International symposium on Farmers' access to data

Centurion, South Africa
24 November 2017

Program, keynote speeches and presentations

Ajit Maru

Dan Berne

Jeremy De Beer

Johannes Abbott
Nico Kroese
Stephen Kalyesubula
Moses Odeke
Juanita Chaves Posada

Program committee
Valeria Pesce (GFAR), Michael Brobbey (GODAN), Gracian Chimwaza (ITOCA)

International Symposium on Farmers' Access to Data

24th November 2017

Centurion, South Africa

Program

9:30 – 10:00	Arrival and registration
10:15 – 10:30	Welcome and introduction
10:30 – 12:00	Panel 1 "Data and Farmers" 10:30 – 11:00: Keynote speech – Ajit Maru 11:00 – 11:20: Presentation - Johannes Abbott 11:20 – 12:00: Panel discussion & Q&A
12:00 – 12:15	Break
12:15 – 13:45	Panel 2 "Digital Agriculture - Challenges and Opportunities" 12:15 – 12:45: Keynote speech – Dan Berne 12:45 – 13:00: Presentation - Nico Kroese 13:00 – 13:15: Presentation - Stephen Kalyesubula 13:15 – 13:45: Panel discussion & Q&A
13:45 – 14:40	Lunch
14:40 – 16:10	Panel 3 "Fair and equitable open data" 14:40 – 15:10: Keynote speech – Jeremy De Beer 15:10 – 15:25: Presentation – Juanita Chaves 15:25 – 15:40: Presentation – Moses Odeke 15:40 – 16:10: Panel discussion & Q&A
16:10 – 16:15	Closing

Description of panels

Panel 1 - Ajit Maru - "Data and Farmers"

Ajit Maru, Ph.D., grew up in Kenya, studied veterinary sciences in India and has served the Indian Council of Agricultural Research, National Dairy Development Board of India, International Service for National Agricultural Research, Dhirubhai Ambani Institute of Information and Communication Technology and the Global Forum on Agricultural Research/FAO in his professional career spanning almost 40 years. He now follows his lifelong interest in understanding and improving the livelihoods of small holder farmers. At the moment he is working on developing a single window platform to support small holder farmers of Gujarat, India, in their farming and participation in markets.

Abstract

I explore (why, what, where, how) the paradigm shift is occurring in agriculture making it data driven, information rich and knowledge intensive. I then distinguish between use of data from the farm (precision farming) and data outside the farm (Digital agriculture, Agriculture 4.0) and the implications of its sharing and exchange from the point of the view of the smallholder farmer, as farmers are not a homogenous entity. I will look at the emergence of open and closed information chains as it is occurring in supermarket and fast food restaurant chains and in alternative agriculture of small farmers linked to farmers markets. I list out which data is used how by a farmer in farming operations and then show its use and abuse when data is shared by an individual farmer and when aggregated. I also describe farmers, actors and stakeholders of agricultural data and information chains. Finally I describe and indicate what in my opinion now needs to be done starting from International treaties and conventions to national and local policies, rules, regulations, norms, codes etc., and structures.

Panelists

1. **Johannes Abbott** from Farmboek will present the Farmboek information service for farmers
2. **Alpha Mtakwa**, farmer and Agricultural Officer at Sokoine University
3. **Charles Mbuthia** from the Kenyan National Farmers Federation (KENAFF)

Panel 2 – Dan Berne - "Digital Agriculture - Challenges and Opportunities"

Dan Berne is an independent consultant working at the nexus of water, food and energy. He leads the strategic planning work in the industrial agricultural irrigation market for the Northwest Energy Efficiency Alliance (NEEA), a non-profit organization focused on energy efficiency. Working with the non-profit group AgGateway, Dan leads the effort to develop a set of data standards and formats to convert data for use in precision irrigation and other water management programs. He is an expert in standards development, business processes, market development and customer experience strategies.

Abstract

I will focus on the issues of grower adoption of using data-driven practices. What are the obstacles? What can the industry and other organizations do to increase adoption? Using Geoffrey Moore's Technology Adoption Lifecycle, I will define the requirements for data-driven solutions to "cross the chasm." I will examine the role of data standards and address how to deal with data that are used in different geo-political contexts. I will propose a set of activities and guidelines that will help accelerate the adoption of data-driven agricultural solutions.

Panelists

1. **Nico Kroese** from the South African Weather Service, who will present the Rain 4 Africa project
2. **Stephen Kalyesubula** from iLabs@Mak Project of Makerere University, who will present on key data for farm management
3. **Thomas Kwaku Dzandu** from Ahinsan Vegetable Farmer's Association
4. **Nike Tinubu** from Nigeria Cassava Platform

Panel 3 – Jeremy De Beer – "Fair and equitable open data"

Jeremy De Beer is a Full Professor of law at the University of Ottawa's Faculty of Law, where he creates and shapes ideas—about technology innovation, intellectual property, and global trade and development. As an award-winning professor recognized for exceptional contributions to research and law teaching, his current work helps solve practical challenges related to innovation in the digital economy, life science industries, and clean technology sector.

He is a co-founder and director of Open AIR, the Open African Innovation Research network, which connects dozens of multi-disciplinary researchers across African countries, Canada and elsewhere to scale up innovation by easing tensions between intellectual property and access to knowledge.

Abstract

I will explain in this talk how to create a fair and equitable system of benefit sharing around open data. We must acknowledge the access barriers that data ownership may raise, then develop strategies to strengthen a data commons that engages all stakeholders.

Agricultural data is a vital resource in the effort to address food insecurity. This data is used across the food-production chain. For example, farmers rely on agricultural data to decide when to plant crops, scientists use data to conduct research on pests and design disease resistant plants, and governments make policy based on land use data. Open agricultural data has the potential to address food insecurity by making it easier for farmers and other stakeholders to access and use the data they need.

Panelists

1. **Juanita Chaves** from GFAR, who will present on issues of farmers' rights
2. **Moses Odeke** from ASARECA, who will present on the role of mobile phones and private/public infrastructures in enhancing access to data
3. **Tereza Chelule** from the Kenyan National Farmers Federation (KENAFF)
4. **Michael Brobbey** from the GODAN Secretariat

This training course has been convened and sponsored by
the Global Forum on Agricultural Research and Innovation (GFAR)

gfar-secretariat@fao.org

The training was co-organized and co-sponsored with:

- The **Information Training and Outreach Centre for Africa (ITOCA)**
- The **Global Open Data for Agriculture and Nutrition (GODAN)** initiative
- The **Technical Centre for Agricultural and Rural Cooperation (CTA)**

Special thanks to Earth Observation Science & Information Technology of **CSIR**; Land Use and Soil Management Directorate of the **DAFF** and Agricultural Research Center (**ARC**) South Africa for their contributions to the content of the symposium and the preceding training course.

Symposium - Panel 1

Data and Farmers

Panel chair: Ajit Maru

Symposium on Farmers' access to data
Centurion, South Africa, 24 November 2017

FARMERS AND DATA

Ajit Maru

Points to Discuss

- Three Issues:
  - What is the perspective of farmers about data and data management in data driven agriculture?
  - What are the benefits and hazards of data sharing for farmers as expected in data driven agriculture?
  - What is required for balance, symmetry, equity and fairness in data and information flows and use for smallholder farmers?

Paradigm Shift in Farming and Agriculture

Agriculture is changing rapidly to become increasingly data driven, information rich and knowledge intensive to cope with challenges of:

- Participating in globally competitive markets
- Access to natural resources especially water, land and soil nutrients
- Extreme aberrations of weather and Climate change

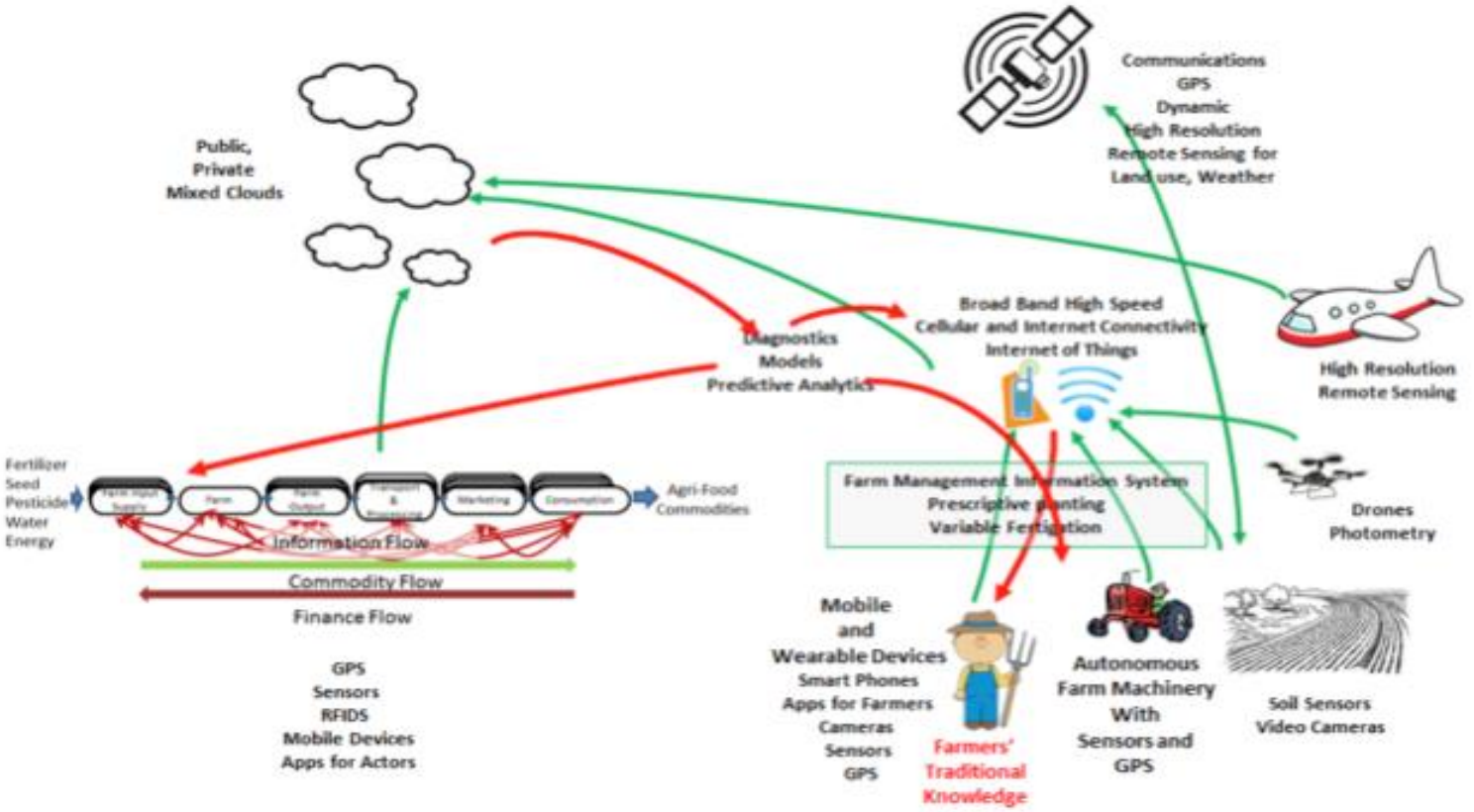
Agriculture 4.0

This new Agriculture 4.0 or Digital Agriculture and Precision Farming is facilitated by innovation in applying Information and Communications Technologies (ICTs) along with other advances in biotechnology, nanotechnology, geo-spatial and materials sciences

Agriculture 4.0

Agriculture 4.0 is also an effort to maximize profitability while optimizing productivity, quality, time and reducing human drudgery in farming and agriculture across the entire agricultural production chain from input to consumption and waste management.

