FIELD TRIP TO PERU AND COLOMBIA

Report for the Douglas Bomford Trust

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INTRODUCTION

I am a PhD. student in Geography in Aberystwyth University as part of EO4cultivar, a four-year, international collaboration project between UK, Colombia and Peru, funded through the International Partnership Programme run by the UK Space Agency. My PhD. research aims to develop a method to identify anomalies within crop plots using satellite imagery.

Between May and July 2019, I carried out a series of field visits in Peru and Colombia, and the Douglas Bomford Trust supported my travel costs with £1180. The aims of the visits were to conduct fieldwork that contributed directly to PhD research, as well as to exchange knowledge with local partners regarding intelligent monitoring of crops using satellite earth observation. This report aims to present the main outcomes of these visits.

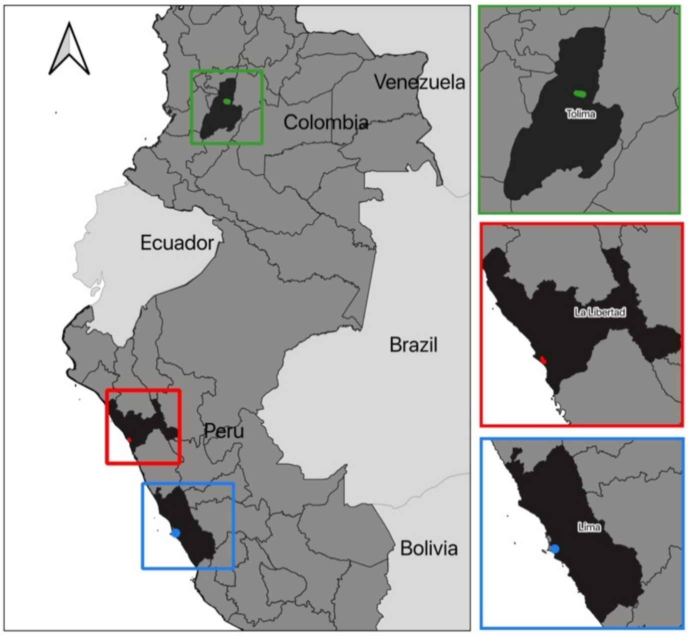

Figure 1.Visited locations

PERU

The visit in Peru was split into 2 locations: Trujillo and Lima. In Trujillo, I visited asparagus, peppers and cranberries plantations. In Lima I visited the Universidad Agraria de La Molina, and the Instituto Nacional de Innovación Agraria (INIA).

TRUJILLO

Trujillo is located in the region of La Libertad, northern Peru, one of the most important departments in Peru in terms of agroindustry. The farm[1] I visited had asparagus and peppers fields at different growth stages, mainly grown to export to USA and Europe. Having different ages crop plots is important to satisfy different market demands along the year.

Figure 2. Asparagus plots

Figure 3. Sun drying ripe peppers

[1] A farm is known as a "fundo" in Peru.

I held meetings with the plantation's agronomist and representatives of the Information and Technology department of the company. The aim was to identify how remote sensing derived data can support them to make informed decisions and to get to know the information platform that they are implementing.

Figure 4. Presentation of the 3 PhD. projects that are carried out as part of the EO4Cultivar project to the farm staff.

As part of the visit I took light interception measurements over asparagus crop plots using the LAI-2200C Plant Canopy Analyzer (See **Error! Reference source not found.**). The Leaf Area Index (LAI) retrieved from these measurements will be correlated with the normalized difference vegetation index (NDVI) derived from satellite imagery. **Error! Reference source not found.** shows the LAI for different phenological stages in the BBCH scale proposed by Feller, Richter, Smolders, & Wichura, (2012).

