CASE STUDY:
Digital Precision Agriculture Advisory Services in Kenya

November 1, 2019
AGRIFIN PRECISION AGRICULTURE ADVISORY SERVICES CASE STUDY

Introduction & Research Summary

BACKGROUND
- The AgriFin Digital Farmer Program (ADF) is a Mercy Corps AgriFin (AFA) program funded by the Bill & Melinda Gates Foundation to expand digitally-enabled services to 1 million smallholder farmers (SHFs) across Kenya, Tanzania, Ethiopia and Nigeria.
- ADF distills lessons from work with a wide range of partners and engagements to share as public learning to drive ecosystem growth.
- AFA has worked with Safaricom since 2015 to develop DigiFarm, an integrated mobile-based platform for digital services tailored for SHFs. A key part of DigiFarm’s product roadmap is to deliver precision agriculture solutions for SHFs to help increase productivity and resilience in the face of climate change.

OBJECTIVES
- Gain a deeper understanding of the players operating in the precision agriculture advisory space in Kenya.
- Design a precision advisory solution to be piloted as part of Safaricom’s DigiFarm platform and commit to sharing lessons learned and results achieved.
- Share the landscape with implementers and donors to contribute to the dialogue on precision agriculture for SHFs.

RESEARCH SUMMARY
- Expert interviews and brief desk review of promising approaches to precision agriculture advisory for SHFs.
- Rapid assessment of precision agriculture advisory, weather and other earth observation providers operating in Kenya.
- Assessment is time stamped at April 2019 and was non-exhaustive.
The AgriFin Digital Farmer Program (ADF) is a Mercy Corps AgriFin (AFA) program funded by the Bill & Melinda Gates Foundation to expand digitally-enabled services to 1 million smallholder farmers (SHFs) across Kenya, Tanzania, Ethiopia, and Nigeria.

SHFs operating in rainfed systems, which cover 98% of farmed land in Kenya, are at great risk from an increasingly variable climate and more frequent extreme weather. They are struggling more-and-more to know how best to manage their farms. There is evidence that precision advisory can help SHFs adapt to climate change and increase their productivity; for example, research shows that SHFs with access to forecasts can achieve up to 66% higher marginal gains and are less likely to experience crop loss. Yet most SHFs don’t have access to accurate, localized weather forecasts let alone a comprehensive suite of precision advisory solutions.

ADF undertook this Case Study “Digital Precision Agriculture Advisory Services in Kenya” to 1) understand the landscape and gaps of precision advisory and earth observation service providers operating in Kenya; and 2) design a precision agriculture advisory solution for Safaricom’s DigiFarm platform. AFA has worked with Safaricom since 2015 to develop DigiFarm, an integrated mobile-based platform for digital services tailored for SHFs. A key part of DigiFarm’s product roadmap is to deliver precision agriculture solutions for SHFs to help increase productivity and resilience in the face of climate change.

KEY CASE STUDY INSIGHTS:

1. A comprehensive precision agriculture advisory solution for SHFs should be crop/livestock specific, location specific, weather-linked and climate-smart and include five major services: (1) Climate Information Services, (2) Value Chain Advisory, (3) Soil Management Services, (4) Pest & Disease Monitoring and Management Advice and (5) an Interactive Farmer Platform.

2. Precision agriculture advisory providers in Kenya are mostly start-ups with the few scaled solutions delivering promising results but with limited customization. No single provider currently operating in Kenya can offer a proven, comprehensive digital precision agriculture advisory solution (based on the definition in Key Insight #1) at scale. Sustainable business models for delivering precision advisory are still TBD with many solutions donor supported. Services are rapidly evolving with new companies launching regularly. Capturing results and learnings over the next 2 years will be critical to drive impact for SHFs.
KEY CASE STUDY INSIGHTS (cont.):

3 Weather forecasts combining ground level observation with satellite data are becoming available in digital formats and can be immediately leveraged to benefit SHFs. Business models for sustainable delivery are still TBD, but accessible, reliable and localized weather forecasts could generate high returns for SHFs and be a quick win for service providers. At the same time, investment is needed to ensure continued improvement in accuracy and availability of localized weather forecasts that can be combined with management advice. Localized agro-weather advisories are highly valued by farmers and contribute to climate smart agriculture.

4 Limited in-country capacity in data collection, processing and analytics is a barrier to achieving scale in digital precision advisory services in Kenya. Capacity in data analytics and modelling is growing but still limited. Geotagging farmers and obtaining accurate farm level data is critical but costly and time consuming. More research is needed to support providers in converting data into impactful messages for farmers. Capacity building and cultivation of B2B partnerships can support better solutions in the industry.

5 Donors and implementors can work together to develop partnerships between earth observatory providers with predictive analytics and modeling skills and advisory providers who know how best to communicate with SHFs; to bundle services through B2B partnerships for greater efficiency and profitability; and to leverage scale opportunities through MNO’s and other partners with 1M+ farmer customers.

ADF ACTION AND NEXT STEPS:

ADF is supporting the implementation of a Precision Agriculture Pilot that leverages the wide-reach of Safaricom’s DigiFarm platform with over 1 million registered users, the Kenya Agriculture & Livestock Research Organization’s (KALRO) deep agronomic expertise, aWhere’s localized weather data and modeling capabilities and NASA’s deep technical expertise with earth observation technologies and data to test and disseminate precision agriculture tools for SHFs during the October 2019 planting season.

ADF will provide updates on the results and learnings from the Precision Agriculture Pilot to further advance industry understanding of best practices in the design and implementation of impactful precision agriculture advisory solutions.
Table of Contents

SECTION I   7 - 16
Technical specifications for digital precision agriculture advisory services for smallholder farmers

SECTION II  18 - 29
Landscape and gap analysis of Kenya’s digital precision agriculture advisory landscape

SECTION III 31 - 33
Recommendations Safaricom’s DigiFarm Precision Agriculture Advisory Pilot

APPENDIX   35 - 51
Digital Precision Agriculture Provider Profiles References
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION I</strong></td>
<td>7 - 16</td>
<td>Technical specifications for digital precision agriculture advisory services for smallholder farmers</td>
</tr>
<tr>
<td><strong>SECTION II</strong></td>
<td>18 - 29</td>
<td>Landscape and gap analysis of Kenya’s digital precision agriculture advisory landscape</td>
</tr>
<tr>
<td><strong>SECTION III</strong></td>
<td>31 - 33</td>
<td>Recommendations Safaricom’s DigiFarm Precision Agriculture Advisory Pilot</td>
</tr>
<tr>
<td><strong>APPENDIX</strong></td>
<td>35 - 51</td>
<td>Digital Precision Agriculture Provider Profiles References</td>
</tr>
</tbody>
</table>
Defining digital precision advisory services for smallholder farmers

1. **Digital precision advisory services** for SHFs leverage digital platforms to provide farmers with **accurate, timely and customized information, advice and services for their crop(s)/livestock and location** based on the use and integration of data on farms and farmers, crop(s)/livestock from pre-production to post-harvest and sale, markets, climate and weather, soil quality and composition, and pest & disease pressure and outbreaks.

2. **Digital precision advisory services** provide B2C, farmer-facing services and are often aggregators of data and information from external sources. They partner with providers of climate information and other earth observatory data on a B2B basis to provide more comprehensive precision solutions.
Insights on reaching SHFs with digital precision advisory solutions

Precision advisory services should be customized across multiple factors and bundled with other inputs and services.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Details</th>
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</table>
| Crop/livestock specific | • Crop type(s)/Livestock type(s)  
                          • Varieties/Breeds                                                      |
| Location specific       | • Georeferenced farm location  
                          • Field/location soil conditions  
                          • Input availability                                                      |
| Weather-linked          | • Crop/livestock type and variety/breed selection  
                          • Agronomic advice including pest/disease  
                          • Planting window/date                                                      |
| Climate-smart           | • Longer-term weather forecasting  
                          • Crop suitability and selection                                            |

- Farmers want **good advice linked to inputs available near them**. Adoption of advisory services will be low if local availability of inputs and services is not factored into recommendations.

- Precision advisory providers will have **more impact** and a higher chance of **achieving profitability** if they 1) **bundle** inputs and services; and 2) **solve logistics** for inputs and outputs (themselves or through partners).

Sources: Consultant interviews/analysis; Tall et al, 2014
Accessible, reliable and localized weather forecasts could generate high returns for farmers and could be a quick win for service providers.

- Because 95% of agriculture in SSA is rainfed, SHFs are highly vulnerable to changes in weather. Climate change is already causing yield declines for staple crops, exacerbating food insecurity. Future changes in rainfall and temperature are projected along with an increase in extreme weather events. This can shift growing seasons and change which agricultural activities are profitable on a farm.

