TETRA TECH

Enabling Crop
Analytics At Scale

Usability Makes the Difference in Digital Boundary Mapping for Smallholder Farmers

6th Grain's state-of-the-art crop monitoring platform FieldFocus utilizes satel-lite remote sensing, client-provided specific crop, and variety information to send recommendations and alerts to help users improve yields and reduce problem response times. Under a grant from Tetra Tech's Enabling Crop Analytics at Scale program, FieldFocus is being tailored for smallholder farmers with smartphones in Kenya, Tanzania and other African countries. Developed for the web and Android platforms, FieldFocus enables farmers to digitize their fields and receive crop health data, weather information, and actionable insights. FieldFocus is available in any country and works for any field size.
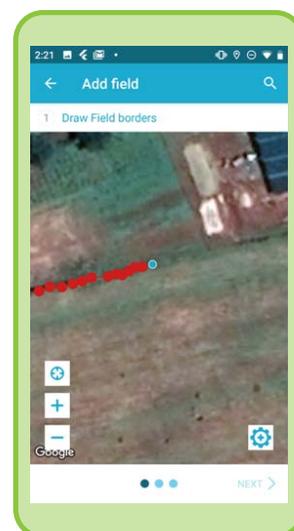
Do Farmers need Record Keeping?

We hear directly from farmers about their need for a record keeping platform that works for small commercial farmers investing in horticultural and cereal crops for regional urban markets. These farmers have voiced their challenges around record keeping, and a desire for a system that will help them track activities across a diversity of fields and farm locations, as well as track expenses.

A VIEW OF A FARMER TRACING THEIR FIELD

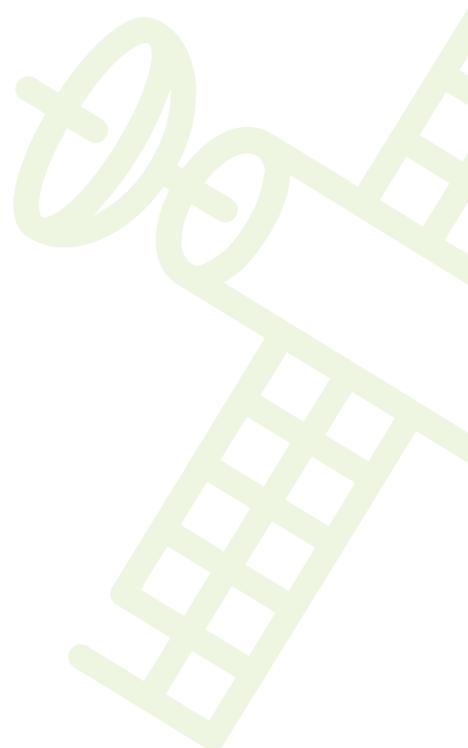## Challenges in Digitizing Field Boundaries for Farmers

Field digitization is very challenging because it would be costly to digitize every field across the world, and because farmers shift their cultivation and plant new crops every season, the digitization would need to be updated continuously. A mobile-phone application used by the grower to directly digitize their fields themselves is a game changing prospect, but it's success depends on a user experience that allows the farmer to complete a highly non-trivial task.

Our project seeks to increase the usability of the digital tool by providing the best possi-ble onboarding and field digitizing experience. If the app is perceived as being easy-to-learn, user-friendly and taking less time while providing high levels of information on farming profitability and strategy, we can increase the number of smartphone-owning smallholder farmers who can map fields.

We investigated an optimal interface for farmers through in depth remote usabil-ity research. The first step involved rigorous user testing where we uncovered critical usability challenges. These provide learnings for the wider eco-system. We describe some of the key challenges below:

Less confidence with 'map as an interface' – farmers are highly proficient with messaging applications like WhatsApp, but are less familiar with maps as an interface, e.g. Google maps. Farmers are more than able to make good use of mapping interfaces, but their first time using the interface must provide a positive and reinforcing experience. We should not expect everyone to be familiar with standard mapping UX patterns, e.g. pinching for zoom.