Figure 5. Taking light interception measurements using the LAI-2200C Plant Canopy Analyzer

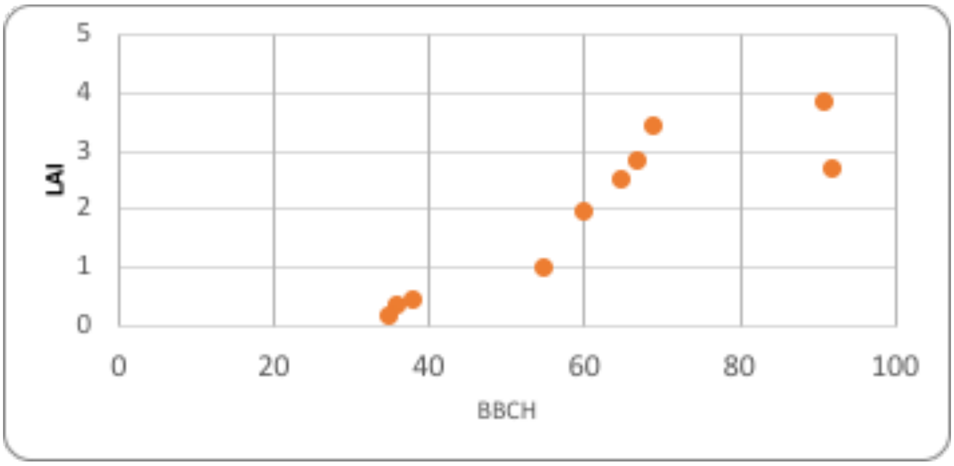

Figure 7. LAI for different phenological stages in asparagus

Figure 6. Farm employee using a mobile app to collect data about crop condition.

A drone with a multispectral camera was flown over one of the asparagus crop plots, so the drone NDVI images can later on be compared with those derived from the Sentinel-2 satellites. In addition, workers in the farm use an app to collect anomalies information in the field. These data go to a centralized database that I can access to relate the NDVI values derived from the satellite imagery and the findings in the field. After finishing the field visits, we agreed on keep sharing the findings of the research projects and delivering the information that was not currently available to me, especially the data related to field anomalies. Also, we will explore implementing the methods in other crops in addition to asparagus, such as peppers and cranberries.

Figure 8. IT department staff, a PhD. student from Stirling University and I at the end of the visit

LIMA

During my visit to Lima I had the opportunity to meet the professor Andres Casas at Universidad Nacional Agraria La Molina, a world expert in asparagus production. We discussed about the BBCH scale codification for asparagus proposed by Feller, Richter, Smolders, & Wichura, (2012).

I also visited the new facilities of the INIA laboratories. The new equipment included a chamber to simulate different climate conditions and study the impact of different climate change scenarios on different crops.

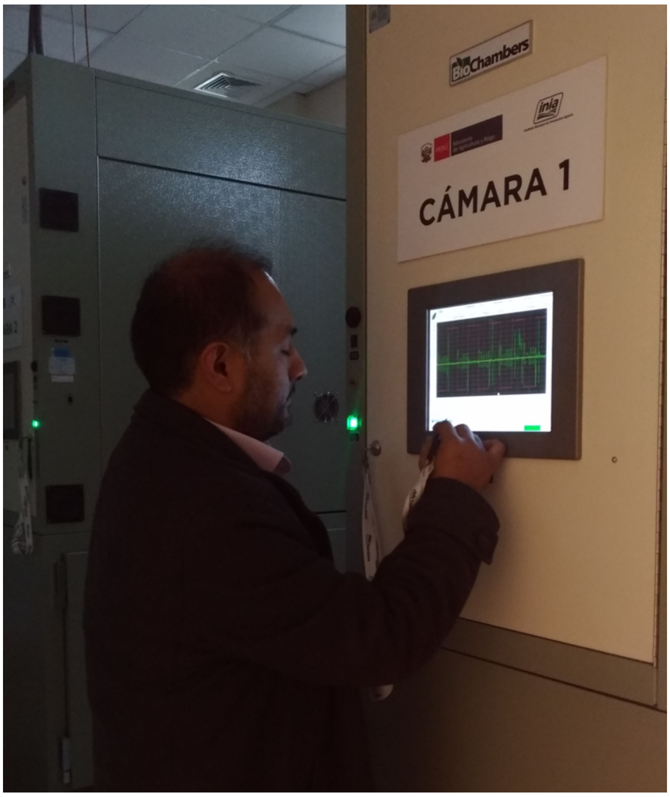

Figure 9. Chamber to simulate climate change conditions in the INIA labs.