Data Driven Agriculture, Agriculture 4.0



Data and Information Farmers Use

Data and information that farmers use can be categorized as:

- that the farmer generates and uses for his/her farm management
- that farmer gets from outside his farm and use it for his/her farm management such for weather, market related farm inputs and products
- that the farmer generates and is used outside his/her farm
- Static data such as land records

Data and Information Farmers Use

- The use of data by farmers is event driven according to the farming cycle for a crop.
- The data farmers use can be static, not changing over long periods of time, or dynamic, changing over time with half life from a few hours to that of the cropping cycle.
- The quantum of data a farmer manages depends on the crop and its value, space (plot, field, farm, local community of farmers etc.), time for cropping cycle, capacity to manage and use data, data tools available, precision desired etc.,

Data and Information Farmers Use

- Data without context is useless to a farmer.
- Data , information and knowledge are intertwined in farming and cannot be separated in use.

Data and Information Farmers Use

- Not all agricultural data is directly useful to farmers
- However, all data that farmers generates is in some way useful to other actors in and stakeholders of Agri-food systems.

Data and Information Farmers Use

The issues farmers face around data they need are:

- Availability
- Accessibility
- Affordability
- Capacity to “appropriate” or get the larger community based ownership in effectively managing and using the data and information in a collective manner.
- Relevance
- Usefulness
- Timeliness
- Trustworthiness
- Ability to use data and information effectively

Benefits of Sharing Data by Farmers

The benefits of sharing farm data are:

- Possibility for collective bargaining in market participation both for input and produce
- More economical logistics such as transport and storage through route mapping and scheduling
- Better market related forecasts
- Better forecasts for disease and pests outbreaks and collective management such as through Integrated Pest Management
- Greater opportunities for innovation and its spread

Benefits of Sharing Data by Farmers

The benefits of sharing farm data are:

- Better, more realistic research for global problems such as spread of diseases and pests, loss of biodiversity, pollution, land degradation etc.
- New areas of research and innovation such as through Big Data Analysis, Artificial Intelligence, etc.,.
- Land ownership with lesser conflicts
- Improved sharing of farm related resources such as machinery, tools and labor.
- Improved farm related services through route mapping and scheduling

Hazards of Data Sharing by Farmers

- The hazards or abuses farmer face when they share their data can be generically listed as:
  - Ethics – Where though no rules are broken but the process or product of data and information management is against prevailing moral practices, for example, data obtained free or by paying low price but sold as information at very high prices
  - Privacy – when the data is used to reveal something not for public use or that can disturb a individual or community
  - Security – when an entity, item or process is made vulnerable to distortion, damage or destruction
  - Safety - when use of data can result in malicious damage or destruction of an entity, item or process
  - Ownership – when the ownership of data is violated or obfuscated
  - Valuation – When data is intentionally under or overvalued

Hazards of Data Sharing by Farmers

The hazards or abuses farmer face when they share their data can be generically listed as:

- Monopoly – When an entity, item or process does not allow through legal contract or a device to access, use, repair it other than the authorized agency
- Helmification – is the regulation of a practice by governmental authorities, usually after the practitioners have proven incapable or unwilling to take care of issues themselves.
- Californication - *Californication* occurs when a single part of a large market is able to dictate the behaviour of practitioners across the entire market.
- Generalization which can distort the value or use of data
- Right to forget or storing data for ever
- Forceful revelation of data other than necessary for a purpose such as when contact list of a person, location or other apps use is demanded for using an app or a device
- Censorship, spying and giving data to unauthorized agencies or illegally for example to Government or to a stakeholder
- Interoperability, Linked Data and Portability

Farmer Categories

“Farmers” are not a homogenous entity. There are different categories of farmers

- Corporate and Large farmers
- Small farmers in developed countries with access to farmer organisations such as cooperatives
- Small farmers in developing countries with and without access to farmer organisations

Farmer Categories

- The capacity of farmers to manage and use data and information are dependent on:
  - Whether they are corporate, large or small
  - Whether they are in a developed country with well organized Agri-food market chains or developing country with evolving market oriented Agri-food market chains.
- Organized Agri-food market chains cannot exist without good farm data and information systems
- In developing countries with chaotic market chains, good farm data and information systems are not to serve their market chains. They serve foreign organized market chains.
- Thus sharing data does not benefit their agriculture and farming.

Data Driven Agriculture and Smallholder Farmers

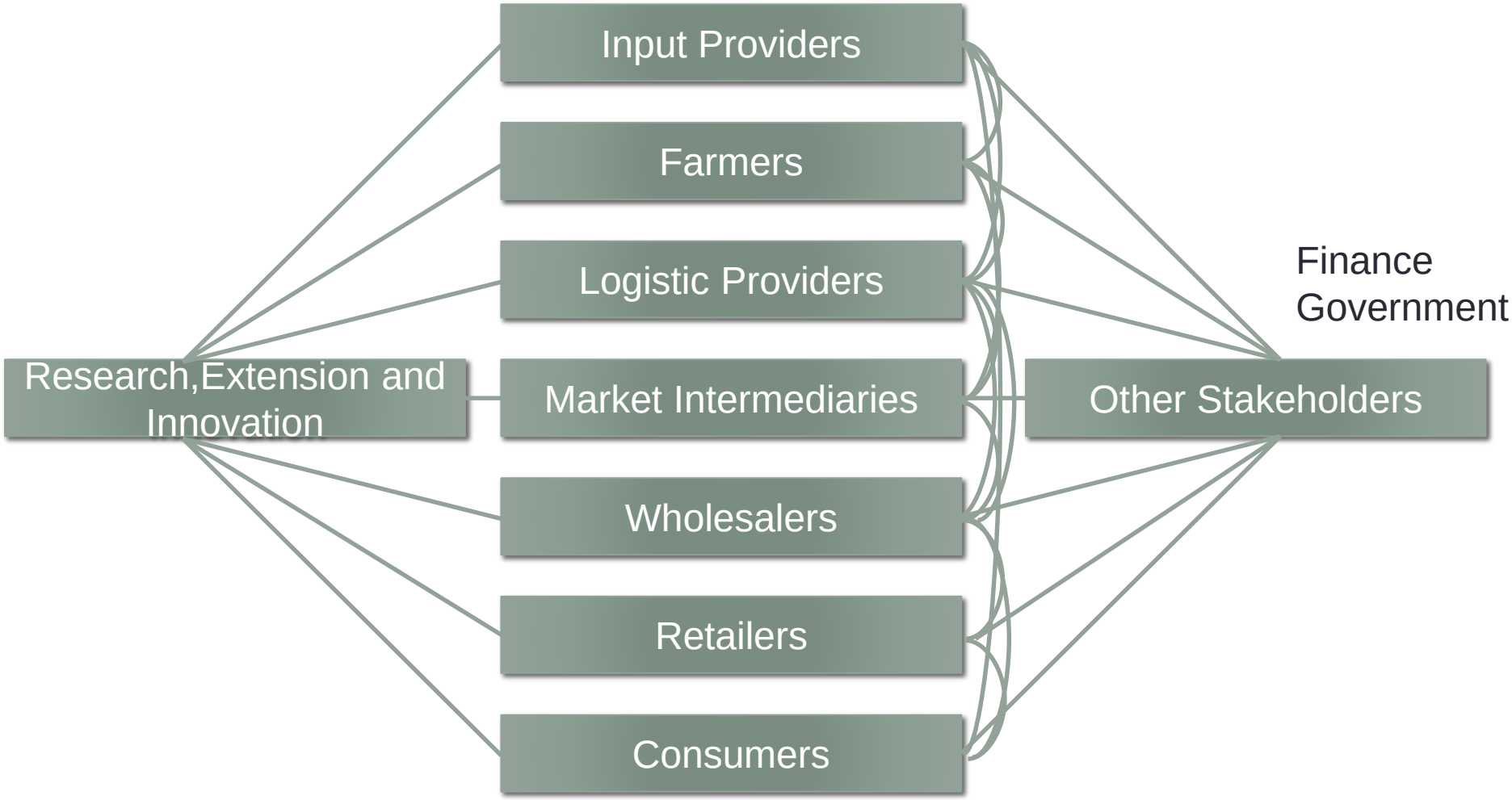
Is Data Driven Agriculture a boon enabling smallholder farmers have a better livelihood or a curse threatening their existence?