- Access by SHFs to weather information is highly variable across SSA (research has shown a range of 2-86%). It is usually limited to low-accuracy national or regional forecasts broadcast on radio and/or TV.

- Farmers are asking for and can benefit from more accurate daily/weekly forecasts and seasonal forecasts for their specific locations. Research shows that farmers can experience up to a 66% marginal gain from using weather and climate services. Farmers with access to localized weather forecasts are less likely to experience crop loss. Weather forecasts are often the most highly valued advisory service by farmers.

- Barriers such as the decline in the number of connected weather stations, disrepair and low reporting from existing stations (<50%), and incomplete and hard to access current and historical data need to be overcome. SSA spends the least of any region on weather and climate services (US$ 1.4 B compared to US$ 5.1 B in S. Asia and US$ 11.5 B in N. America). The World Bank estimates that in Kenya, investment in modern/advanced agro-meteorological services could drive a 10% increase in agriculture’s contribution to GDP.

Sources: Consultant interviews/analysis; Camacho et al, 2011; Georgeson et al, 2017; GSMA, 2017; GSMA, 2016; IPCC, 2019; Snow et al 2016; Usher et al 2018; Vaughan et al 2017; World Bank 2017; World Bank, 2015
Agro-weather advisories are dynamic agronomic and livestock management advice linked to localized weather forecasts (e.g. it won’t rain until next week, wait to top-dress; the rains are coming, here is your planting window for *insert crop name*).

Providing agro-weather advisories is more likely to drive behavior change than weather forecasts only and can stimulate uptake of advisory services.

KUKUA reports that SHFs who receive advisories can increase their income by 10-82%. Studies have shown that farmers using the Integrated Agro-Meteorological Advisory Service in India (reaching ~2.5 million SHFs) have 10–15% higher yields.

Agro-weather advisories can contribute to climate-smart agriculture (e.g. weather-linked soil management advice can increase fertilizer use efficiency).

Location specific agro-weather advisories are the most highly valued precision advisory service.

Companies struggle to find a market among SHFs. In rain-fed systems they see little value in satellite monitoring that can tell them how their crop is growing in relation to the weather, which they can see for themselves.

Most successful applications in SSA rely on large farmer customers.

Soil sensors and satellite crop monitoring data can be useful for water management in irrigated systems.

Companies with outgrowers can benefit from remote sensing; a study in Uganda found that seed outgrowers could benefit by over $1700 per farm/year by using insights from drone flights paid for by the contracting company.

This is a rapidly evolving field with many companies piloting solutions for SHFs. The question of who will pay for solutions proven impactful is TBD.

Utilizing data from drones and satellites to drive returns for SHFs through better crop and water management is a nascent field with few applications proven to be impactful and cost effective at scale.

A comprehensive precision agriculture advisory solution for SHFs should include five major services centered on key content areas

- Comprehensive precision agriculture advisory solutions can be developed in phases, adding layers as proven analytical models, quality content, sustainable partnership and business models, and evidence of impact for farmers emerge.

### Phased Roll-out of Comprehensive Solution

<table>
<thead>
<tr>
<th>Precision Content and Service</th>
<th>Climate Information Services</th>
<th>Value Chain Advisory</th>
<th>Soil Management Services</th>
<th>Pest &amp; Disease Early Warning, Monitoring and Management Advice</th>
<th>Interactive Farmer Platform (digital and human touch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Localised weather forecasts</td>
<td>Value chain advice based on location/crop/livestock</td>
<td>Rec based on local soil characteristics and inputs available in market</td>
<td>Pest/disease info integrated in value chain advisory</td>
<td>Interactive SMS, call-in center, in-person advisory</td>
</tr>
<tr>
<td></td>
<td>Agro-weather advisory</td>
<td>Agro-weather advisory</td>
<td>Recs based on farm soil test</td>
<td>Alerts/management advice for pests and disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate smart advice</td>
<td>Fully integrated advice at the farm level</td>
<td>Fully integrated advice at the farm level</td>
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</tr>
</tbody>
</table>

Illustrative
### Climate Information Services (CIS) allow farmers to make informed decisions based on past, present and future weather

#### What is it?
- “Production, translation, transfer and use of climate knowledge and info for climate-informed decision making.”
- Localized weather and climate information provided to farmers based on historic observations, weather monitored through the growing season, and predictions at a range of timescales.
- Timescales range from daily forecasts to seasonal predictions to climate change (<2 decades).
- Includes early warning of extreme weather events.

#### How do farmers use it?
- Intra-seasonal: scheduling, tactical crop management
- Seasonal: Crop selection or herd management
- Interannual: Crop sequence or stocking rates
- Annual/bi-annual: Crop rotations

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#### IMPACT FOR SMALLHOLDERS
Increased climate variability in rain-fed systems = major need for weather and climate information. Proven impact.

#### READINESS FOR SCALE
Data accuracy sometimes unknown/low. Not always accessible for digital distribution. Should include agro-advisory.

#### EASE OF IMPLEMENTATION
Providers are available. Digital platforms are available. Getting right data and messages to farmers, especially women, needs work.

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#### DATA SOURCES
<table>
<thead>
<tr>
<th>Who?</th>
<th>What?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Meteorological Services</td>
<td>Weather data</td>
</tr>
<tr>
<td>Earth Observatory Companies</td>
<td>Satellite data</td>
</tr>
<tr>
<td>Farmers</td>
<td>Data analytics (historic and predictive)</td>
</tr>
</tbody>
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Value Chain Advisory services provide comprehensive support to farmers from pre-production through to post-harvest and marketing

What is it?

- Location and crop/livestock linked pre-production, production, harvest, post-harvest and market information and advice. For crops includes variety/species, mechanization across production cycle, land preparation, inputs (fertilizer/seed), weed control, pest & disease management, harvesting, storage, and market information. Ideally linked to input availability.
- Agro-weather advisory. Planting and harvest time, input use throughout season.

How do farmers use it?

- Planning for the cropping season/production cycle (which inputs, timing of preparation and planting).
- In-season decision-making about inputs, management, harvest and sales.

**IMPACT FOR SMALLHOLDERS**

Timely, relevant advice. Agro-weather advisories can be highly impactful.

**READINESS FOR SCALE**

Value chain info tailored to location can be made more relevant and localized. Agro-weather advisories are being piloted.

**EASE OF IMPLEMENTATION**

Requires back-end data analytics, integration and crafting effective messages from extensive content and complex data.

**DATA SOURCES**

**Who?**
- Research Institutions, Universities, NGOs
- Digital advisory companies
- Earth observatory companies
- Farmers

**What?**
- Data/info on full production cycle
- Market information data
- Satellite crop monitoring data
- Data analytics/modeling for monitoring/prediction

Sources: Consultant interviews/analysis
Soil Management Information is utilized by farmers to make crop and crop rotation decisions, optimize their use of inputs and maximize yields.

**What is it?**
- Fertilizer/soil management recommendations based on soil test or soil map for farm and crop(s) and (ideally) cost:benefit for farmer.
- Integrated into the digital platform to provide digital follow-up messaging.
- Linked to what is available in the local market.
- Soil test done at right time in production cycle.
- Links to agro-weather advisory (e.g. when to top dress based on weather forecast).

**How do farmers use it?**
- Land prep decisions.
- Decisions on fertilizer use by crop throughout season.
- Decisions on crop rotation and fallowing.

**IMPACT FOR SMALLHOLDERS**
Fertilizer use and better soil management increases yields. Impact depends on usability of the info/availability of inputs.

**READINESS FOR SCALE**
Lab test slow to scale. Rapid tests are in the pilot phase and scalability is TBD. Soil map data is effective in some areas.

**EASE OF IMPLEMENTATION**
Business model TBD. Requires boots-on-the-ground for testing/advice. The right inputs must be available locally.

**DATA SOURCES**
- Soil testing companies
- Research institutions
- Earth observation companies

**Who?**
- Soil data
- Soil maps
- Soil tests

Sources: Consultant interviews/analysis
Pest & Disease Early Warning, Monitoring and Management Advice provides farmers with the info they need to apply cost-effective management solutions throughout the season

**What is it?**
- Timely advice for pest/disease management.
- Early warning messages when pest & disease outbreaks are expected.
- Notification on pest life cycle stage with management advice linked to crop cycle (based on planting date).
- Monitoring tool for farmers to self-assess outbreaks/infestations.
- Integration to interactive platform for farmers to receive diagnosis and advice based on images.