Standard geo-location APIs on phones can be unreliable on rural farms – challenges with user devices in emerging markets must be accounted for, e.g. GPS is best to use as a reliable baseline. Other API location providers, e.g. via cell tower, are often inaccurate and best avoided.

Linear step-by-step UX flows are critical – Interfaces that provide complex features like field mapping must have a linear step by step flow, along with very clear messaging on what the next step for the user should be. Although providing the user more options on how they might potentially map their field, e.g. add points or trace your own boundary, is tempting, this may confuse the user and cause them to give up.

Services should be data light and work offline – we should remove data intensive features that will require the grower to have large amounts of data transferred to their phone, thus increasing the cost for app use. There is also a clear need for the applications to work well while out of standard cellular coverage.
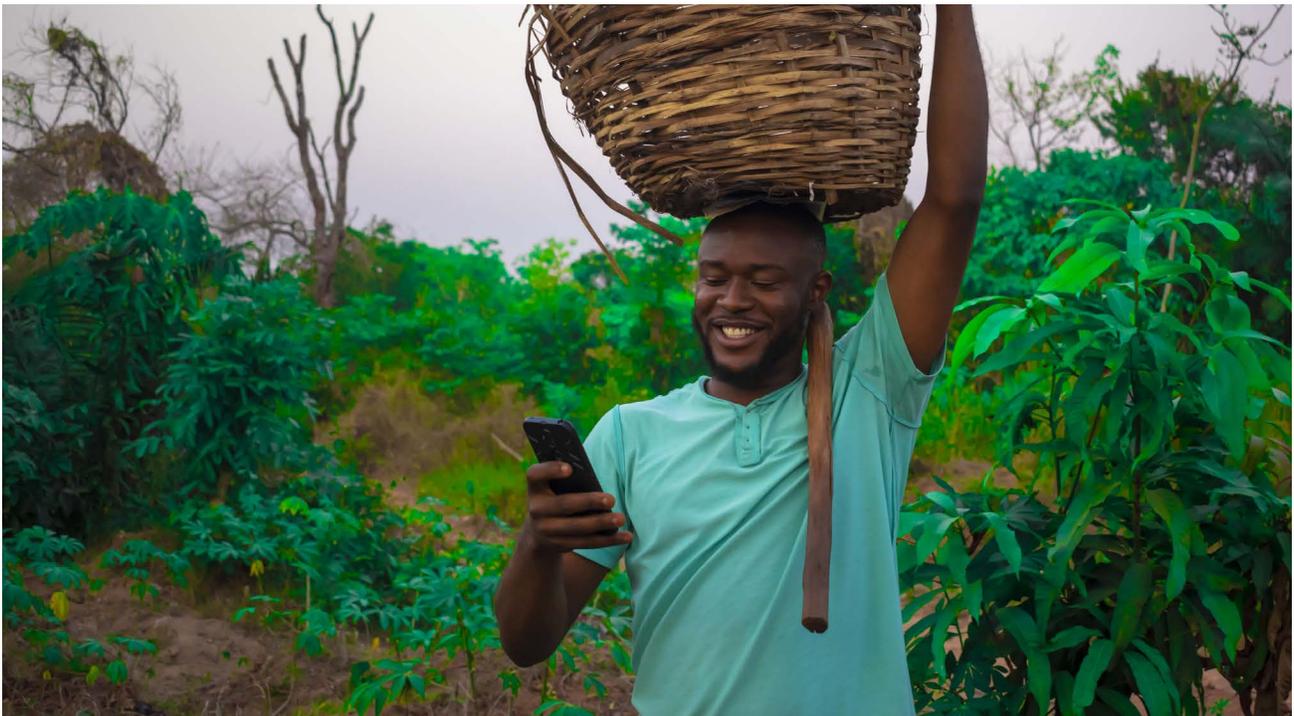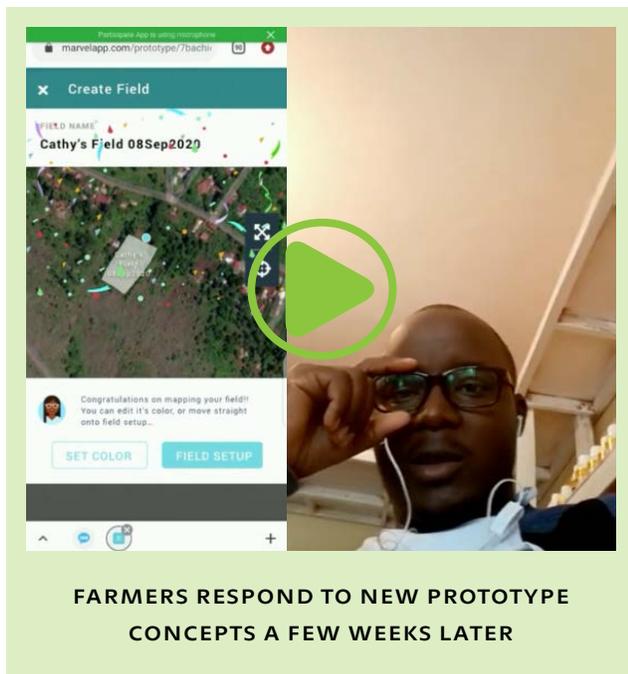
How we tested & improved the service