Challenges for Small Holder Farmers to Practice Data Driven Agriculture

Challenges Smallholder farmers in developing countries face in practicing data driven agriculture are:

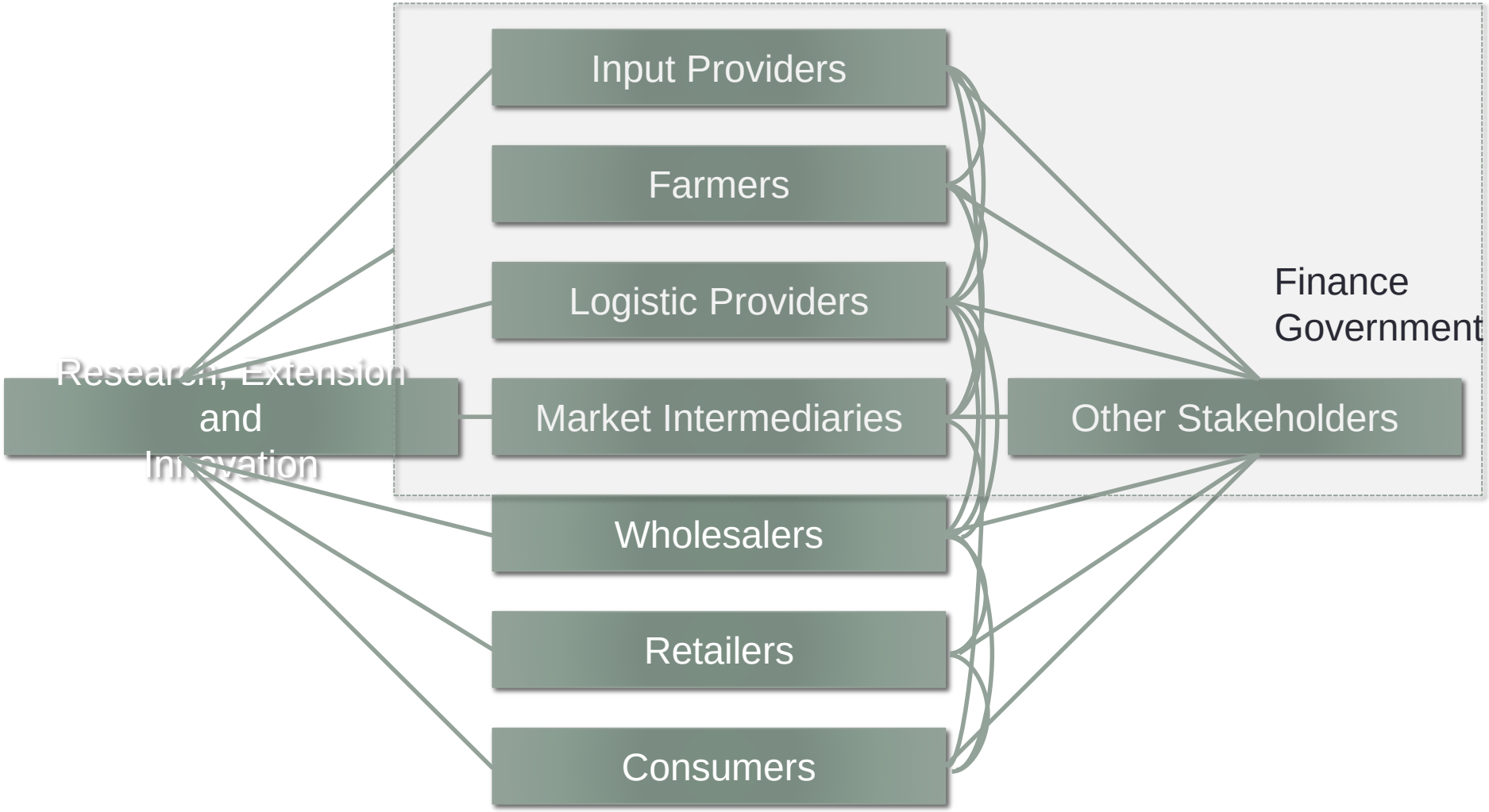
- Capacities to manage and use data
- Ownership of data
- Lack of farm and farmer aggregation
- Access to appropriate, affordable technology
- Lack of supporting Institutions and structure
- Trajectory of Government policies