**How do farmers use it?**
- Pest & disease management decisions throughout the crop cycle.
- Crop rotation and fallowing decisions.

**IMPACT FOR SMALLHOLDERS**
Globally farmers lose up to 40% of their crops to pests on an annual basis. Pest risk is never zero; timely tracking is critical.

**READINESS FOR SCALE**
Precision digital services are in the pilot phase. Disease alerts and tracking less developed than for pests.

**EASE OF IMPLEMENTATION**
Most effective solutions will require trained agents to provide back-up support to farmers for interpreting information.

<table>
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<tr>
<th>DATA SOURCES</th>
<th>Who?</th>
<th>What?</th>
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<tbody>
<tr>
<td></td>
<td>Research institutions</td>
<td>Satellite monitoring data</td>
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<tr>
<td></td>
<td>Earth observation companies</td>
<td>Pest life-cycle models and datasets</td>
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<tr>
<td></td>
<td>Farmers</td>
<td>Risk modeling</td>
</tr>
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</table>

Sources: Consultant interviews/analysis; Oerke 2006
Interactive Farmer Platforms give a “human touch” to precision advisory services, supporting farmers to make the best use of info and advice, and increasing impact

What is it?

• Interactive SMS, call-in center and/or on-the-ground agents who can support farmers in implementing recommendations from the precision advisory service.
• Can also include:
  ➢ Pull information for farmers to dig deeper into topics of interest.
  ➢ Agents with content (e.g. videos, mini-training modules).

How do farmers use it?

• When they don’t understand a recommendation, have a problem that has not been addressed by a recommendation, or have a timely issue that needs to be addressed immediately, farmers can access the interactive service(s) to get the information and advice they need.

IMPACT FOR SMALLHOLDERS

Experience consistently shows that farmers want and need interactive, and preferably in-person, support, and it increases impact.

READINESS FOR SCALE

Numerous types of platforms for engaging farmers in interactive services exist. Design and success is context specific.

EASE OF IMPLEMENTATION

Financing this service can be a challenge; farmers usually not willing to pay. Need to staff appropriately. Need real-time advice.

DATA SOURCES

Who?
• Digital advisory companies with agriculture staff
• Extension networks
• Mobile Network Operators
• Farmers

What?
• Answering questions, diagnosing, trouble-shooting

Sources: Consultant interviews/analysis
# Table of Contents

**SECTION I** 7 - 16

Technical specifications for digital precision agriculture advisory services for smallholder farmers

**SECTION II** 18 - 29

Landscape and gap analysis of Kenya’s digital precision agriculture advisory landscape

**SECTION III** 31 - 33

Recommendations
Safaricom’s DigiFarm Precision Agriculture Advisory Pilot

**APPENDIX** 35 - 51

Digital Precision Agriculture Provider Profiles
References
More than 25 providers of precision advisory, weather forecasts and earth observatory in Kenya were assessed

Criteria for inclusion:
- Active deployment in Kenya as of April 2019
- Responsive to interview request between March-April 2019
- Data or advisory provider
- Note: IoT applications (e.g. internet connected water pumps such as SunCulture; mechanization sourcing such as Hello Tractor) were not included in the assessment. IoT applications often have strong value propositions for farmers and could be strong value-add B2B partners for existing precision advisory providers.

Precision advisory
- 15 providers profiled: Agrics, AgroCares, Apollo Agriculture, Arifu, CROPMON, KALRO, iCow, iShamba, Mbegu Choice, Precision Agriculture for Development (PAD), PRISE-CABI, TechnoBrain, Ujuzi Kilimo, Waterwatch, Yielder
- See Appendix slides 34-48 for provider profiles.
- Notes:
  - Waterwatch has an AgriCoach app in Burundi but not yet built for Kenya.
  - Tulaa https://www.tulaa.io/ falls in this category but was not interviewed.
  - AgriBora www.agribora.com aspires to provide precision advisory and accurate weather data in Kenya but not yet operational.

Earth Observatory: Weather data and forecasts
- 5 providers profiled: Kenya Meteorological Department, aWhere, KUKUA, TAHMO, Weather Impact
- See slides 24-25 for provider profiles.
- Notes:
  - ACRE Africa not profiled but has ~130 automated weather stations in East Africa.
  - IBM Research (along with IBM businesses the Weather Company and Wunderground.com) is coming onto the scene but had no active precision advisory applications in Kenya at the time of the assessment. To watch: partnership with Hello Tractor to deliver timely and relevant info to farmers (https://www.hellotractor.com/ibm/)
  - Other companies active in SSA (but not SSA) to watch: Climacell and Ignitia.

Earth Observatory: Satellite, Drone
- 6 providers profiled: eLeaf, Geodatics, NEO. Vandersat, Astral Aerial, Upande
- See slides 26-27 for provider profiles.
- Notes:
  - Satelligence and Aerobotics were also profiled but do not currently have active deployment in Kenya.
**Precision Advisory:**
No single provider currently operating in Kenya can offer a proven, comprehensive digital precision agriculture advisory solution at scale.

<table>
<thead>
<tr>
<th>Precision Advisory Provider Type</th>
<th>Established companies</th>
<th>Start-up companies</th>
<th>Research institutions/Industry Associations</th>
<th>Projects/NGOs/Cooperatives</th>
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<tbody>
<tr>
<td>Climate Information Services</td>
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*Note: Provider type based on actual operations as of April 2019.*

*Note: Most Value Chain Advisory providers offer soil and pest/disease management info, usually based on crops grown, but these services do not meet the definitions of precision services provided on slides 14-15. iShamba provides pest & disease management advice based on farmer WhatsApp messaging.*
Precision Advisory:
Digital precision advisory providers are mostly start-ups or pilots with the few scaled solutions offering limited customization

Most precision agriculture advisory solutions are in the prototyping or pilot phase. Few have reached proof-of-concept and even fewer have started scaling-up.

Providers who have started to scale offer simple precision services with limited customization.

Providers utilizing data analytics platforms to offer more customized services are mostly prototyping or piloting their solutions and need at least 1 year (or 2 cropping seasons) to develop a solution that can be piloted at a larger scale.

• Only 3 companies and 1 project have (self-reportedly) reached close to or over 100,000 farmers (PAD-366,000, iShamba-300,000, CROPMON-200,000, iCow-95,992, Arifu-1 million).

• Majority of solutions are being launched by SME’s with less than 50 employees that have been in operation for less than 5 years.

• Many solutions with field-level operations function in only a handful of counties and cover a handful of crops/livestock. iShamba and iCow operate country-wide and have extensive crop/livestock coverage. CROPMON operated in 28 counties.

• Services include crop specific advice only (e.g. iCow, Arifu); crop specific advice manually customized by location (e.g. iShamba, PAD); and semi-localized weather forecasts (e.g. iShamba, PAD). CROPMON offered the most customized weather advisories at 5x5km scale (rain) and crop monitoring at 10x10km but closed in August 2019.

• KALRO’s Kenya Agricultural Observatory Platform (e.g. www.kaop.co.ke) has huge potential for scale at a highly customized level but is currently only offering weather by ward on a web-based platform that is currently largely inaccessible to SHFs.

• While some providers are reaching a large number of farmers, their precision services (or components there of) are still being tested and adjusted before rolling-out at a larger scale.

• Services still under development include localized agro-weather advisories (e.g. Agrics, KALRO, PAD, Ujuzi Kilimo), rapid soil testing and advice (e.g. Ujuzi Kilimo), satellite-based crop monitoring (e.g. CROPMON, Agrics) and pest & disease early warning (e.g. PRISE, Waterwatch).
Precision Advisory:

Services are rapidly evolving with new companies or applications launching regularly; testing pathways to sustainable business models; and collecting data on impact that is limited but promising.

The industry is **new, fragmented and growing rapidly.**

**Sustainable business models** for delivering digital precision advisory services to SHFs in Kenya are TBD.

- Almost all the solutions profiled have launched their precision advisory components within the past 3-years.
- New applications are coming on-line every year.
- There is currently limited partnerships or awareness between actors in part because of the competitive nature of an industry in early stages with critical challenges to developing sustainable business models.
- Many providers are at least partially donor funded with the objective to develop a sustainable business model over time.
- Many providers have either observed or assume that SHFs won’t pay for advisory services and are trying to sell their services to other players such as insurance companies, large-scale buyers, large-scale commercial farmers and/or farmer cooperatives or are working on cross-subsidy models, funding advisory services out of products such as input loans.
- SoilCares has found that farmers are willing to pay but most agents operating scanners are not yet profitable.
- CROPMON found that farmers highly valued localized weather forecasts and found it 98% accurate but had limited use for the satellite-based crop monitoring.
- iShamba found that users can have yields as much as 50% greater than similar farmers.
- 90% of iCow users used some content; 60% changed a behavior.