COLOMBIA

I did three main activities in Colombia: Attending the Jornada de Actualización Internacional en Sistemas de Información de suelos, a field visit to rice and sugar cane in Ibagué, and a talk at the Universidad de Ibagué.

BOGOTÁ - JORNADA DE ACTUALIZACIÓN INTERNACIONAL EN SISTEMAS DE INFORMACIÓN DE SUELOS

This event was jointly organised by the Corporación Colombiana de Investigación Agropecuaria (AGROSAVIA) and the Korea – Latin America Food & Agriculture Cooperation Initiative (KoLFACI) in Bogotá. It was a three days event, in which experts from different soil related organizations such as FAO, the International Soil Reference and Information Centre (ISRIC), CIAT-CGIAR, AGROSAVIA and the Korean Rural Development Administration (RDA) presented the most recent experiences in soil information systems and soil digital mapping. The attendees came from the KoLFACI research institutes members in Paraguay, Honduras, Costa Rica, Guatemala, Colombia and Nicaragua. Experts from Colombian Institutions such as UPRA and the national Geographic Institute (IGAC) also attended the event.

The event comprised a visit to AGROSAVIA facilities, a tour around the soil laboratories, and a presentation about AGROSAVIA technological infrastructure to manage and analyse soil samples. As part of the visit, a soil characterization was carried out in a soil pit and a soil auger in two different locations in the "Sabana de Bogota" region.

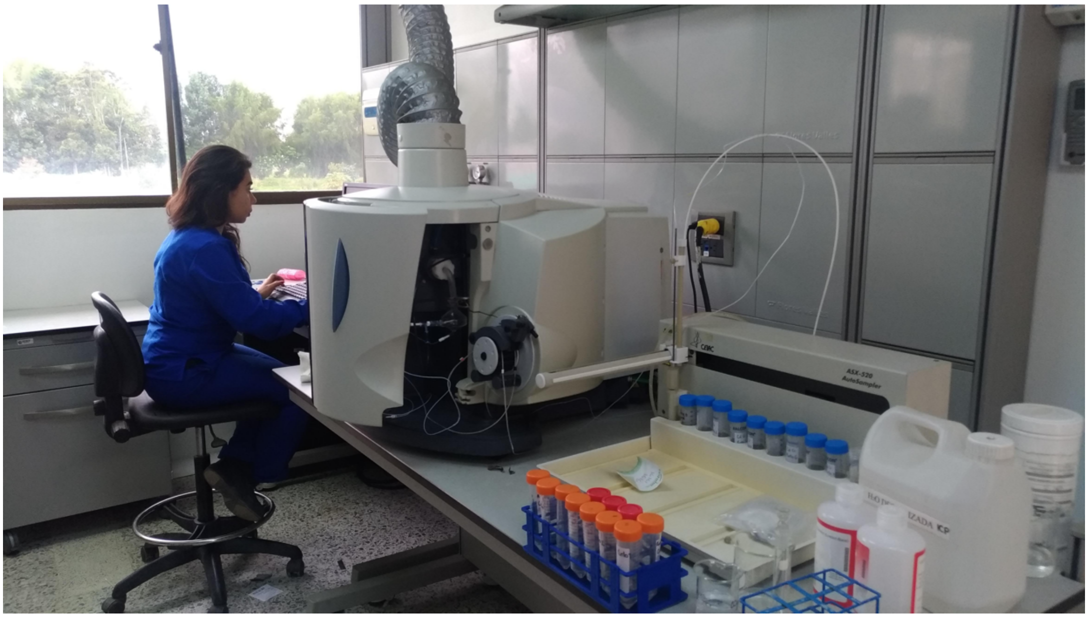

Figure 10. Soils laboratory facilities in AGROSAVIA

Figure 11. Soil experts from Colombia and Costa Rica characterizing soil properties in a soil pit as part of the event field visits

Figure 12. Identifying the landscape from the "Sabana de Bogotá".