Open and Closed Information Chains in Agri-food Systems



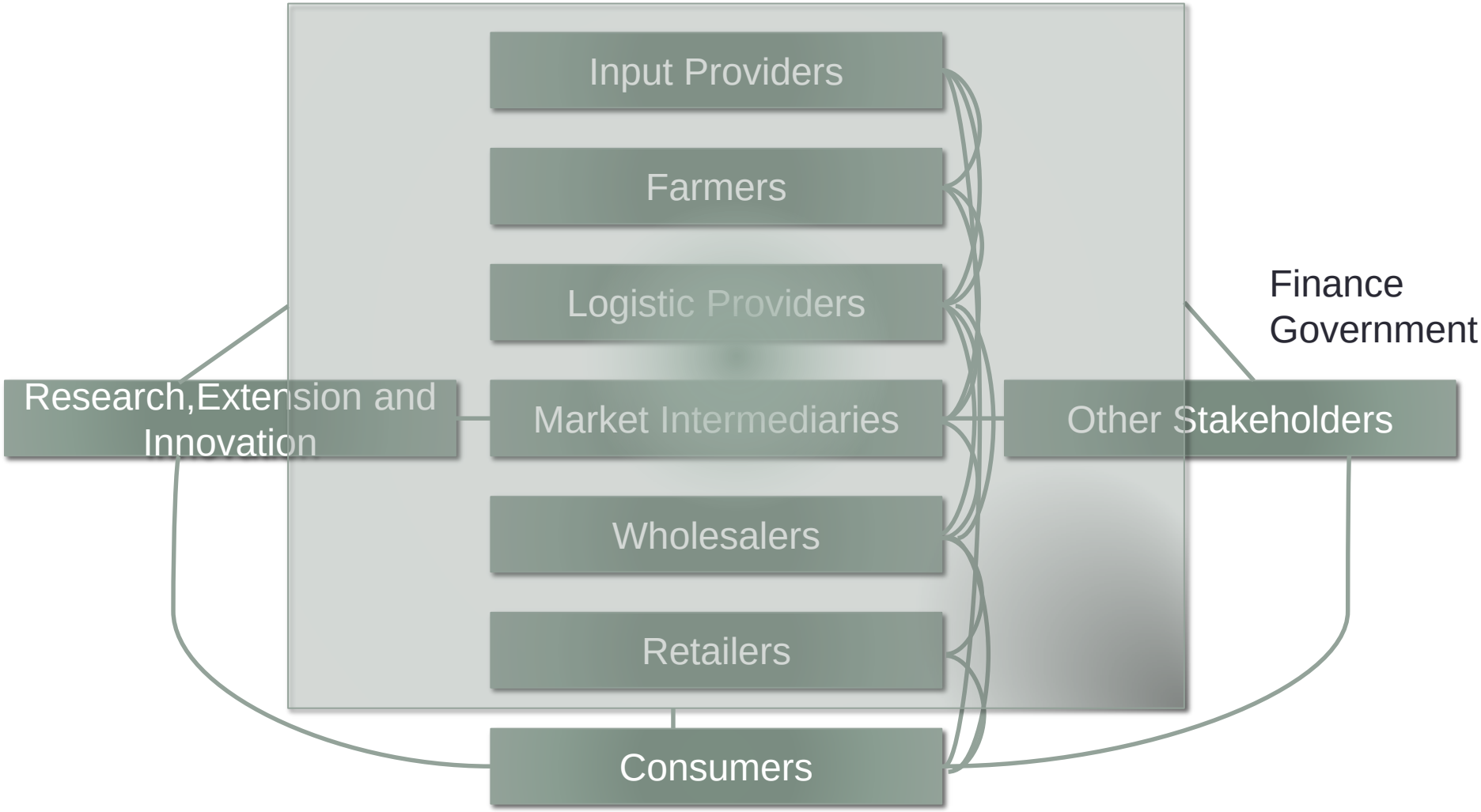
Open, Laissez Faire Markets

Open and Closed Information Chains in Agri-food Systems



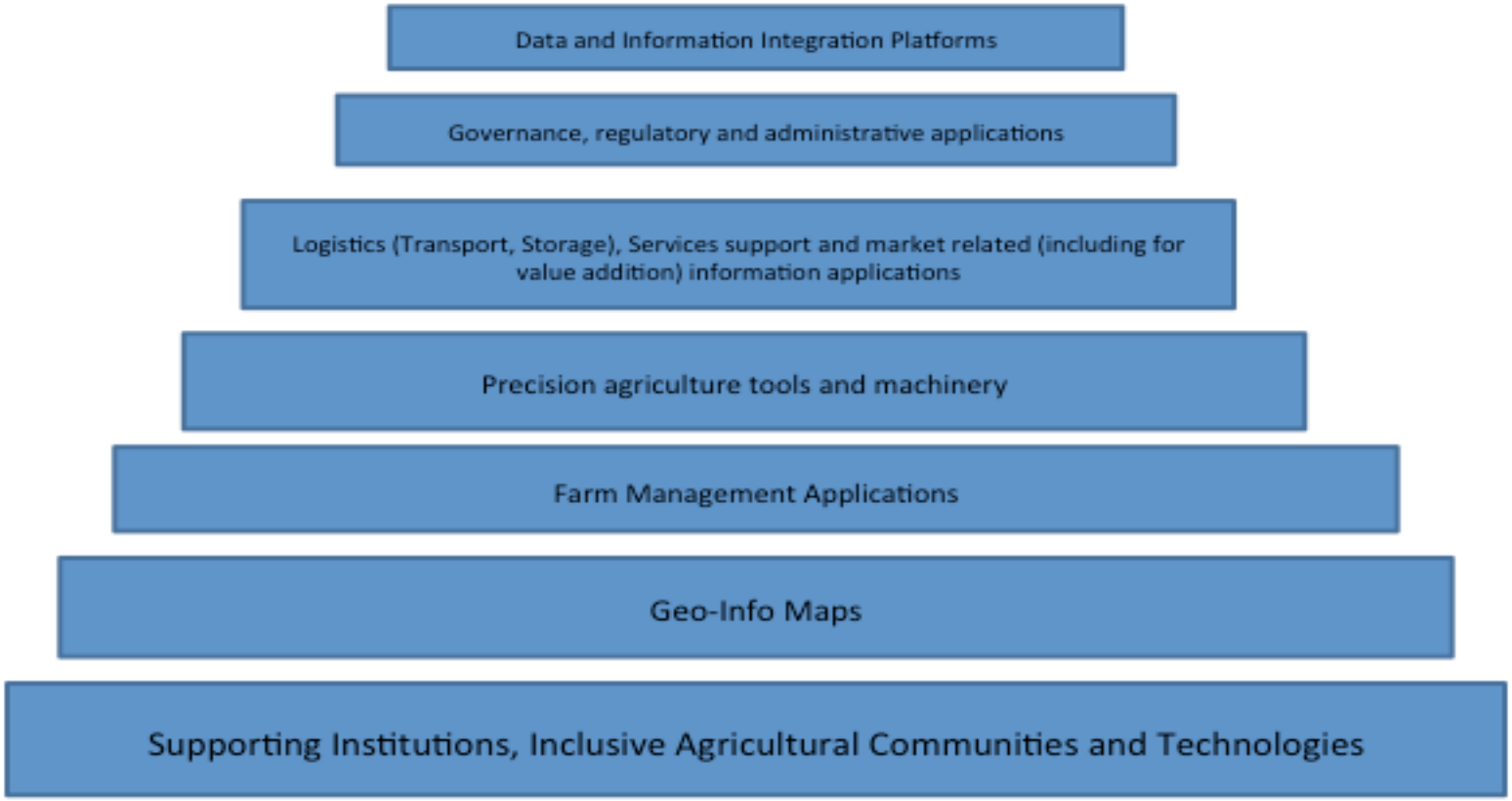
Cooperatives and Producer Companies

Open and Closed Information Chains in Agri-food Systems



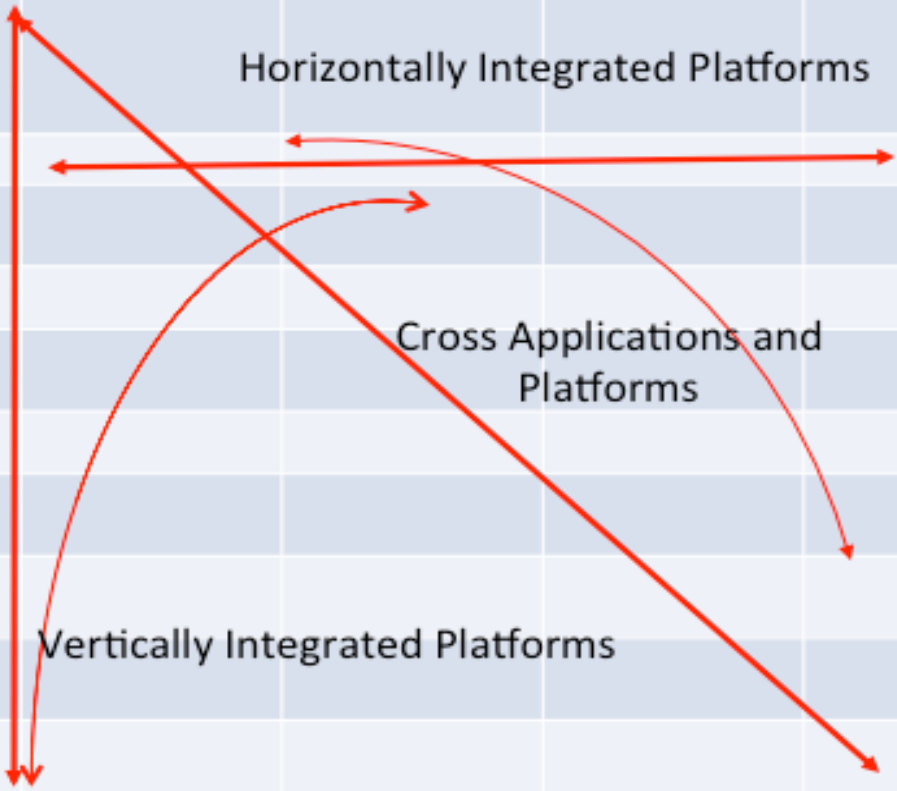
Super Markets and Fast Food Restaurant Chains in Developed Countries

Building Data and Information Ecosystems for Smallholder Farmers



Digital Platforms

Applications	Farm Management Service	Farm Advisory Services	Logistics Services	Land Governance	Agribusiness Related Services
Governance					
Agriculture and Farming (Weather, Regulations, Extension, etc)					
Farm Management					
Transport Management					
Financial Services					
Market and Marketer Information					
Storage Information					
Processor and Bulk Consumer Information					
Individual Consumer Information					
Input Supply and Supplier Information					
Residue and Waste Management					
Recreation Information					



GFAR

What can be done for fairer data and information flows for smallholder farmers?

- International Arrangements, Agreements and Treaties
- Institutions, Policies, Strategies, Rules, Norms, Regulatory Mechanisms, Standards
- Inclusive development with with all stakeholders of Data Standards
- Capacity Development of Farmers and SMEs in Agri-food Chains to manage and use data effectively
- “Virtual” Aggregation of Farmers, Data Cooperatives and Producer Organisations with Data and Information Functions
- Trust Centers and Data Repositories

What can be done for fairer data and information flows for smallholder farmers?

- Inclusive governance of flow of data, information, knowledge, skills and technology through Data Cooperatives, Trust Centres and Platforms
- New Business Models
- Platforms
- Open Technologies for farming and on-farm processing of farm products as also for data and information management
- Improving Rural access to Internet and Cellular Connectivity
- Lowering cost of hardware, software and connectivity

Conclusion

Smallholder Farmers, who now face an existential challenge (and the Society as a whole) can benefit if an appropriate ecosystem to support them in practicing Data Driven Agriculture is developed.

Thank You

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International symposium on Farmers' access to data

Centurion, South Africa, 24 November 2017

Extended version of keynote speech 1

"Farmers and data"

Ajit Maru

Farmers and Data

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Summary

In order to develop a Roadmap for enabling "Data Driven Agriculture" for smallholder farmers in developing countries, I explore (why, what, where, how) this paradigm shift is of making agriculture more data driven, information rich and knowledge intensive is occuring. I distinguish between use of data from the farm (precision farming) and its use with data outside the farm (Digital agriculture, Agriculture 4.0) as also the implications of its sharing and exchange from the point of the view of the smallholder farmer in developing countries. Farmers are not a homogenous entity and their capacities to cope with these changes in agriculture are not the same. The issues smallholder farmers face in the practice of this agriculture is amplified by various constraints not faced by corporate, large and even comparatively small and family farmers in developed countries. I list out which data is used how by a farmer in farming operations and then show its use and possible abuse when data is shared by an individual farmer and when it is aggregated. I look at the emergence of open and closed data and information chains as they are now occurring in large corporate supermarkets and fast food restaurant chains that increasingly dominate market oriented agriculture across the world and in its counter movement for alternative agriculture such as in agro-ecology and farmers markets. Finally I describe and indicate what in my opinion now needs to be done starting from International treaties and conventions to national and local policies, rules, regulations, standards, norms, codes etc., capacities development, access to appropriate more precise and cheaper, affordable farm precision equipment and new structures such as data cooperatives, trust centres, data repositories and platforms to support data management for farmers, especially small holder farmers so that they can also practice data driven agriculture.

Farmers and Data

Introduction

About 3 years ago, the Global Forum on Agricultural Research (GFAR) organized a Workshop on "Forward Thinking Agricultural Development for Western India". At this workshop, I met a group of farmers from the Aravalli (named after the hill ranges that pass between Gujarat and Rajasthan) District of Gujarat. Most farmers of Aravalli District are smallholder farmers, each owning an average of 6-8 bighas (1-1.25 acres) of land, and are tribals, a community considered economically and socially backward. These farmers are shifting from traditional crops like Millet (Bajra) and pulses to horticulture, medicinal plants and spices such as turmeric that are all market oriented crops. The leader of these famers, a young man of about 30, kept on meeting me in the corridors of the Workshop venue and persistently asked me how the University (Sardar Krushinagar Dantewada Agricultural University) can help them manage and use their farm data as they now grow crops that are also exported. They need Good Agricultural Practices (GAP) Compliance so that their produce can be exported and they get better value of crops.

Figure 1: Aravalli Hills of Gujarat and Rajsthan

These discussions triggered for me a deeper exploration of the issues (beyond those in academic discussions, including my own, are written) around how these farmers who are considered the most poor and least educated, have in managing the data, information and knowledge they produce and use as also what I would need to consider and include in developing a Roadmap for Data Driven Agriculture for them.

The needs of farmer for practicing data driven agriculture

I noted that the need to participate in globally competitive markets was triggering their need to manage their data and information effectively but they also wanted data and information to economically and effectively use the natural resources for farming they had access to. And, they all were concerned of the effects of climate change, especially extreme aberrations of weather, which resulted in unseasonal rains, hailstorms, drought and floods and wanted ways to minimize their risks to their livelihoods.

The new agriculture they were trying to practice was according to USDA, "the thoughtful ***use of big data to supplement on farm precision agriculture***. It means having the right farm data, at the right time, to make better decisions that improve long-term profitability."

Precision agriculture is effective use of data generated ***on the farm***. These concepts are also closely related to Digital farming (CEMA, 2017) and Agriculture 4.0 etc. An extension of this concept is to use ***data and information flows within***

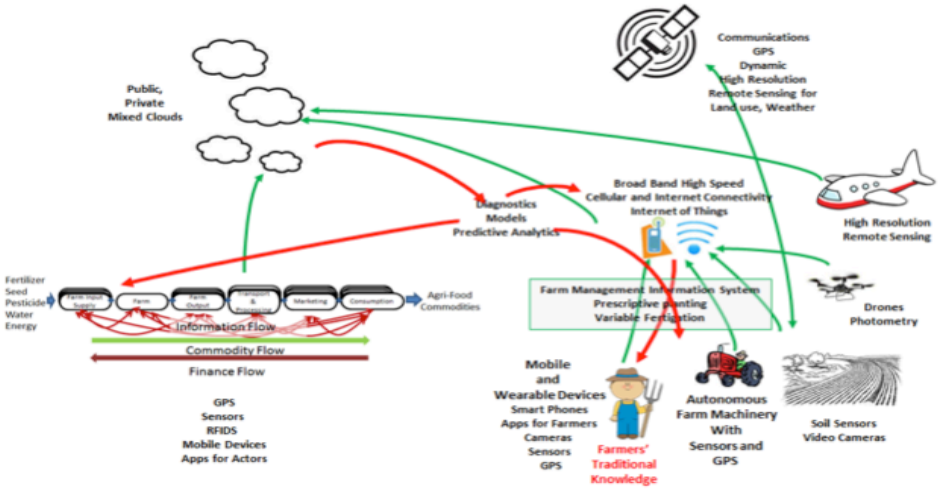

Figure 2: Data and Information Flows and ICTs used in Agriculture 4.0

and across Agri-food chains to holistically optimize these chains' productivity in the use and recycling of natural resources such as water, land and soil nutrients, use of fossil fuels and energy, improve product quality, reduce human pain and drudgery involved in farming and profitability.

These concepts make farm data both a critical input as also a valuable product of farming. But, as a corollary, these concepts if applied without appropriate rules, regulations and ethics of balance, equity and fairness can make these farmers, who are the least powerful of all actors and stakeholders, even more vulnerable to the asymmetries of financial, commodity and information flows in Agri-food chains that have always been a challenge for them.

Data Farmers Produce and Use

Types of data

These farmers use, in an unguided, unorganized and unstructured manner, three sets of data and information in their farming. The first set is data that is generated on the farm and is also used only for the farm. This includes seed and

fertilizer use, date of sowing etc. The second set is the data is data and information generated else where, such as weather and market prices, but used for the farm. The third set is data generated on the farm, processed, aggregated and/or amalgamated with other data and information generated elsewhere and used by various actors and stakeholders, such as the Government for establishing ownership, revenue and subsidization, market intermediaries for logistics and market related information, farm input providers, farm services providers including banks, insurance agencies, farm advisory services, scientists, other farmers and their associations etc. A set that I realized missing was of data they shared with neighboring farmers locally. This is because they have few means for this sharing. While almost all the data generated by farmers has use outside the farm, a large proportion of "agricultural" data such as Government statistical and research data have little direct on-farm use.