Few providers have **hard evidence of impact** for SHFs (given short run-times) but some are **monitoring** farmer satisfaction and accuracy of products.
Precision Advisory:
Data collection and processing remains a barrier to achieving scale in digital precision advisory services

Geotagging farmers and obtaining accurate farm level data is a key barrier to scaling precision advisory solutions in Kenya.

The technology and capabilities required to generate precision data for SHFs is developing more rapidly than the skills and capacity needed on-the-ground to effectively communicate this information to farmers.

- Collecting farm-location and other farm level data were indicated as key barriers by many providers in Kenya. Obtaining the exact farm location and collecting farm level data (e.g. crops grown) are critical first steps to providing precision services but are time consuming and costly.

- Accurate data collection usually requires an agent going to the field. Relying on farmer entered data is less expensive but has high potential for inaccuracy opening-up all actors to risks (bad or irrelevant info provided, farmers are negatively impacted and lose trust).

- Apps for entering farmer data are proliferating but workable business models for data collection are lagging-behind.

- Players in Kenya are starting to access precise data but many have limited experience and/or skills to translate this into meaningful messages SHFs.

- More research is needed on what information is most valued and what messages have the most impact by/for SHFs. This is even true for basic weather forecasts; farmers don't always know how to interpret probabilities and would like concrete info on what days it will rain, what days temperatures will be above a certain degree, etc.

- Through A/B testing, PAD found that changes such as sending different types of messages at different times of day, using active language in the messages, and reminding farmers of important information can result in increased usage of the tools available.
Weather forecasts are becoming available in digital formats and can be immediately leveraged to benefit SHFs.

**Seasonal and weekly forecasts available to farmers** need to improve to drive real farm-level change.

- The best weather forecast for any given location should be generated through predictive analytics using satellite data and calibrated, high quality ground level observations from the KMD stations plus the 300+ private stations in the country.

- The World Bank is funding access to aWhere weather forecasts through the “Kenya Climate Smart Agriculture Program.” Latitude/longitude or ward level forecasts can be accessed at [www.kaop.co.ke](http://www.kaop.co.ke) but data is not widely available for dissemination through private actors.

- Forecasts from the KMD can be difficult to leverage for digital platforms and are not available at a highly localized scale. Providers such as TAHMO and KUKUA provide digital access but do not have full country coverage. Providers such as Weather Impact need B2B partnerships or other entry points (e.g. donor funding) before reaching farmers at scale.

- Ground level weather data will improve over the next decade.

- Private and public investment is increasing to improve current/install new stations.

- The World Bank is funding improvement of KMD ground level observations and installation of automated weather stations and, through KALRO, supporting integration of data from multiple sources to generate better predictions.

- TAHMO and KUKUA are installing new stations.

- Other digital weather services that seek to reach SHFs will come on-line in Kenya in the near future.

- IBM owns the Weather Company and Weather Underground and has plans to leverage these data platforms for the benefit of SHFs. In Kenya they are partnering with Hello Tractor to disseminate precision info including weather but this was not operational as of April 2019.

- Other providers such as Ignitia and Climacell are interested in the Kenyan market.
Earth Observatory:
Capabilities in data analytics and modelling are primarily located outside the country; capacity building and B2B relationships are required to deploy high impact precision advisory solutions

- Companies who source and analyze satellite and other data for agriculture applications in Kenya are generally headquartered in Europe or North America and dependent on B2B partnerships to translate their data into meaningful and actionable insights for and deliver to SHFs.
- Most companies operating in Kenya either do not have this analytical capacity, outsource it to companies or institutions headquartered elsewhere or have the capacity but it is based out of the country. KALRO is working to develop a Big Data Analytics Platform but this is not yet operational.
- The strict government regulations and high cost of drone applications will likely limit applications for SHFs in the near-term.
- Drone applications that can predict harvests, for example, have some promise, but the question of "who pays" still needs to be answered.
- Astral Aerial is testing solutions for SHFs in Kenya but the cost:benefit is TBD.

Data analytics capacity, including predictive analytics and big data analysis, is very limited in-country.

Drones currently have limited use in Kenya in the near-term for precision advisory applications relevant to SHFs.
# Earth Observatory Providers in Kenya: Weather

<table>
<thead>
<tr>
<th>Provider</th>
<th>Coverage and scale</th>
<th>Data accessibility</th>
<th>Business model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kenya Meteorological Department (KMD)</strong> <a href="http://www.meteo.go.ke/">http://www.meteo.go.ke/</a></td>
<td>Weather stations: 36 synoptic stations; 3000+ rainfall stations; 24 automatic weather stations; and 13 agrometeorological stations. Stations are not well distributed through the country. Some stations are old and in disrepair. There is inadequate technical capacity for maintaining the equipment. Mandated as the “single authoritative voice for weather warnings” in the country. Publicly available forecasts are by region.</td>
<td>Forecasts are available on the KMD website: 5-day, 7-day, monthly and seasonal. Agrometeorological bulletins are available on the website for 10-day periods and by region. csv data files by county can be acquired.</td>
<td>Forecasts on website are free. Data files can be accessed based on written request to the department.</td>
</tr>
<tr>
<td><strong>aWhere <a href="https://www.awhere.com/">https://www.awhere.com/</a></strong></td>
<td>Predictive modeling for agriculture based on 1.7 million virtual weather stations globally. Uses blend of observed (ground station) and satellite weather data. Weather data resolution is at a 9km x 9km scale. Three main solutions offered: 1) In-time weather data to drive decisions, 2) Weather insights that combine crop models with weather data to create advisories, and 3) Maps for Economic Resilience that offer GIS-ready files for trend assessment and integrate with other GIS assets to generate new insights (e.g. number of people impacted by drought). API of aWhere integrates weather data with other data a to drive weather-based agro-advisories. Weather data includes observed and 15-day forecast with all key weather variables for agriculture (precipitation, temperature, humidity, wind speed solar radiation and potential evapotranspiration and comparison to historic values,).</td>
<td>Available by latitude/longitude or by ward through the Kenya Agricultural Observatory Platform: <a href="http://www.kaop.co.ke/">http://www.kaop.co.ke/</a> Weather data available to purchase at 9x9km scale, including historical weather data.</td>
<td>B2B (agribusiness, commodities, NGOs) B2G</td>
</tr>
</tbody>
</table>

Sources: Consultant interviews/analysis; Climate Development and Knowledge Network 2012
**Earth Observatory Providers in Kenya: Weather**

<table>
<thead>
<tr>
<th>Provider</th>
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<th>Business model</th>
</tr>
</thead>
<tbody>
<tr>
<td>KUKUA</td>
<td>Number of stations in KY unknown. 100+ weather stations in Kenya, Tanzania, Rwanda, Uganda, Mozambique, Ghana and Nigeria (2018). Ultimate goal of installing 7000 stations. Small cost-effective weather stations that are solar powered and internet connected via GPRS with 15-min readings. Established at MNO booster stations. Data is uploaded to the cloud via Eseye AnyNet SIM. It is combined with ECMRF global models and analyzed by Foreca, which develops localized weather forecasts.</td>
<td>Daily, weekly and seasonal forecasts are available via SMS or app. Raw data is available via csv files.</td>
<td>Sells data to researchers, government, multinationals, commodity trader and insurance companies.</td>
</tr>
<tr>
<td>Weather Impact</td>
<td>Provides agro-meteorological forecasts, extreme weather alerts, farm management advice and climate analytics. Projects in 6 African countries, Myanmar and the Netherlands. Buys data from ECMWF. Models chance of extreme weather. Predictive analytics to understand likelihood of weather forecast being correct or not. 5x5km rain, 10x10km temp for forecasts.</td>
<td>Raw data accessible in digital format. Also delivers via web and SMS. In Kenya, data was accessible through CROPMON project (2015-2019).</td>
<td>Sells to public and private companies. Also provides directly to farmers.</td>
</tr>
</tbody>
</table>

Sources: Consultant interviews; Usher et al 2018; Weather Impact 2019
# Earth Observatory Providers in Kenya: Satellites

