners will improve the quality of implementations and can reduce the risk of project failure.

Minimum Run and Maintain Cost

Rezatec believes that the minimum 'run and maintain' cost to keep the solution operating and generating impact can be achieved by securing at least 3 portal users. Rezatec already secured interests from three potential end users including as listed below prior to 2020 but the effect of Covid-19 has made it difficult to engage with those who had shown interest. However, it has been possible to engage with the Mexican Government's organisation CONDADESUCA and at the time of writing are the most likely conduit to finding a potential commercial customer within the target countries.

At the time of writing, Rezatec has secured exports and further sales opportunity pipeline. It is important to note that these figures are not derived from the countries where the COMPASS project has been active; they are from a developing country in another part of the world. They have however been derived from the refinement of the service/app initially developed as part of the COMPASS project which has been used as the 'proof of concept' for the new service. There is therefore a direct link (and causality) between COMPASS and this realised and potential export value.

This is a positive outcome for the project given that a key objective of the programme funding COMPASS is to increase the demand for space expertise from developing countries and, thereby, increase the level of exports from UK businesses in that sector.

Expansion Strategy

Beyond the grant funded project, the expansion strategy in terms of geography and product functionality will replicate, where applicable, the route to market practiced in Mexico. Expansion is anticipated to be phased as follows:

- 2021 onwards - commercial stage – insurance companies pay Rezatec for accessing data assets belonging to multiple farmers to assess farming practices and encourage usage of the platform in order to lower premiums. A key element is to offer a more compelling fee-based Data-as-a-Service (DaaS) capability that contains enhanced analytics. This phase will initiate an open marketplace for crop/agricultural land data and data services.

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The expansion of the Rezatec service into Central & South America wheat and sugar cane markets will magnify the development of the COMPASS platform. Expanding into new crops will forge new sales channels for Rezatec:

- The Latin American region is an important net exporter of food and agricultural commodities, accounting for 16% of total global food and agriculture exports and 4% of total food and agriculture imports. (Source: Latin America. Agricultural perspectives. Economic research by Rabobank).
- The region is one of the few parts of the world with significant resources of unexploited agricultural land (concentrated in Brazil and Argentina), suggesting the region will continue to play a pivotal role in global food production and exports in the future.
- Many of the region´s countries have achieved respectable rates of agricultural productivity growth in the recent past. Nevertheless, raising productivity will be essential to meet domestic food needs or to maintain or enhance export competitiveness.

Project Achievements

The technology developed by the project uses Earth Observation (EO) satellite data along with in-situ data captured by the farmers to help them identify factors that cause the yield gap between crop potential and actual field performance. COMPASS provides decision support tools to help growers, including smallholders, improve their technical, environmental and financial performance, delivered via a smartphone interface so that it is accessible even in areas with no fixed line broadband connectivity.

COMPASS also provides information of benefit to potential commercial users such as advisory services, agribusiness, farmer co-operatives, crop insurers and governments to create a long-term income stream to support Rezatec's provision of these services. Providing crop insurers with improved information allows lower cost crop insurance products to be developed, supported by government and industry, so farmers have access to low-cost income stabilisation tools.

Rezatec believes that following successful implementation of wheat crop monitoring in Mexico and expansion into Argentina it can find at a minimum a responsive market in Brazil and Argentina. The agriculture sector in Argentina is export oriented. Market Year 2016/17 features substantial year-on-year increases in planted acreage (from 34 to 36 M ha), the harvest of cereals (from 111 to 125 MMT) and grain and oilseed exports (from 82 to 93 MMT).

(Source: speech of Leandro Pierbattisti, a representative of Argentina's Federation of Elevators Association, XIV International Conference "Black Sea Grain, April 2017).

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The project has worked to directly engage the smallholders in project delivery, through collecting crop data and attending workshops, so that they are supported to develop their skills and learn about how satellite data can be used to improve crop management.

This international collaboration represents a new opportunity for the UK because:

- It takes UK developed technology using space data and applies it to new countries, Mexico & Argentina, and a new context, tracking crop growth performance for smallholders growing wheat, maize and sugar cane in developing countries
- Opens up new markets in Latin America for UK companies in an area with strong growth potential for the UK commercial and academic partners.

Headline outcomes and impacts of COMPASS are:

- 8,350+ have attended events including a presentation on the COMPASS project
- A fully functional app developed and in use by farmers at the end of March 2021
- Engagement with farmers by the international partners is set to continue during 2021 providing the prospect of an increase in the number of users of the app, which stood at 637 at the time of writing
- UK grantees have secured exports with further sales opportunity pipeline
- Five crop models developed
- Partners have gained significant expertise in the integration of satellite data with crop growth modelling techniques and the UK knowledge base in this field has been expanded considerably

Impact stories from end users and communities

The pilot user farmers have been interviewed periodically who have been using the app for the past two years approximately and have provided us with regular feedback. This allowed development of a user-friendly version built with functional features including irrigation schedule and sowing date recommendations which were not initially part of our project objectives. They were established upon several interviews held with the end users to understand the real requirements where the EO data and the crop model can be best utilised in combination with the weather data.

From discussions with in-country partners, further new generic features have also been added that are not crop dependent: automatic calculation of the size of each field in hectares on field entry; recording work carried out on a particular field was always a feature, however now the cost of that work can be recorded in any currency. After harvesting it is now possible to know the value of the crop harvested and how much it has cost to produce that (excluding labour), by field and by hectare.

Within the sugarcane industry, yield reduction at each ratoon was a statistic that the farmers could use as a support decision tool as to when it might be optimal to re-plant.

Farmer engagement

Farmers interest in the work was encouraging. Many were keen to discuss the irrigation and sowing date recommendations and they were interested in how they were made. Understandably doubts were expressed over making a change in established farming practices. Farmers were acutely aware of the financial risk of applying the recommendations at a whole field level and it was not surprising that many expressed an interest in testing the approach on sub-area of fields. Sugarcane farmers from Campeche are some of the highly enthusiastic group of farmers who have been highly engaged on feedback activities. The common functional feature which interested all these sugarcane regions is the NDVI access. Farmers interviewed expressed a need for an NDVI time series of their fields for historical comparison on field performances between the seasons.

Further farmer interviews held and led to the new functional feature which estimates the average yield loss with respect to the age of the ratoon cycles. This request was initially raised by farmers of Cordoba region (one of the three Sugarcane regions) and as said above, has been implemented.

Impact on gender equality

934 farmers have been engaged during our regular farmers meetings with the consortium and are represented by both genders. The COMPASS app, especially with the NDVI feature, did prove the impact on work life balance in particular with the female farmers. For example, during a farmers meeting held in Campeche female farmers that attended expressed how access to NDVI feature on the compass app reduces the need for accessing the remote farms more frequently to monitor the crop's status and this also helps mitigate the safety issue which they normally faced with field monitoring.

Conclusions

The COMPASS project achievements should be acknowledged as important contributions to the learning and use of digital technology in agriculture. The project partners have gained significant expertise in the integration of satellite data with crop growth modelling techniques and the UK knowledge base in this field has been expanded considerably.

A key feature of the project was the business model, designed to use the data collected to provide a commercial 'information-service' to customers such as farm advisory services, agribusiness, farmer co-operatives, crop insurers and governments. That service would create the income stream required to support Rezatec's provision of the app services to the farmers, free of charge. Rezatec has already secured exports, with a further sales opportunity pipeline.