Uses of data

These sets of data are used for different purposes in their Agri-food systems. For these farmer, these could include:

1. Planning: What to grow, When to grow, Where to grow? What farm operation to do when and where on the farm?
2. Monitoring and Assessment: How is the crop growing?
3. Event Management and Intervention: Whether and What action should be taken on the farm/crop? How and when?
4. Autonomous action through use of ICTs, for example, switching on water pumps to irrigate their fields valve when soil humidity falls below 35 per cent.

Figure 3: Chlorophyll Meter

5. Optimization: What will be the economic, environmental or social return/effect on the investment/action?
6. Forecasting: How much will be the crop yield? How much profit?
7. Tracking and Tracing: Where is the product, item, resource or material? What is its source and where will it go next?

The data and information they can use can be further characterized according to the phase in the farming cycle as being for pre-planting planning, planting, cultivation and harvest and post-harvest processing related phases. For the pre-planting planning phase, these farmers may need to know the archived cropping pattern of the land, weather patterns and climate, soil conditions, rainfall forecasts and irrigation availability in the cropping season, forecasted prices of

inputs, time to harvest the crop, yield, forecast of market price of the produce and possible return on investment among other information to decide the crops in a particular season for the farm. The planting related data includes that related to land preparation according to the requirements of the chosen crop for the field, use and availability of farm machinery and farm labor, seed quantity needed, fertilizer and manure needs, weather especially rainfall and irrigation schedules, etc. At cultivation phase, the farmer may need data to monitor the crop such as for growth, soil humidity, pest and weed density, use of pesticides and weedicides etc. At the harvest and post harvest phase, the farmer may need data and information on the right stage of the crop to harvest, availability of farm machinery and labor, storing and packing the main product and the byproducts, market price of the products, transport availability and cost etc. The data collected, managed and use in farming can be static, or data that does not change over long periods of time such as land ownership and farm field boundaries or dynamic, the changes over time. Some of this dynamic data can have a very short useful life, for example, daily weather data and some longer, for example, soil nutrient values.

Issues related to data and information farmers face

For these farmers, the use of data, information and knowledge are and will be intertwined and interrelated and cannot be treated individually and independently. Data loses its context if separated from information he/she needs and uses. This is sometimes seen, for example, when farmers are given raw weather data without the context of what the data means for his/her farming operation. The other issues these farmers will face around data and information they need are:

- Availability
- Accessibility
- Affordability
- Capacity to "appropriate" or get the larger community based ownership in effectively managing and using the data and information in a collective manner.
- Relevance
- Usefulness
- Timeliness
- Trustworthiness
- Ability to use data and information effectively

Lack of Capacity

For these farmers, data needs to be transformed through different processes into information and this information used with experience as knowledge. At every stage an important core process is that of learning. This is not a linear process and at each stage of process the farmer uses, shares and exchanges data, information and knowledge from several sources each with their unique

characteristics. This is the capacity that is now becoming critical for farmers to have in this paradigm shift in agriculture.

Benefits and Hazards in Data Sharing

As illustrated above, these farmers manage a vast amount of data and information even for one crop on a single plot, field or farm. This data and information again individually has different worth or value and with it benefits and hazards when it is used for an individual farm, field or plot and when aggregated across and within farms. Table 1 list farming cycle related data and their use, benefits and hazards when used individually at farm level or when aggregated in various ways and if shared.

The benefits from data sharing for these farmers locally and globally are:

1. Possible for collective bargaining in market participation both for input and produce and logistics such as transport and storage
2. Better market related forecasts
3. Better forecasts for disease and pests outbreaks and collective management such as through Integrated Pest Management
4. Greater opportunities for innovation and its spread
5. Better, more realistic research for problems such as spread of diseases and pests, loss of biodiversity, pollution, land degradation etc.
6. Land ownership with lesser conflicts
7. Improved sharing of farm related resources such as machinery, tools and labor.
8. Improved farm related services through route mapping and scheduling

The hazards or abuses farmer face when they share their data can be generically listed as:

- Ethics – Where though no rules are broken but the process or product of data and information management is against prevailing moral practices, for example, data obtained free or by paying low price but sold as information at very high prices
- Privacy – when the data is used to reveal something not for public use or that can disturb a individual or community
- Security – when an entity, item or process is made vulnerable to distortion, damage or destruction
- Safety - when use of data can result in malicious damage or destruction of an entity, item or process
- Ownership – when the ownership of data is violated or obfuscated
- Valuation – When data is intentionally under or overvalued w
- Monetisation/Commercialisation – When data is made into money or used for commercial purposes
- Spam (and Spam based frauds) – provided unsolicited and misleading data and information and luring recipients of the message to voluntarily to part with data, information, funds etc.,.

- Social Engineering – Using ICTs to deceive users to expose private and confidential data and information for fraudulent purposes
- Liability – where use of data and information can result in damage for which the data generator or disseminator can be held responsible
- Denial of Service - Not allowing users to access another application, website, data or information without informing them
- Denial of use an application, website, machine or tool unless agreement to share data is made
- Monopoly – When an entity, item or process does not allow through legal contract or a device to access, use, repair it other than the authorized agency
- Helmification – is the regulation of a practice by governmental authorities, usually after the practitioners have proven incapable or unwilling to take care of issues themselves.
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- Censorship, spying and giving data to unauthorized agencies or illegally for example to Government or to a stakeholder
- Interoperability
- Portability

Challenges for Smallholder Farmers from Data Driven Farming

Data driven agriculture is a major, almost existential, challenge to smallholder farmers in developing countries. While they have to compete in globally competitive markets in the same manner as corporate and large farmers and smallholder farmers in developed countries, the suitable technology to practice precision agriculture affordably in small farms, such as mass scale very high resolution (<2 meters) satellite imaging, GIS linked farm machinery and low cost sensors, are just emerging.

Data Management

Data driven agriculture has serious challenges for these farmers from the quantum of data he/she will need to process. These farmers, as all smallholder farmer in developing countries do, usually grow more than one crop in a season to spread farming risks. Multiply the data and information as illustrated above for the 2-3 crops a smallholder cultivates in one season in several, separate plots or fields and the magnitude of data management needed by these farmers is revealed. The capacities of these smallholder farmers to process data and

effectively use the information there off are at the moment are almost missing. Current extension systems in these countries still operate in a "T & V" and Package of Practices mode where the dynamicity of farming operations and with it effective use of data is not addressed.

Ownership of Data

A widely held norm is that the person who farms the land owns the data and information generated from it. In many smallholder-farming situations, there is a system where farmland is sharecropped or leased for a season, year or more by smallholder farmers. The long term and historical data of the farm such as land records, soil health, disease and pests have to be maintained by the owner of the land and the current data by the cultivator, who changes periodically. This raises issues of ownership and management of data. In India, a system of soil health card, which aims to provide farmers the status of soil nutrition on their land and advise fertilizer interventions for specific crops, is provided to the landowner and not the cultivator, thus raising issues of who the owner of the data is and in turn decision maker of the farm is?

Farm and Farmer Aggregation

With this change in agriculture and farming, there will be an increasing pressure for aggregation of farms, their land, their inputs and outputs to be cost effective and participate in markets. As physical aggregation of farmers' land such as through cooperatives has failed, there will be increasing "virtual" aggregation where the cropping profiles of the aggregated land, their operations and outputs.

Appropriate and low cost precision farming technology

The current trend of increase in the precision and reduction in the cost of new farming technologies especially geo-spatial and information and communications technologies (ICT) will enable small farmers to also practice precision farming and gives hope only if other support structures and systems also support them in this shift.

Institutions and Structures

The most crucial issue in the emergence of this new agriculture for developing countries is the evolution of Institutions and structures such as the policies, regulatory frameworks and mechanisms, information and communications related infrastructure and extension systems that allow data and information to be managed, used, shared and exchanged effectively, equitably and fairly, especially in developing countries. These are slow to emerge. Those that exist or have been developed recently are partial towards satisfying the interests of large farmers.

Trajectory of agricultural and farming related policies

The current trajectory of agriculture and farming related policies, both at national and global levels, that are resulting in rapid urbanization, increasing globally competitive market orientation of Agri-food systems, growth of multinational supermarkets and restaurant chains, lesser public funding on research and extension, globalization of access of new agricultural technologies with information and financial services also seriously threaten smallholder farming by forcing them out of market participation.

When all these challenges are viewed together, it becomes clear why data driven agriculture is an existential threat to these farmers. These new challenges to their farming are making their farming and the larger Agri-food system more knowledge intensive than ever before but without the necessary Institutions and support systems, especially extension and advisory services. This change in agriculture will require new capacities in farmers. In fact, the change will be so drastic that it will be a question whether they will be called farmers or data analysts and knowledge workers. Those who will be able to cope with these challenges now will sustain themselves. Those who cannot already are or will soon be forced out of farming.

The Data Control Battle Ground

Figure 4: Traditional Vegetable Market in India

In a world with increasingly globalized, highly competitive markets, knowing and forecasting agricultural markets behavior as early as possible in other Agri-food systems and regions is commercially very advantageous. With data driven agriculture, the control of data flows in Agri-food systems and with it its use, is the new battleground with the large corporates arraigned at one side of the movement and a growing counter movement which is fighting this corporate takeover of the control of Agri-food systems through movements such as of agro-ecological, sustainable farming, zero budget farming, fair price to farmers and farmer oriented marketing systems such as through producer companies and cooperatives.

Open data movement

The open agricultural data movement is caught between these two movements. As Agri-food systems evolve through technology, economic and societal pressures, there is a need for primary data from the fundamental unit of Agri-food systems, the farm, to be open. Both schools of thought can benefit from open sharing and exchange of farm data. While the corporates based systems aim to use the openly shared data to ultimately control and bias markets, the counter movement believes that open sharing of agricultural and related data and information is a public good beneficial to the progress of society.