<table>
<thead>
<tr>
<th>Provider</th>
<th>Services</th>
<th>Partners/Projects in Kenyan Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>eLeaf</strong>&lt;sup&gt;*&lt;/sup&gt;</td>
<td>Satellite based applications and data to optimize crop production and water management. Crop monitoring with PiMapping technology. Converts satellite pictures into quantified data (kg per ha). Analytics to determine cause of low growth. Predictive algorithms with historical data.</td>
<td>waPOR, FAO: Open access portal to monitor water productivity through remote sensing (Kenya plus many other SSA countries)</td>
</tr>
<tr>
<td><strong>Geodatics</strong></td>
<td>Geodatics collects geodata (satellite/remote sensing, soil landscape and yield gap data) and builds a geo-referenced scientific knowledge base; integrates the geodata and farm profiles and translates this into tailored advice for smallholders.</td>
<td>Agrics in Western Kenya (Busia, Kakamega, Bungoma) funded by G4AW 2015-2018. Agrics and Geodatics might merge.</td>
</tr>
<tr>
<td><strong>NEO BV</strong>&lt;sup&gt;*&lt;/sup&gt;</td>
<td>“World leader in monitoring and detection of changed objects using earth observation technologies.” In agriculture, provides crop growth monitoring services. Data acquisition (e.g. satellite imagery) and analysis. Radiometric calibration. Provides fraction of sunlight reflected on each pixel compared to the incoming amount of radiation which indicates crop condition.</td>
<td>CROPMON: Kenya. Provides data on the crop condition which is translated into the most probable crop growth limiting factor (climate, soil fertility, water supply, etc.) and disseminated to farmers as a management recommendation.</td>
</tr>
<tr>
<td><strong>VanderSat</strong></td>
<td>Daily satellite observations of water and temperature data with no cloud obstruction or darkness. 100x100 m resolution for soil moisture, vegetation, water content and temperature for every spot on earth. 40 years of satellite archive. 1000 times cheaper than traditional sensors. Uses passive radar technology.</td>
<td>Insurance applications (ACRE Africa partnership).</td>
</tr>
</tbody>
</table>

<sup>*</sup>Assessment also reviewed Satelligence [https://satelligence.com/](https://satelligence.com/) but they are not currently operating in Kenya.

Sources: Consultant interviews; Akuku et al 2019
# Earth Observatory Providers in Kenya: Drones

<table>
<thead>
<tr>
<th>Provider non-exhaustive*</th>
<th>Services</th>
<th>Partners/ Projects in Kenyan Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Astral Aerial</strong>&lt;br&gt;<a href="https://astral-aerial.com/">https://astral-aerial.com/</a>&lt;br&gt;For profit company since 2016. HQ in Nairobi.&lt;br&gt;Subsidiary of Astral Aviation.</td>
<td>In agriculture plans to provide these services: Precision agriculture, mapping of farms, crop spraying, livestock monitoring and inventory keeping, crop health and monitoring. Piloting the monitoring of crop health with drones that cover 100 acres per flight. Obtains direct visibility into crop health by using infra red, thermal sensors and multispectral sensors. Can collect data on sunlight absorption rates, transpiration rates, crop health, soil quality and more. Cargo drone has a payload capability of up to 2000kg, 1200 Km Range and flight time of up to 26 hours on surveillance mode. Smaller drone is capable of 8 hours of flight carrying up to 4kg payload.</td>
<td>Supporting farmers with crop health monitoring in Siaya, Trans Nzoia and Nakuru counties. Disruptive Agricultural Technology “Data Analytics and Agricultural Intelligence” cohort winner (World Bank, 2019 to provide crop health monitoring to smallholder farmers.</td>
</tr>
<tr>
<td><strong>Upande</strong>&lt;br&gt;www.upande.com&lt;br&gt;For profit social enterprise since 2009. HQ in Nairobi.</td>
<td>In agriculture primarily works with flower and logistics. Provides drone monitoring services (mapping and inspection, monitoring plant health and density) at the 3x3cm scale. Testing algorithms for monitoring large scale production of potato, wheat and sugarcane. Also provides tools for remote monitoring of facilities and farms. Currently rolling out temperature/humidity/pressure sensors in greenhouses/cold stores/trucks. Also deploying automatic water meters, level sensors, pressure sensors, weather stations and soil moisture sensors.</td>
<td>Larger-scale agribusinesses in the flower and agricultural logistics industries are primary clients. In order to lower the cost of hardware, inhouse electronics are being developed to make Upande’s IoT solution affordable to small holder farmers.</td>
</tr>
</tbody>
</table>

*Assessment also reviewed Aerobotics https://www.aerobotics.com/ but they are not currently operating in Kenya.

Sources: Consultant interviews; Akuku et al 2019; Astral Aerial, 2019
Donors are driving innovation digital precision agriculture in Kenya

Examples:

- **Agrifin Digital Farmer**, a 3-year, $5 million investment by the Bill & Melinda Gates Foundation, is continuing and expanding the work of AgriFin Accelerate to reach farmers with “smart-farming” solutions, including precision advisory services, in Kenya, Ethiopia and Nigeria.

- The Dutch Government is an active player across SSA in ICT for Ag. **Geodata for Agriculture and Water (G4AW)** funded out of the Netherlands space office is funding innovative solutions, including 2 in Kenya. In Kenya there are 13 Dutch companies/orgs active in this space and 4-6 interested in becoming active.

- The **World Bank**, through the $280 million Kenya Climate Smart Agriculture Project running from 2017-2022, is investing in “Supporting Agro-weather, Market, Climate and Advisory Services.”
  - US $16.5 M. Improving agrometeorological forecasting and monitoring.
  - US $11.4 M. Developing integrated weather and market information system with **KALRO** as the lead partner. Includes developing a big-data platform and delivering integrated weather and market advisory services.
  - US $5 M. Building technical and Institutional Capacity including for KMD and KALRO.

Sources: Akuku et al 2019; World Bank 2017b
Table of Contents

SECTION I  7 - 16
Technical specifications for digital precision agriculture advisory services for smallholder farmers

SECTION II  18 - 29
Landscape and gap analysis of Kenya’s digital precision agriculture advisory landscape

SECTION III  31 - 33
Recommendations
Safaricom’s DigiFarm Precision Agriculture Advisory Pilot

APPENDIX  35 - 51
Digital Precision Agriculture Provider Profiles
References
**Recommendations:**

<table>
<thead>
<tr>
<th>DONORS/GOVERNMENT</th>
<th>IMPLEMENTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unlock weather data for service providers and <strong>invest immediately in delivery of</strong> accurate and localized agro-weather advisories.</td>
<td>• Develop precision advisory services that are <strong>accurate and as close to the farm-level as possible.</strong></td>
</tr>
<tr>
<td>• Capitalize on scale opportunities through MNOs and other partners with 1M+ farmer customers.</td>
<td>• Take a <strong>phased approach to rolling-out precision advisory services</strong> to SHFs building from basic to complex solutions.</td>
</tr>
<tr>
<td>• Invest in <strong>improving the accuracy of localized weather data</strong> available for distribution to farmers.</td>
<td>• Immediately reach farmers with important information by <strong>scaling localized forecasts and developing, testing and scaling agro-weather advisories</strong> as the entry point for precision information for farmers.</td>
</tr>
<tr>
<td>• Invest in georeferencing farms to reduce the cost barrier for service providers to make highly localized, accurate advisories available to farmers.</td>
<td>• Maintain a <strong>flexible platform</strong> that allows for additional services to be added and <strong>build on nascent/developing approaches</strong>, including IoT, to precision advisory as they become more fully developed over the next 1-3 years.</td>
</tr>
<tr>
<td>• <strong>Bring implementors together.</strong> Link implementors with georeferenced farms with businesses who are piloting or trying to scale their services. Link willing implementors to bundle their services for more impact and a higher chance of profitability</td>
<td>• <strong>Build PPPs</strong> and business relationships between MNOs (or other scale-actors), government meteorological departments, precision agriculture advisory providers currently reaching farmers, earth observatory and big data analytics partners and partners with the proven ability to translate data into impactful messages to farmers.</td>
</tr>
<tr>
<td>• Fund research to <strong>determine</strong> what <strong>types of messages</strong> are the <strong>most impactful for farmers.</strong></td>
<td>• <strong>Share what you have learned</strong> (as much as is realistic given competitive nature of industry) so others can build from your challenges and successes in this rapidly changing field.</td>
</tr>
<tr>
<td>• Help implementors develop B2B relationships with earth observatory and big data analytics providers.</td>
<td></td>
</tr>
<tr>
<td>• At the same time, invest in <strong>building the big data analytics capacity</strong> of Kenya providers.</td>
<td></td>
</tr>
<tr>
<td>• Monitor and track the success of the pilots/start-ups operating in Kenya. More will be known in the next 2-3 seasons about what precision solutions are the most impactful for farmers.</td>
<td></td>
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</tbody>
</table>
ADF ACTION:
Precision Agriculture Pilot on Safaricom’s DigiFarm platform with partners KALRO, NASA and aWhere

Background

• AFA has worked with Safaricom since 2015 to develop DigiFarm, an integrated mobile-based platform for digital services tailored for SHFs.