Figure 13. Event attendees during the field visit

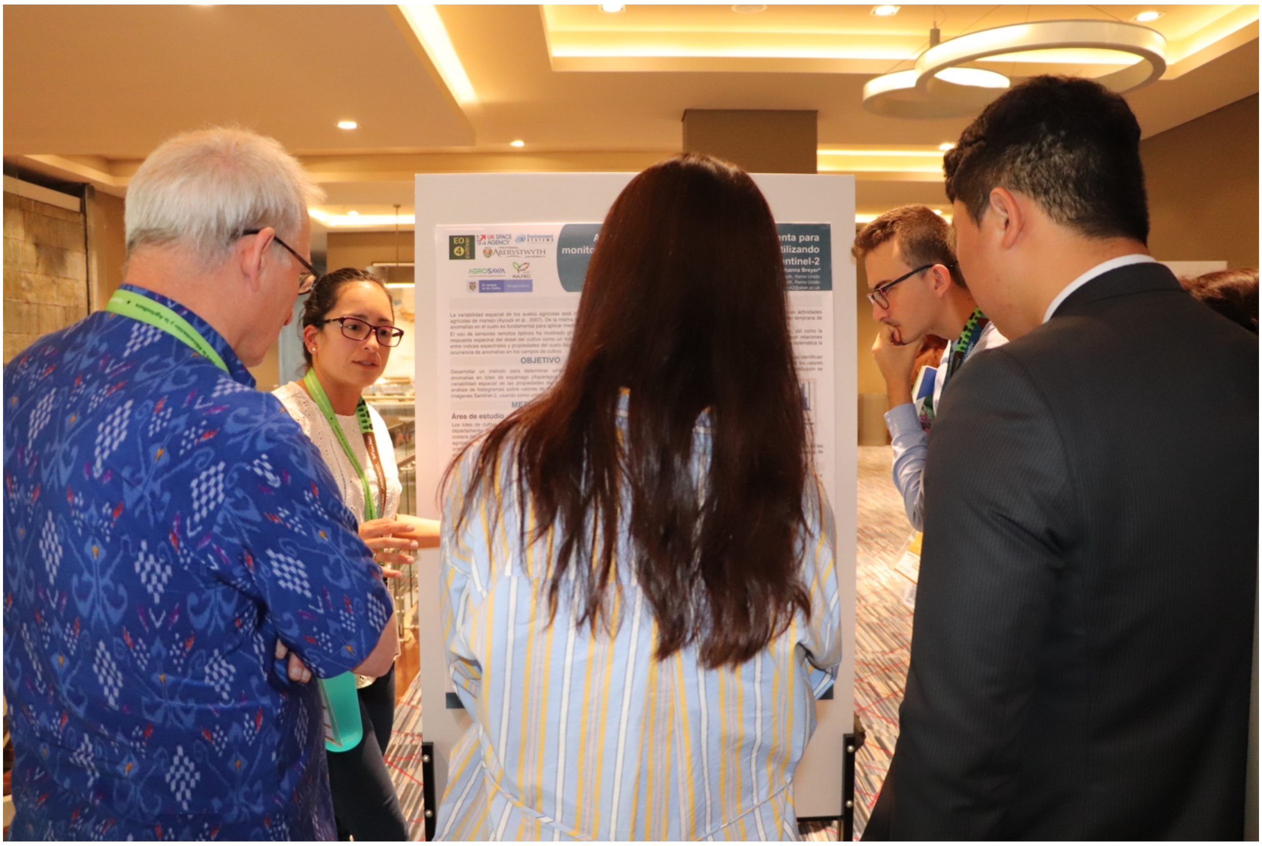

Figure 14. Presenting the poster titled "Análisis de histogramas como herramienta para monitoreo de anomalías en suelos agrícolas utilizando imágenes Sentinel-2".