Increasing Corporatization of Agri-food Systems

Symmetry, equity and fairness in data flows, access and use is a function of evolution and maturity of Agri-food systems which themselves are a reflection of societal attitudes and their ethics and norms, politics and economics. At the moment, almost all Agri-food systems across the world are flawed. They are in various grades, increasingly biased towards large, multinational corporations who are progressively controlling these systems through primary control of inputs to farming, farm land itself and the marketing and consumption of agricultural commodities and products through supermarkets and restaurant chains. The indicators of the bias, through Government policies, regulation and regulatory mechanisms, especially those related to food safety and international agricultural trade treaties and agreements, are the dominance of supermarkets and restaurant chains to farmers markets and small and micro retailers as also the number of nodes between farmers and consumers in todays Agri-food systems across the world. In fact, many International and National think tanks influencing public policy measure and recognize evolution of Agri-food systems on the basis of how their Agri-food systems are organized and their so-called efficiencies. The corporates dominated Agri-food systems, mostly in economically developed markets but rapidly spreading in developing countries, has lesser number of nodes, many a times about 2-3, such as farmer-supermarket or farmer-wholesaler/processor-supermarket to the 7-14 nodes such as Small Farmer-Aggregator-Wholesaler- Public Market- Processor – Product Wholesaler – Retailer - Consumer in Agri-food systems of economically developing countries. From a data and information management perspective this lesser number of nodes reduces the complexity and improve the efficiencies of information flows within the Agri-food systems but also affect smallholder farmers and small retailers by exclusion to data and information flowing in the market chain and the Agri-food system.

Agri-food systems, such as of Supermarket chains, need to be relatively less open in sharing their data and information outside their own systems. They only need data related to markets outside their own systems. Within their systems, the data sharing is controlled on need to know basis. This data is used by the Corporate bodies to monitor crop production, resource use and their costs, research and innovation especially aimed to optimize the Agri-food chain for

maximum profitability. In such systems, the so-called "farmer" is deprived from all decision-making on "his/her farm" and becomes merely a technician. This can have very adverse impact on the management of agricultural knowledge in the long run as was experienced after the Soviet era in the newly Independent countries.

The urgent need for New Institutions and Structures for Data Driven Agriculture

The symmetry, balance, fairness and equity in data flows and use therefore need to be addressed through supporting institutions and structures such as policies, legislation, regulations and regulatory mechanisms as also communications related infrastructure and extension systems that curb asymmetries and enable effective sharing, exchange and use of data by the weaker nodes in the system. A large part of this development is dependent of the political and social power of those in the emerging new Agri-food systems. These are slow to emerge even in developed countries but in developing countries they are almost missing. Those that currently exist or have been developed recently are partial towards satisfying the interests of developed countries and large farmers. The smallholder farmer, the first mile market intermediaries and service providers are certainly weak and neglected in these systems. There is an urgent need to relook, renew and develop new Institutions and supporting structures for farmers, and more so for smallholder farmers in developing countries for them to shift into practice of data driven agriculture.

Figure 5: Supermarket with Horticulture Shelf in India

Developing the Roadmap

The roadmap for data management in Agri-food systems with data driven agriculture must aim at symmetry, balance and equity in the data flow and its use among all actors and stakeholders in and across their value addition chains. The farmer is only one node, albeit an important one, in these Agri-food systems. He/She produces and consumes data which when aggregated across farms, crops, seasons etc., and analyzed such as through big data analytics gains greater value. But, this can also become increasingly hazardous to the interests of farmers' where this symmetry or ability to use information is weak.

From International to National Development of Institutions and Structures

The need for data driven agriculture has its roots in the need to participate in globally competitive market oriented agriculture. Therefore, the initiation of the development of Institutions such as policies, strategies, rules, regulations and standards related to agricultural data and information sharing, exchange and flows needs to start at an International level through arrangements, agreements and treaties with structures and mechanisms to implement and regulate them. These must be linked to international and regional agricultural trade treaties. The development of country level polices, strategies, rules, regulations and use of standards. At the moment there are no such international efforts. This has been attempted in the sharing and exchange of plant genetic resources based on the premise that these are a universal public good. Agricultural and nutrition related data should also be treated as a universal public good related to global food security, sustainable development goals and elimination of global hunger and extreme poverty.

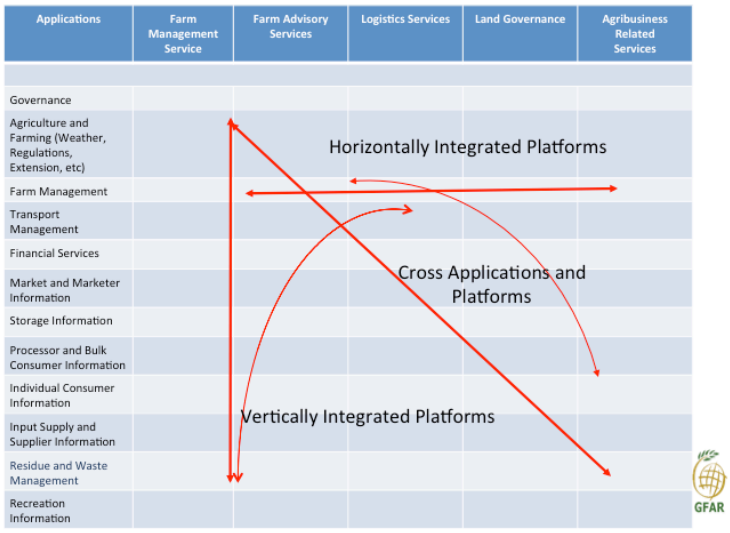

Figure 6: Schema of Agricultural Data and Information Platform

Failure of "Apps" and Websites for Farmers and the need for Platforms

There seems to be a mistaken notion, especially among agricultural scientists and technologists, that the developing and provision of software such as mobile phone "apps" is the critical pathway to introducing digital agriculture to farmers. At the moment globally there are tens of thousands of such apps, most of them pilot developments with little use except for publishing a paper in a scientific event. There is an underlying assumption while developing these apps that farmers data and information needs are very simple and that the farmer has the resources with time to access multiple apps and websites to solve their problems, farm efficiently and participate in markets.

The most appropriate approach is to develop platforms where all apps can be standardized to be interoperable with sharing of data and information and offer farmers solutions with a basket of options. Platforms will also enable a level playing field for small and big entrepreneurs to offer data and information services.

The development of these tools and platforms must be paralleled by initiation of an ecosystem to support data driven agriculture through Institutions and governance structures to ensure symmetry, balance, equity and fairness in agricultural data and information flows and movements and for inclusion of agricultural communities with sufficient capacities to participate in these flows and ability to use precision farming technologies.

What should the Roadmap include?

The Roadmap should include:

- Development and Implementation of policies promoting and enabling aggregation of family farmers and farming systems such as through cooperatives, producer organizations, farmer organizations etc. with functions to financially and technically manage and use data and information (Data Cooperatives)
- Development of Trust Centers with Data and Information Agreements, Treaties with regulatory and enforcement mechanisms to share data at various levels and among multiple categories of users from plot, farm, farming system, region, national to global agricultural and related systems.
- Inclusive Development of Standards for Data collection, Sharing, Interoperability
- Inclusive governance of flow of data, information, knowledge, skills and technology through Data Cooperatives, Trust Centres and Platforms
- "Virtual" aggregation of farms, synchronization of farm inputs, processes, outputs and logistics to participate in markets through use of ICTs.
- Development of new forms of advisory and support systems to build needed capacities for use of new knowledge, skills and technology
- New business-models with rules, regulations, codes etc. that integrate governments, farmers and banks, insurance, market intermediaries, cooperatives etc. for participation in markets including that of data and information
- Open technologies for farming and on-farm processing of farm products as also for data and information
- Lowering cost of Hardware, infrastructure and connectivity
- Increasing democratization of science, learning and support to exponential innovation

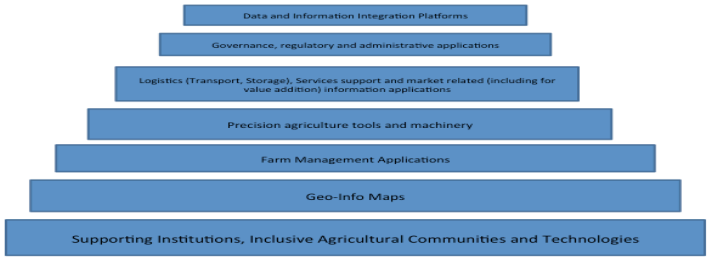

Figure 7: Evolution of Data and Information Ecosystem for Agriculture 4.0

India and Developing Data Driven Agriculture

In India there is a patchwork of initiatives and structures being created that can form the foundations of an ecosystem for its farmers to adopt data driven agriculture. It has a policy of right to information to all information generated by public Institutions. There is an ongoing judicial debate on issues of privacy and security related to sharing and exchanging of data and information. India has a countrywide cooperatives movement in rural finance, agricultural marketing and

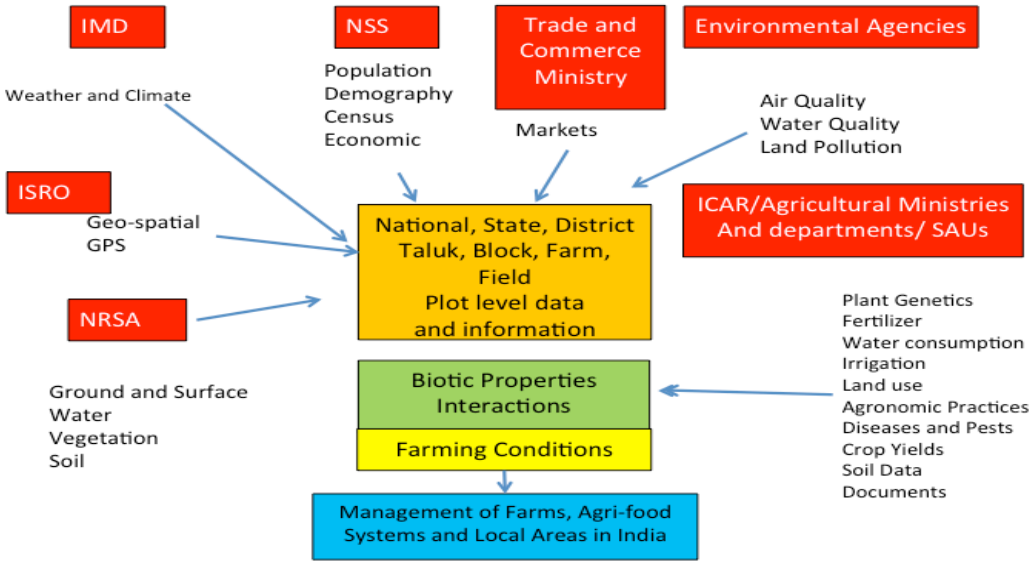

Figure 8: Data and Information Integration Needed in India for Agriculture 4.0

input production and supply especially fertilizers. The country since a decade has also been encouraging and supporting the formation of producers companies. India has a country wide cellular phone connectivity with almost 1 billion cellular phones connected. Through its Digital India initiative it is extending high-speed broadband Internet connectivity across all rural areas in the country. India has indigenous capacity for agricultural geo-spatial applications, including satellite imaging, such as for weather, crop estimation, land use and soil health mapping. The country has embarked on improving rural infrastructure for logistics and market related structures. The country has been slow on agricultural markets related reform though recently it has diluted the implementation of the Agricultural Produce Marketing Committees act that prevents purchase of agricultural commodities directly from farmers, their participation in markets only through APMC market yards and transport of agricultural commodities freely across state and district boundaries. The country has also initiated a major program for financial inclusion of all especially the rural poor through the banking system. The country has however a very nascent indigenous effort to develop precision agricultural tools and machinery. There is also little or no effort to build capacities in India's farmers the new capacities needed to practice precision farming and participate in data driven agriculture The most important what is missing is a vision in the agricultural establishment

of development agencies and its formal public sector research and innovation system that all these initiatives can be threaded together to bring in a digital agricultural revolution in the country.