• Because SHFs are vulnerable to increasing climate variability and climate shocks, a key part of the DigiFarm product roadmap is to deliver precision agriculture solutions for SHFs to help increase productivity and income and to minimize risks for the digital marketplace and digital credit.

Pilot objectives

• Leverage the wide-reach of the DigiFarm platform with over 1 million registered users, KALRO’s deep agronomic expertise including 300+ scientists, aWhere’s localized weather data and modeling capabilities and NASA’s deep technical expertise with earth observation technologies and data to test and disseminate precision agriculture tools for SHFs during the October 2019 planting season.

• Understand farmers needs and use patterns of precision advice and evaluate the impact on productivity and resilience.

Partner Roles

Provide location relevant agronomic management information for selected crops.

With agronomic info from KALRO, develop weather-based decision trees for six crops to create SMS messages for farmers and 15-day weather forecasts.

Engage with KALRO and aWhere to build-out longer-term and more accurate weather forecasting.

Collect farm location and data as input into aWhere models. Create awareness among customers. Share the messages with farmers (SMS push or pull).

Pilot funding. Partner coordination and relationship management. Implement monitoring, evaluation and learning (MEL).
**ADF ACTION:**
Precision Agriculture Pilot on Safaricom’s DigiFarm platform with partners KALRO, NASA and aWhere

### Pilot Design

- **Target farmers:**
  - Registered to DigiFarm with access to buyers through the platform. Growing maize, soya, sorghum, potatoes, sunflower, and/or green grams.
  - Located in 10-13 counties.
- **Pilot period:** Four months over the short-rains growing season between October 2019-January 2020
- **Activities:**
  - Develop farm specific advice based on geotagged location of farm including: 1) up to 15-day weather forecast and 2) Farming advice based on analysis of observed/forecasted weather data and the growth stage of each crop.
  - Deliver advice to farmers as push SMS or pull content depending on result of a pre-pilot farmer survey.
  - Implement an MEL plan to determine the viability of scaling the pilot.

### MEL Plan

- **Purpose:**
  - Gather data to test the hypothesis that precision agriculture can have a significant and meaningful impact on SHFs income, productivity, and resilience.
  - Evaluate usage of the product and product effectiveness. Identify factors that motivate or constrain SHF adoption and active use of DIS for precision agriculture.
  - Evaluate effectiveness and cost: benefit.
- **Methodologies:**
  - Monthly usage reports.
  - Phone-based surveys with subsample of geo-tagged farmers throughout cropping season.
  - Qualitative interviews with sub-sample of farmers from each VC at cropping season mid-point.
  - Pilot farmers included as a cohort group in the broader DigiFarm Impact Assessment.

**NEXT STEPS:** Check back with Mercy Corps for results and learnings from the precision agriculture pilot!
Table of Contents

SECTION I  7 - 16
Technical specifications for digital precision agriculture advisory services for smallholder farmers

SECTION II  18 - 29
Landscape and gap analysis of Kenya’s digital precision agriculture advisory landscape

SECTION III  31 - 33
Safaricom’s DigiFarm Precision Agriculture Advisory Pilot
Recommendations & Next Steps

APPENDIX  35 - 51
Digital Precision Agriculture Provider Profiles
References
Provider Details: Agrics and Geodatics

http://agrics.org/

**Organization type:** Start-up companies likely to merge, founded 2015

**ICTs:** SMS, call-in center

**Country presence:** HQ in the Netherlands, Kenya country office in Western

**Overview:** Have achieved success in supporting farmers to achieve increased yields through input credit program. With funding from G4AW, geotagging farmers and using a range of earth observation info combined with crop growth models to predict realistic yields and tailor fertilizer recommendations. Work with fertilizer companies to create customized blends and provide fertilizers with input credit. Follow-up with weather-based fertilizer management recs. Trying to cover cost of farmer advisory through the input credit program. Agrics has agronomists and Geodatics has data analysts and modelers. Also prototyped an AI platform for soil recognition and yield/repayment prediction.

**Crops:** Potatoes, Soy, Maize, Sorghum

**Livestock:** N/A

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**Precision Services**

**Climate Information Services:** Weather-linked soil management advisories; weekly weather forecasts (from CROPMON); developing climate risk indicators for farmers and regions.

**Value Chain Advisory:** In-season farmer advise based on satellite crop growth monitoring.

**Soil Management:** Using detailed farmer data, earth observation data (historic weather, soil grids, crop growth) and crop growth models, determine exact N-P-K needed to obtain realistic yields and translate this into fertilizer rec. Work with fertilizer companies to develop exact blends. Manage logistics of getting fertilizer to farmers on credit.

**Pests & Disease:** N/A

**Status of roll-out:** 20,000 farmers in Western Kenya
Provider Details: AgroCares

https://www.agrocares.com/en

Organization type: Start-up company founded 2013
ICTs: Smart-phone app
Country presence: HQ in Netherlands, Local office in Kenya
Partners: SoilCares Foundation, CROPMON, DigiFarm, Cooperatives, Agrodealers, County Governments, NGOs
Overview: Cloud-based. mobile soil (SoilCares), feed (FeedCares) and leaf (LeafCares) testing and insect monitoring (InsectCares) backed up by in-house big-data analytic capabilities. SoilCare’s SoilScanner and Lab-in-a-Box are services currently available in SSA, including Kenya. Roll-out is supported by SoilCares Foundation, which provides training to agents and farmers and tracks use and impact. AgroCares builds API’s for clients including DigiFarm to track SoilScanner use. AgroCares also provided data-analytics and messages on weather and soil via the CROPMON project (see slide 39).
Crops: SoilScanner results includes “suitable crop types” based on soil testing result
Livestock: Launching FeedCares, a mobile livestock feed testing product in 2019

Precision Services

Climate Information Services: Not core business. See CROPMON slide 39 for example of service provided.
Value Chain Advisory: Not core business. See CROPMON slide 39 for example of service provided.
Soil Management: SoilCares hand-held testing device provides in-field monitoring of soil nutrients via a smart-phone app and hand-held printer. Smart-phone app delivers soil fertility assessment and management advice including target yield, soil status, actual nutrient need, soil correction plan and suitable crop types. Supports B2B clients to integrate soil data into their advisory services.
Pests & Disease: Digital tool for counting and locating insects (InsectCares). Developing data analytic capability to use satellite data to assess pest and disease pressure. Not yet deployed in SSA.
Status of roll-out: Since 2017, has reached 20,000+ farmers in Kenya with SoilCares services
Provider Details: Apollo Agriculture

https://apolloagriculture.com/

**Organization type:** Start-up company founded 2016

**ICTs:** IVR, radio, phone calls, SMS

**Country presence:** Kenya only, 9 counties

**Overview:** Agricultural fintech company that helps small-scale farmers maximize their profits. Apollo Agriculture provides bundled input financing to small-scale farmers. Apollo builds credit profiles for unbanked smallholders using machine learning models that process large volumes of customer data, including satellite data of customers’ fields. To reduce the cost of reaching and financing farmers and enable rapid scale, they have built automated operations that overcome the need for expensive, manual processes. For instance, over the course of the season, Apollo customers receive guidance on farming techniques through highly engaging automated “IVR” phone calls, delivered to customers’ feature (non-smart) phones as a pre-recorded phone call. This IVR platform is one example of how Apollo’s digital approach allows them to dynamically engage with customers, regardless of literacy levels and remote locations. Goal is to enable the transition from subsistence to commercial farming.

**Crops:** Maize (core product), Potato, Sorghum, Beans

**Livestock:** N/A

**Status of roll-out:** First season was 2017. Has substantially grown customer base while also introducing new bundled finance products in non-maize crops. Have grown from operating in 1 county in 2017 to operating in 9 in 2019.
Provider Details: Arifu

https://www.arifu.com/

**Organization type:** Start-up business founded 2013

**ICTs:** Interactive SMS, chat apps

**Country presence:** HQ in Kenya

**Overview:** Technical ability to tailor content and learning to needs of individual users. Limited agricultural content but currently working to expand agriculture focus including hiring agriculture-dedicated staff. Precision agriculture content limited to customization by crop/livestock. Operates in Kenya, Tanzania, Nigeria, Zambia and Rwanda.