The good news is that once we tweaked the interface to address these solvable usability challenges, farmers reported a greatly improved and widely accessible user experience. The video extracts below provide insight into our user–centric design process, supported by our partners Farm.ink with the assistance of their learn.ink service.

FARMERS HIGHLIGHT CHALLENGES & DESCRIBE WHAT EXCITES THEM ABOUT INITIAL APP
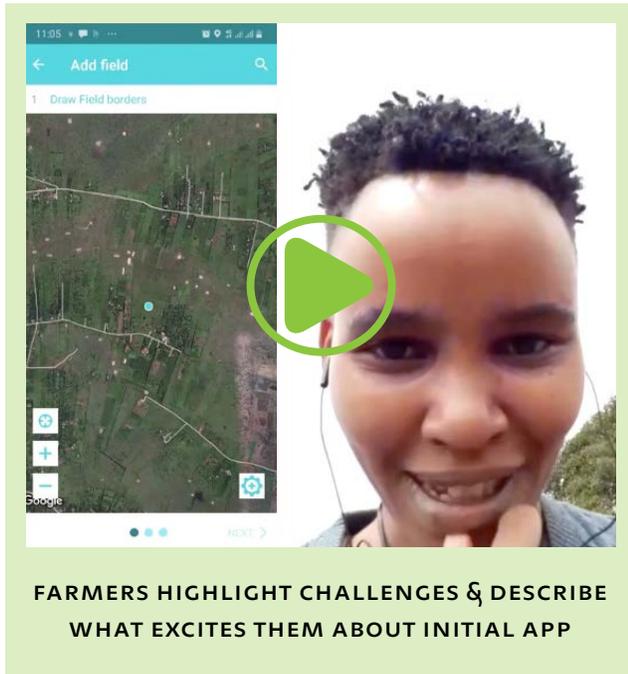
"You really need to remember the steps, I wish they were on the display"

—JUSTUS

FARMERS RESPOND TO NEW PROTOTYPE CONCEPTS A FEW WEEKS LATER

"That is awesome, now we are on the same page"

—CATHERINE

After fields were digitized, we employed an expert to re-digitize four fields to estimate the accuracy of the grower-digitized fields using the 'Follow Me' function. We found that three of the four fields digitized had linear accuracy of less than 6 meters or +/-12% difference in field size. This means that for most fields, the difference in field boundaries caused by cell phone GPS accuracy, slight differences in user practice, and other unseen differences do not result in significant differences in boundary size.

White boundary was created by the expert, whereas the red boundary was created by the grower with their phone.