Table 1: Benefits and Hazards from Sharing Farm Data

S.No.	Farming Event	Individual Farm's Data		Aggregated Farms' Data		Possible remedial action that can bring better balance/equity/symmetry in use
		Benefits from Sharing*	Hazards from Sharing	Benefits from Sharing	Hazards from Sharing	
	A. Pre-Planting Planning					
A.1	Setting farm/field /plot crop layout (such as through a GIS) using land records	Easier access to financial services, like Mortgage, Overdraft, Subsidies		Can foster virtual aggregation of farms according to crop, input, needs, farm operations scheduling, crop storage, transport marketing,	Illegal occupation of communal lands	Government Policies, Regulatory Mechanisms for privacy and security of data and information and safeguards against misuse, public access only on need to know basis, creation of strong ethical basis among all actors
		May prevent Illegal occupation or Land Grab or sale	Opens up possibility of Land Grab or sale			Data Cooperatives
		Provides easier direction for access to farm or field				
A.2	Soil Health Data (Archival and Current) for estimating fertilizer and manure requireme	Access to expert advice for soil management	Enables targeting by fertilizer suppliers and other input providers	Can enable aggregated purchase and application of fertilizers,	Enables targeting by fertilizer suppliers and other input providers	Setting up of Data Cooperatives and Producer Companies for purchase and use of farm inputs

S.No.	Farming Event	Individual Farm's Data		Aggregated Farms' Data		Possible remedial action that can bring better balance/equity/symmetry in use
		Benefits from Sharing*	Hazards from Sharing	Benefits from Sharing	Hazards from Sharing	
	nt			Enables long Term Soil Management planning		
A.3	Local Weather data	Crop Sowing can be done in a planned manner, short term forecast on farm inputs needs including labor and farm machinery				
A.4	Seeding Data / Crop to be sown data	Access to expert advice for seed to be used, seeding rate etc.	Enables targeting by seed suppliers and other input providers	Can enable aggregated purchase and application of seeds	Enables targeting by seed suppliers and other input providers	Setting up of Data Cooperatives and Producer Companies for purchase and use of farm inputs
				Enables Estimation of Crop Sown		

S.No.	Farming Event	Individual Farm's Data		Aggregated Farms' Data		Possible remedial action that can bring better balance/equity/symmetry in use
		Benefits from Sharing*	Hazards from Sharing	Benefits from Sharing	Hazards from Sharing	
A.5	Fertilizer (and other soil treatment chemicals) Needed for Crop to be Sown	Access to expert advice for fertilizer to be used, rate of application etc.	Enables targeting by fertilizer suppliers and other input providers	Can enable aggregated purchase and application of fertilizers	Enables targeting by fertilizer suppliers and other input providers	Setting up of Data Cooperatives and Producer Companies for purchase and use of farm inputs
	B. Planting					
B.1	Date of Sowing	Other local farmer can schedule their farm operation when shared resources such as farm machinery and labor is used			When use with local weather data, forecast on possible yield and crop production in an area can be made	Government Policies, Regulatory Mechanisms for privacy and security of data and information and safeguards against misuse Setting up of Data Cooperatives and Producer Companies to allow sale, sharing, exchange of data
	C. Cultivation					
C.1	Data to monitor Crop Growth such Chlorophyll index, Weed type and density	Can assist better understanding of crop health through comparison of other farm/field data	Can contribute to forecasting demand of fertilizers, weedicides etc		Can contribute to forecast of irrigation, possible pest and disease attacks	Government Policies, Regulatory Mechanisms for privacy and security of data and information and safeguards against misuse

S.No.	Farming Event	Individual Farm's Data		Aggregated Farms' Data		Possible remedial action that can bring better balance/equity/symmetry in use
		Benefits from Sharing*	Hazards from Sharing	Benefits from Sharing	Hazards from Sharing	
		Enables preventive interventions to be taken				Setting up of Data Cooperatives and Producer Companies to allow sale, sharing, exchange of data
	Local Weather data	Can contribute to forecast of irrigation, possible pest and disease attacks		Can contribute to forecast of irrigation, possible pest and disease attacks	Can contribute to forecast of irrigation, possible pest and disease attacks	Setting up of Data Cooperatives and Producer Companies to allow sale, sharing, exchange of data
	D. Harvest and Post Harvest					
D.1	Date of Harvest and local weather data	Can contribute to forecast of harvested crop for farmer	Can contribute to forecast of harvested crop for market intermediaries	Can contribute to forecast of harvested crop for the local Area	Can contribute to forecast of harvested crop for the local Area	Setting up of Data Cooperatives and Producer Companies to allow sale, sharing, exchange of data
		Assist in use of shared farming resources such as farm machinery and labor	Can contribute to forecast of need for storage, packaging transport etc	Assist in use of shared farming resources such as farm machinery and labor in the area	Can contribute to forecast of need for storage, packaging transport in the local area etc	

S.No.	Farming Event	Individual Farm's Data		Aggregated Farms' Data		Possible remedial action that can bring better balance/equity/symmetry in use
		Benefits from Sharing*	Hazards from Sharing	Benefits from Sharing	Hazards from Sharing	
All data on status of farming operations and crop condition and health if available as forecasts can contribute to distortion of markets if there is lack of symmetry in information flows. Collated over a watershed, region or country, this data can be used to forecast import and export of commodities, fertilizers, seeds, pesticides, product quality and in turn distort national and international markets.						

- All the data in this column are needed for GAP Compliance

References:

CEMA (2017) Digital Farming: What does it really mean? (Available at http://www.cema-agri.org/page/digital-farming-what-does-it-really-mean) Last accessed on 15/11/2017.

GFAR

GODAN
Global Open Data
for Agriculture & Nutrition

INFORMATION TRAINING AND
ITOCA
OUTREACH CENTRE FOR AFRICA

CTA

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Dynamics

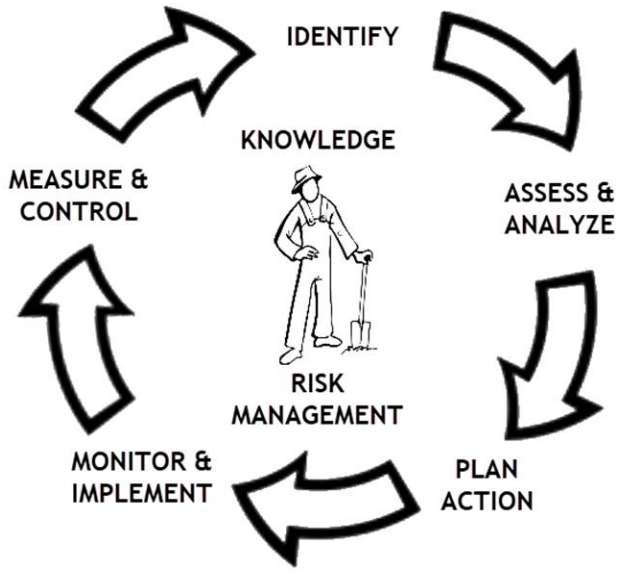
Weather Risks(Intensity)
- Rainfall
- Temperature
- Wind
- Hail
- Flood
- Drought

Resource Risks
- Soil
- Water
- Access to Inputs
- Pollution

Economic Risks
- Prices
- Access to Markets
- Trade Tariffs
- Administrative costs

Labour Risks
- Access to labour
- Labour Cost
- Labour Reliability

Locational Risks
- Crop Suitability
- Distance to Market
- Safety



Health Risks
- Aids
- Malaria
- Zoonosis

Biological Risks
- Diseases
- Insects
- Weeds

Financial Risks
- Access to Finance
- Input Costs
- Unforeseen Costs
- Interest rates

Policy and Political Risks
- Trade Policy
- Tenure Security
- Certainty

Infrastructure Risks(condition)
- Energy
- Water transport
- Roads
- Storage Facilities
- Processing Facilities
- Communication
- Access to Equipment and Spares

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The Essence

Farmboek is an Online Risk Management Platform that uses **Big Data** and **Technical Information**, administrated within **Blockchain Technology**, to improve the sustainability of Commercial- and Small scale Farmers in Africa.