**Crops:** Potatoes, Maize, Cabbages, Tomato, Rice

**Livestock:** Dairy, Chicken

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**Precision Services**

**Climate Information Services:** N/A

**Value Chain Advisory:** Basic crop and livestock management content linked to crop calendar and customized for the learner.

**Soil Management:** Basic fertilizer recs based on crop.

**Pests & Disease:** Basic pest & disease info based on crop.

**Status of roll-out:** Agriculture content reaching **1,000,000 farmers** across partners, including DigiFarm, Equity Bank and KCB in Kenya.
Provider Details: CROPMON

https://g4aw.spaceoffice.nl/en/projects/g4aw-projects/75/crop-monitoring-service-cropmon-.html

**Organization type:** G4AW funded project with objective to develop sustainable business model

**ICTs:** SMS; smart-phone/tablet app, online desktop portal

**Partners:** Soil Cares Research (data analytics), Soil Cares Ltd. (soil testing), Springg (software development), Weather Impact (weather forecasts), NEO (satellite crop monitoring), Equity Group Foundation, Cereal Growers Association, Sugar Research Institute, Coffee Management Services

**Country presence:** Project implemented in 28 counties in Kenya from 2015-2019

**Overview:** Piloting an agro-weather advisory service based on geotagged location of farms. Leverages international partners for weather/crop monitoring data/data analytics. Management advice based on crop growth model utilizing satellite data which does not determine cause. Value proposition for farmers unclear because they can see the growth status for themselves; however farmers report that weather forecasts are 98% accurate. Project closed in August 2019. Partners continue to work together with support from 2SCALE to find a clear pathway to a sustainable business model.

**Crops:** Coffee, maize, grass, wheat, sugarcane

**Livestock:** N/A

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**Precision Services**

**Climate Information Services:** Weekly forecast with weather-based cropping advice; 5x5km rain; 10x10km temperature

**Value Chain Advisory:** 1 advisory message/week based on 10x10m satellite crop growth monitoring

**Soil Management:** SoilScanner testing, data not integrated to model

**Pests & Disease:** In progress

**Status of roll-out:** April 2019: 20,000 farmers received 2 SMS/week weather and advisory; 50,000 received 1 SMS/week weather. August 2019: Project reported reaching 200,000 farmers.
Provider Details: Kenya Agricultural Observatory (KALRO)

Organization type: Government Research
ICTs: Website (http://www.kaop.co.ke/), SMS, Apps
Partners: aWhere, CGIAR, many other precision players
Overview: Designing a full-scale agro-weather platform to cover the entire country and all crops and livestock. Leverages KALRO’s 300+ agronomists and existing app-based info on crop management and market information. Developing big data platform to integrate layers of data into farmer advisories. Expected to develop a sustainable business plan in <3 years.
Crops: All (existing apps for potato, avocado, banana, cashew, cassava, cowpea, coconut, coffee, garlic, gooseberry, guava, macadamia, mango, pomegranate, pyrethrum, spider flower, sugarcane, tea, spider flower)
Livestock: All (existing apps for dryland pasture, range pasture, cattle feeding, indigenous chickens)

Precision Services

Climate Information Services: Partners with aWhere to provide weather forecasts at different timescales using historic and long term-trends versus current patterns for the entire country at 9x9km scale. Also buying data from Kenya Met and 300 private weather stations.
Value Chain Advisory: Agro-weather advisories throughout season.
Soil Management: TBD
Pests & Disease: Pest and disease forecasting; apps for Fall Army Worm and other diseases.
Status of roll-out: PROTOTYPING aWhere weather data available for the whole country to the ward level on www.kaop.co.ke. Agro-weather advisories and Big Data Platform in development. Financed by World Bank
Provider Details: iCow

http://www.icow.co.ke/

Organization type: Start-up company founded 2012

ICTs: USSD pull menu, SMS and call-in center

Country presence: HQ in Kenya

Overview: Extensive value chain specific learning content. Soil and seed recommendation based on farmer location (county/constituency). Farmers can access a list of service providers based on location. Interactive platform for responding to farmer queries. Does not provide weather forecasts. No back-end data-analytics. Report that 90% of users used some content, 60% changed a behavior.

Crops: Potatoes, African Nightshade, Amaranth, Cassava, Cowpea, Green gram, Pigeon pea, pumpkin, Spider plant, Yam, Tomatoes, Cabbages, Sukuma, Beans, Peas, Peppers, Spinach, Onions, Carrot, Aubergine, Maize, Sorghum, Millet, Wheat, Rice

Livestock: Bees, Dairy cows (heifer, calf), Chicken-Kienyeji, Broilers, Layers, Goats, Rabbits

Precision Services

Climate Information Services: N/A

Value Chain Advisory: Full season advice by crop; seed variety rec for maize/potatoes based on county

Soil Management: Soil type by sub-county but not linked to advice; info on locally available soil testing services

Pests & Disease: Farmers query based on symptoms and get automated management advice for tomato and maize pest and diseases

Status of roll-out: 95,992 active users.
Provider Details: iShamba

https://ishamba.com/

**Organization type:** iShamba is a program of Mediae, a start-up company launched in 1997

**ICTs:** SMS, WhatsApp, call-in center

**Country presence:** HQ in Kenya

**Overview:** iShamba has achieved the largest scale of farmer clients and operates in all 47 counties. Wide range of crops/livestock covered. Signed members receive weekly SMSs and access to a call-in center. Provides weather reports seasonally, weekly and by location (county level) and manually tailors advice based on crop grown and farm location. Employs a team of agronomists and other agricultural experts (e.g. veterinarian, agribusiness). Limited back-end, in-house data analytics capabilities. iShamba farmers have reported to have higher yields than similar non-users, in some cases higher than 50%.

**Crops:** Potato, Sunflower, Soy, Amaranth, Avocado, Banana, Beans, Black Nightshade, Cabbages, Carrots, Cassava, Maize, Millet, Garden Peas, Green grams, Kale, Mangoes, Onions, Pigeon Pea, Sorghum, Spinach, Sweet Potatoes, Tomatoes, Tree tomatoes, Passion, Oranges, Pawpaw, French beans

**Livestock:** Bees, Dairy cows (heifer, calf), Chicken layers and broilers, Indigenous chickens, Meat goats, Pigs, Rabbits, Dairy goats

**Precision Services**

**Climate Information Services:** Distributes forecasts from the Kenya Meteorological Department and aWhere.

**Value Chain Advisory:** Crop information sent seasonally based on crop calendar by location (manually generated based on when rains start in county) and livestock information based on events. Full value chains covered.

**Soil Management:** Promotes soil testing and provides agri-tips on how to improve soils for specific crops.

**Pests & Disease:** Identification of pests and diseases using mobile messaging and images through WhatsApp. Provides recommendations on products for treatment and management advice for specific pests/diseases and crops.

**Status of roll-out:** 300,000 farmers with goal to reach 1 million pending funding.
Provider Details: MbeguChoice

http://www.mbeguchoice.com/

**Organization type:** Hosted by the Seed Trade Association of Kenya (STAK); originally developed by Agri Experience Ltd. with funding from the Kenya Markets Trust (KMT), launched 2015

**ICTs:** Website, Android mobile app

**Country Presence:** Kenya only

**Partners:** STAK, Kenya Agriculture and Livestock Research Organization (KALRO), Kenya Plant Health Inspection Service (KEPHIS), KMT, Agri Experience Ltd.

**Overview:** MbeguChoice is an online and Android app-based tool (available on Google Play) for farmers, agrodealers and extension workers to get information on the crop varieties best suited to their area and production goals and plans. It currently maps 237 seed varieties of 20 crops to the counties and agro-ecological zones where they are best suited. Free to users. User can be online or offline with app. Not available for feature phones. Not currently linked to other services such as credit. Doesn’t link farmer to seed source.

**Crops:** Irish Potatoes, Soya Beans, Cassava, Chickpea, Climbing bean, Common bean, Cowpea, Dolichus bean, Finger millet, Foxtail Millet, Maize hybrid, Maize OPV, Green grams, Pearl millet, Pigeon pea, Rice paddy, Rice upland, Sorghum, Sweet potato, Wheat

**Livestock:** N/A

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**Precision Services**

**Climate Information Services:** N/A

**Value Chain Advisory:** Crop variety recommendations only. User selects county, ecological zone and crop – and desired maturity, special characteristics, and rainy season if desired – and receives variety recommendation. Newest varieties are listed first.