Feature roadmap for a new app, defined by farmers

FieldFocus Light was conceived on the basis of our rigorous usability testing. Accurate record keeping begins with an accurate field size through digitizing each field's bound-ary. FieldFocus Light introduces an innovative 'Follow Me' function, which allows the user to walk the boundaries of their plot, regardless of size, and create a digitized boundary. This boundary is then used to record crop, variety, historical production information and day-to-day management activities. The app uses an interactive chat as a means to guide the user through the pivotal field mapping process, an approach designed as a result of our user testing with Kenyan farmers with Farm.ink.

In response to farmer feedback, the following features will also be prioritised for Field Focus Light:

> Field boundary with exact area in cultivation
> Crop, variety and start date of current crop
> Previous year's crop and productivity records
> Farmer management including fertilizer use and how often the field is visited
> Records of cost of each crop input and enabling a clear accounting of the cost of production for each crop and season.

We will add alerts and notifications that will allow for direct engagement by agronomists and deliver warnings when the field falls below the average regional productivity or is at risk for disease alerts.

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SAMPLE SCREENS FROM NEW APP
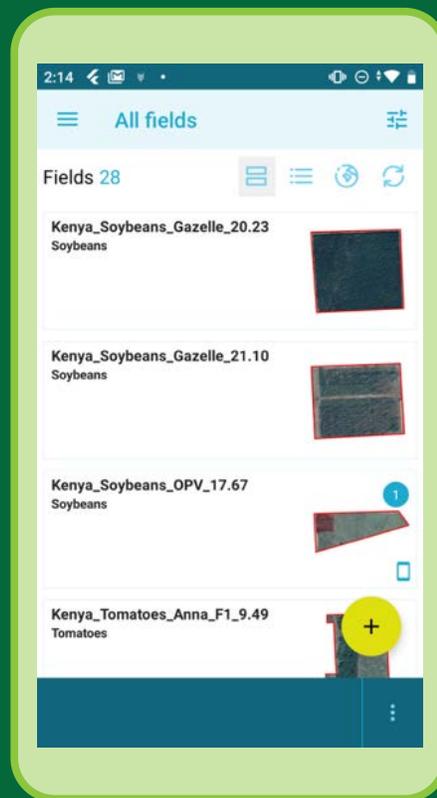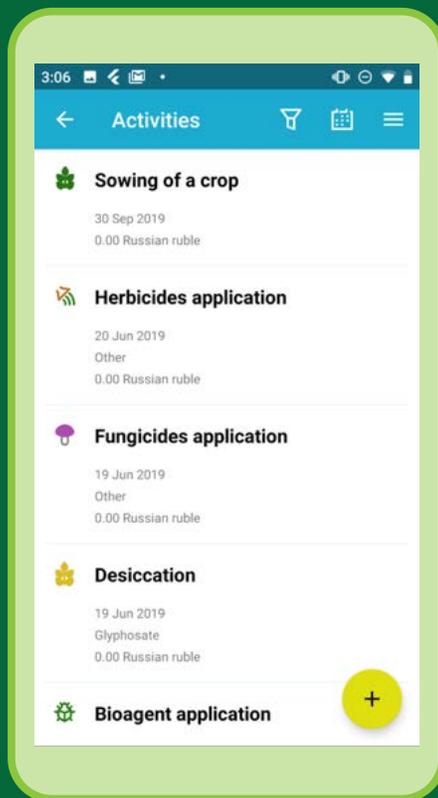
Next steps

Digitizing fields is just the first step of the user journey. The application allows the user to keep records which will record both expenditures and revenue generated, allowing for easy calculation of the profit gained on each field. Agronomists that growers share their field records with can diagnose their issues, send better agronomy information and improve their agriculture practices. We will also generate alerts and notifications from weather and satellite remote sensing of biomass from our digital agronomy system that can be sent via the app.

FieldFocus Light is available in English in the Android App Store, with regular releases occurring throughout 2021. We plan to translate the app into Swahili and other languages in the coming months.

Tetra Tech's **Enabling Crop Analytics at Scale** program's focus is to identify ways the scientific community can drive down the cost of developing appropriate training data for agricultural communities. By providing free, useful and engaging tools such as Field–Focus Light to smallholders across Africa, 6th Grain and Farm.ink can accelerate the transformation of satellite data and agriculture information.