Figure 15. Participants on the last day of the event

IBAGUÉ- RICE AND SUGAR CANE CROPS VISITS

I visited a farm located in the Ibague Plateau (See Figure 1), a region with an average temperature of 21 °C. The visited farm produces rice, corn, livestock and panela. Panela is a traditional type of sugar produced by concentrating extracted cane juice.

Figure 16. Rice plants at the front and sugar cane plants at the back

The main aim of the visit was to carry out a knowledge exchange session with agronomist from the farm to identify how the crop properties and management activities were reflected in the satellite derived products.

As part of the visit I gave a presentation about general concepts of geographic information and earth observation to the precision agriculture staff from the farm. I also ran a training session on the use of the QField app to collect georeferenced field data and we went to the field to validate the anomalies identified by applying the method proposed in my research.

Figure 17. Exchange knowledge sessions with different teams of the farm.

Figure 18. Precision agriculture team members synchronizing data collected in the field using Qfield

The rice fields are irrigated using a surface method in which the water is distributed within the field through a series of ridges that follow contour lines along the field. The water of the main canal is guided towards this “maze” by building trenches with sand bags, and a “irrigator” checks that the water is evenly distributed along the field. Guaranteeing an even soil moisture in the field is very important because otherwise the rice plants do not emerge at the same time and the yield is not homogeneous when harvesting. On time alerts about those areas that are not properly irrigated, help the irrigator fix the irrigation problems and optimize yield.

Figure 19. Contour lines irrigation for rice

A drone flight was made jointly with Oscar Barrero, a professor from the Universidad de Ibagué. The aim was to retrieve NDVI images from two plots and compare the results with the products obtained using the satellite images.

Figure 20. Students from Universidad de Ibague flying the drone to retrieve NDVI images from 2 crop plots

IBAGUÉ- TALK AT UNIVERSIDAD DE IBAGUÉ

During my visit to Ibagué, I made a presentation about the basics of remote sensing and its applications on agriculture in the Universidad de Ibague. Most of the attendees were undergraduate and postgraduate students from the faculty of Engineering. The talk was organized by the department of Electronic Engineering and was a part of a joint work with the University of Ibague to use remote sensing for crop monitoring.

Figure 21. Giving talk about Remote sensing applied to crop monitoring at Universidad de Ibagué.

CONCLUSIONS

After the field visits and especially after interacting and exchange knowledge with experts in different fields I have reached different conclusions:

- Each crop system is unique and varies highly over space and time. These variations and changes are reflected in the crop condition, which in turn can be identified using remote sensing (RS) techniques. However, the interpretation of the data retrieved from satellite images is only possible by integrating RS techniques with the local knowledge about the particular conditions of an agricultural system. Thus, it is fundamental to develop research projects jointly with the potential stakeholders in order to solve real needs in the agricultural sector. This fieldwork gave me elements to adjust my research based on the knowledge exchange sessions with agronomist, field workers and IT professionals that are closer to the agricultural systems studied.

- Proper management of field data is fundamental to keep track of the crop condition and agricultural activities, but also to be able to analyse data later on and draw conclusions out of it.
- Different spectral indices have to be considered to study different crop conditions in different crop systems and growth stages. The indices used to monitor anomalies in asparagus in Peru might not be useful to monitor rice fields in Ibague. In addition, a specific index might be useful to monitor rice during specific growth stages, but it might be useless for a different crop age.

REFERENCES

[1]. Feller, C., Richter, E., Smolders, T., & Wichura, A. (2012). Phenological growth stages of edible asparagus (Asparagus officinalis): Codification and description according to the BBCH scale. *Annals of Applied Biology*, *160*(2), 174–180. https://doi.org/10.1111/j.1744-7348.2012.00530.x