**Soil Management:** N/A

**Pests & Disease:** N/A

**Status of roll-out:** Website and app have over 30,000 users in Kenya
Provider Details: Precision Agriculture for Development (PAD)

Organization type: NGO launched in 2016

ICTs: Two-way SMS, push messages

Country presence: HQ US, Local office Kenya. Also has programs/teams in Rwanda, Uganda, Ethiopia, India, Pakistan and Bangladesh.

Partners: Ministry of Agriculture (MoA), CABI, KALRO, Kenya Meteorological Department, KEPHIS, Seed companies, National Potato Council of Kenya, Tulaa, One Acre Fund

Overview: Core partner is the MOA through the MoA-INFO platform. Expanding platform focus from Fall Armyworm advisory to include more comprehensive advisory services for 6 main crops linked to farmer location; seed varieties recommendations based on location; fertilizer management based on farm size/budget; and providing weekly weather forecast (currently being piloted in 2 counties). Research capabilities using A/B tests to concurrently improve user experience and deliver more appropriate information. Agronomists, economists, data scientists, and data analysts on staff.

Crops: Maize, Beans, Irish Potatoes, Sweet Potatoes, Pigeon Peas, Bananas

Livestock: N/A

Precision Services

Climate Information Services: Weekly forecasts localized to climatic zones (2 counties)

Value Chain Advisory: From pre-planting to post-harvest. Timing of messages based on location. Maize seed selector based on farmer selected duration and suitability for area.

Soil Management: Tailored fertilizer recs for maize based on amount of land and amount of $ available for fertilizer (4 counties).

Pests & Disease: Users can assess the extent of FAW infestation on their maize based on sampling 5 spots in their field and then receive advice on whether or not pesticide use is recommended.

Status of roll-out: Fall Armyworm 366,000+ farmers; PILOTING weather forecasts and other advisory services in 2019 cropping seasons
Provider Details: PRISE-CABI


**Organization type:** Pest Risk Information Service Project of CABI

**ICTs:** Telegram App messaging to agents


**Partners:** Assimila, King’s College London, local extension services, UK Space Agency (donor)

**Overview:** Utilizes earth observation data and plant and pest lifecycle models to create pest alerts. Leverages existing network of Plant Health Specialists (from Plantwise [https://www.plantwise.org/](https://www.plantwise.org/)) and extension agents. Trying to develop a sustainable business model by selling the service to large-scale producers and agriculture insurance sector. Positive qualitative feedback on model accuracy—poor quality quantitative data. Takes ~2 years to add a new crop.

**Crops:** Maize, Beans, Tomatoes, adding Cabbage, Cocoa

**Livestock:** N/A

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**Precision Services**

**Climate Information Services:** N/A

**Value Chain Advisory:** N/A

**Soil Management:** N/A

**Pests & Disease:** Pest risk forecasting system, Messages to farmers for managing the pest at the right time in the crop and pest stage. County level targeting.

**Status of roll-out:** PRISE is PILOTING pest alerts and validating and calibrating models. Plantwise is fully scaled with 150 clinics, covering 91 pests in Kenya.
Provider Details: Techno Brain

https://technobraingroup.com/

Organization type: For profit company founded 1997

ICTs: Smartphone app, touchscreen kiosks, IVS, SMS

Country presence: HQ in Kenya, represented in over 20 African countries

Partners: Microsoft, aWhere, Export Trading Group

Overview: Ambitious plans to use intelligent cloud with farm/weather data to give info to farmers to make better decisions globally. In Kenya, Ulima smart phone app rolled out in Kiambu, Nakuru and Lakiopia counties. Early stages with limited localized data other than weather forecast but functionality to provide precision recommendations. Will take 2-3 years to reach scale. Piloting a B2C business model charging for 25% of the info/services and providing 75% for free. Has also launched www.enlima.com (soft launch 2019), an online platform linking farmers to market. Has 14 agronomists in Kenya/S. Africa and precision ag programs in 5 countries in SSA and in India. Large data processing and analytical capacity.

Crops: Potatoes, Cabbage, Coffee, Maize, Onion, Pulse, Rice, Sorghum, Sweet potato, Sunflower, Tea, Tomatoes, Wheat

Livestock: Chicken, Beef cattle, Dairy cow, Pig, Sheep, Goat

Precision Services

Climate Information Services: Weather forecast at the county level on Ulima app.


Soil Management: Management info available on Ulima app.

Pests & Disease: Management information available on the Ulima app.

Status of roll-out: 30,000 farmers on the Ulima app in Kenya
Provider Details: Waterwatch Cooperative

https://waterwatchcooperative.com/

**Organization type:** Cooperative with several legal entities including Waterwatch Solutions which develops apps to support farmers and Waterwatch Investment Fund which funds app development, founded 2014

**ICTs:** Smart phone apps

**Country presence:** HQ in the Netherlands, one project in Kenya; also works in Vietnam, Ghana, Burundi

**Partners:** Satelligence, eLeaf, Vito, Weather Impact, ExtraReality, KALRO, KEPHIS

**Overview:** Builds a variety of technical precision services into apps depending on client and country/crop context and starting with the clients needs. The Crop Disease and Tracking Solution (CDAT) smartphone app, which combines weather data, satellite imagery and pictures from farmers to diagnose and track crop disease, is being developed for potatoes in Kenya. The AgriCoach app in Burundi supports farmers with weather forecasts, a Crop Selector (what to plant), Activity Timer (when to implement management practices) and information on how to optimize yield. A Value Chain Advisory app is under development combining services from multiple applications including FinTech solutions.

**Crops:** Potatoes (Kenya), Various (Burundi), Cacao (Ghana), Coffee (Vietnam)  
**Livestock:** N/A

**Precision Services**

**Climate Information Services:** CDAT provides a 10-day forecast with actionable insight/timing for treating potatoes.

**Value Chain Advisory:** Under development.

**Soil Management:** N/A

**Pests & Disease:** CDAT provides disease/pest alerts based on weather/algorithms of disease pressure for potatoes. Predicts disease, verifies based on image recognition and provides management advice using machine learning/AI.

**Status of roll-out:** CDAT is PROTOTYPING. By the end of 2020, it will be tested with potato farmers in Nakuru and in 2021 will be tested on larger scale and ready for market mid-year.
Provider Details: Ujuzi Kilimo

http://ujuzikilimo.com/

**Organization type:** Start-up company founded 2016

**ICTs:** Interactive SMS

**Country presence:** Kenya is the sole country of operation; operates in Nyeri and Embu and expanding to Trans-Nzoia and Kakamega May 2019

**Partners:** Farmers Pride Africa https://farmersprideafrica.com/; KUKUA; aWhere

**Overview:** Provides farm specific recommendations (fertilizer, agro-weather advisory) based on data collected with the Ujuzi hand-held soil-testing device, weather forecasts and in-house data analytics. The device captures soil characteristics, topography and environmental data which is analyzed by experts to provide actionable recommendations. Farmers can ask questions of the staff agronomist. Has software developers and data scientists on-staff. Charges 1000KES for soil test plus customized recommendations per crop per field per season.

**Crops:** Maize, beans, cabbages, potatoes and 8 other crops

**Livestock:** N/A

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**Precision Services**

**Climate Information Services:** 5-day weather forecasts by location

**Value Chain Advisory:** Agro-weather advisory; crop specific advice throughout season

**Soil Management:** Macronutrient and salinity status and corrective advice/recommendation

**Pests & Disease:** N/A

**Status of roll-out:** 10,000+ farmers
Provider Details: Yielder

http://www.yielder.world/

**Organization type:** For profit company launched in 2018

**ICTs:** Smart phone app

**Country presence:** Kenya is sole country of operation

**Partners:** Implementers: SNV, Rabobank Foundation, Incentro, Dalberg Research, Media HQ, Contenful / Collaborators: TechnoServe, Farm Africa, Wageningen, Hortfresh, Abel Derks, Biovision Africa Trust

**Overview:** Yielder: Grow Smart app is a farmer information and communication platform. Provides a platform for farmers to answer questions from each other. Provides a platform for farmers to pull existing data and information from NGOs, research institutions, and other content providers. Provides relevant and timely push notifications to farmers based on their profile (region and crop). Through Yielder farmers can receive digital trainings. Free for farmers.

**Crops:** Various crops

**Livestock:** Dairy

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**Precision Services**

**Climate Information Services:** Weather forecast based on farm location.

**Value Chain Advisory:** Tailored to farmer location and crops. Market prices and crop production information.

**Soil Management:** Basic soil management info.

**Pests & Disease:** Crop specific pest management decision guide/info on important diseases and pests.

**Status of roll-out:** Fully functional app launched in 2019. 6000 direct downloads and **20,000 users**.
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