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Risk Management

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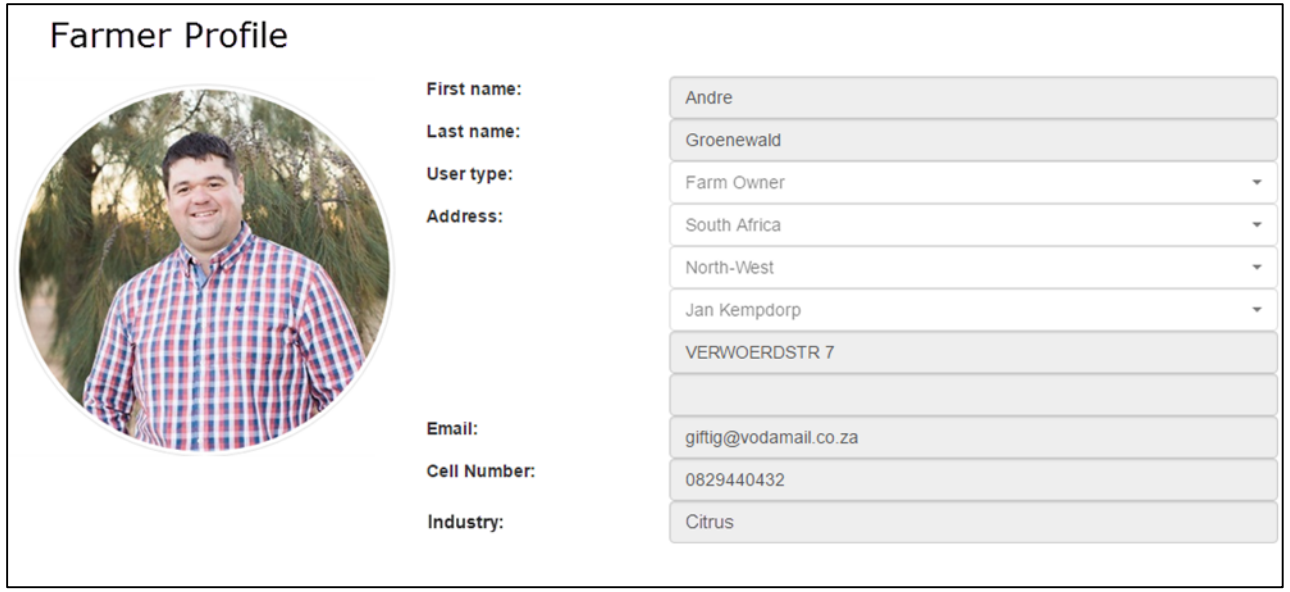
Big Data Extraction



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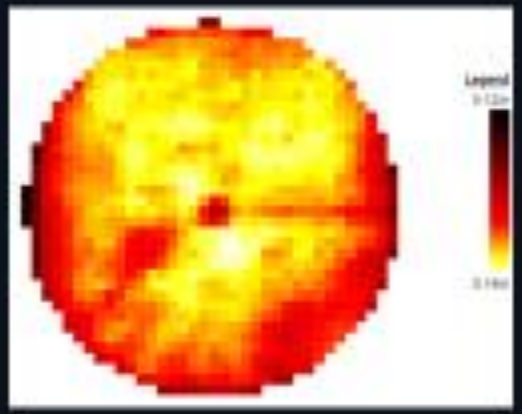
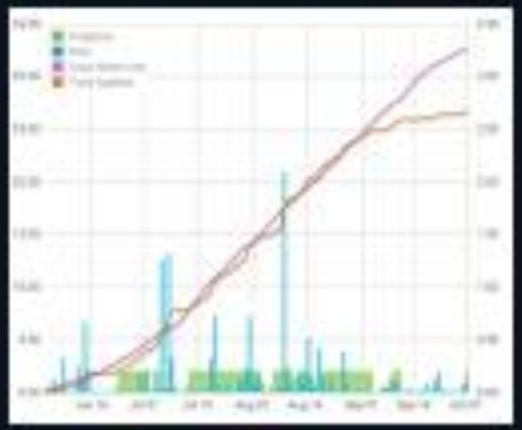
Field 302

Crop Protection



Water Use



Cumulative Water Use

Farmboek provides AGRIFICIAL INTELLIGENCE ™ to enhance the value proposition towards our customers.

Blockchain Technology

Immutable Data

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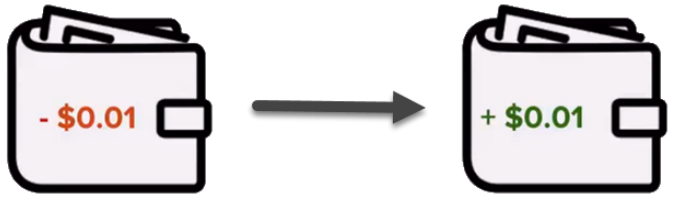
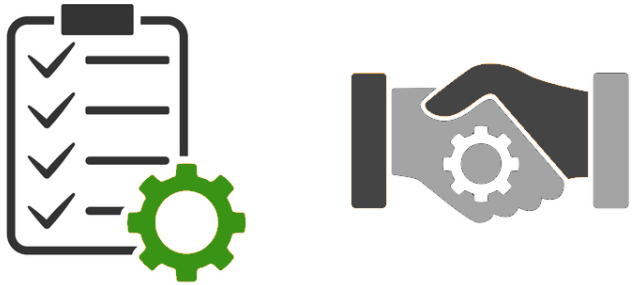
Seamless Transacting



No Transaction Fees

Afriota



Smart Contracts

Data Integrity

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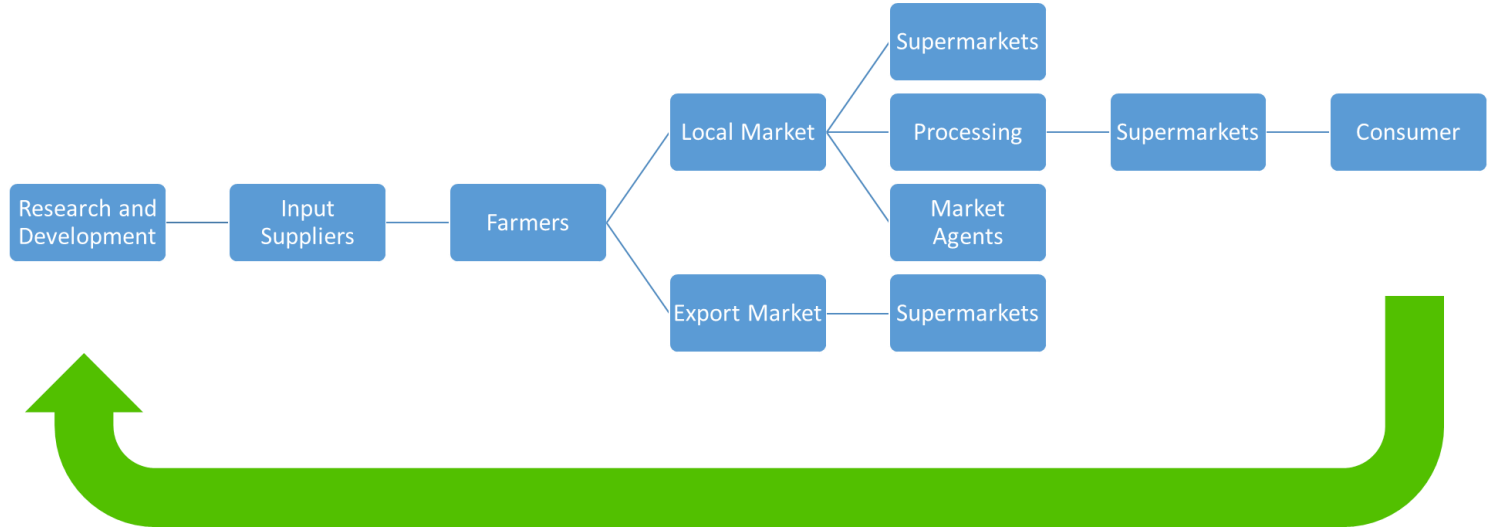
Supply Chain Auditing

- Traceability
- Global Gap
- Quality Control



Bigger **barrier to entry**

than

trading tariffs

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Sharing Economy

Access Trumps Ownership

- Maximise Asset Productivity
- Economy of Scale

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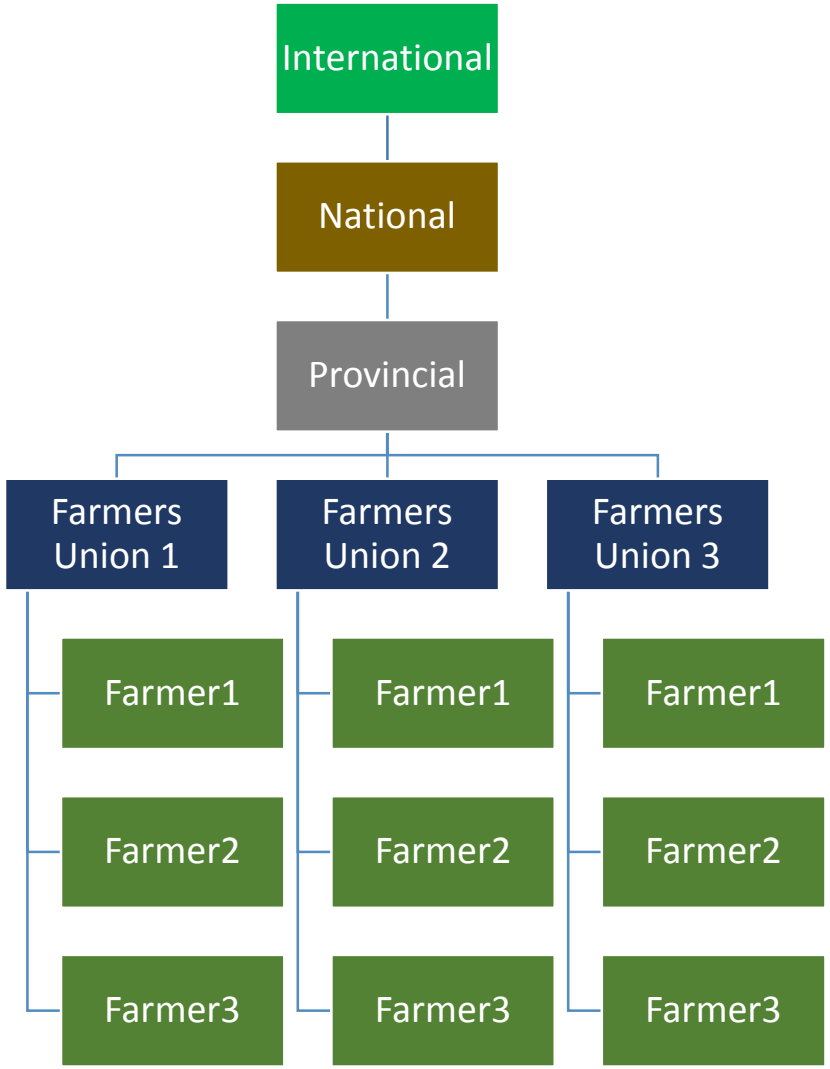
Organised Agriculture Structure



Agricultural Organisations' main function is to influence policy through advocacy

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Digital Alternative – Replaces Membership Fees

Digital Farmers' Organisation

- Local Farmers' Union
- Industry
- Safety
- Crisis
- Policy
- Marketplace
- Knowledgebase

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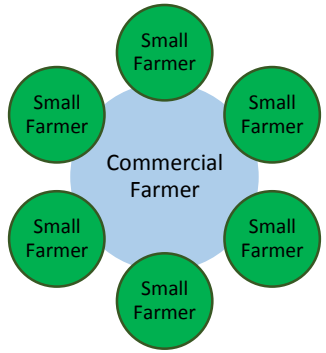
Agricultural Organization
NGO – Policy

Farmers

Projects



Agri Agencies
NGO – Projects

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IXO

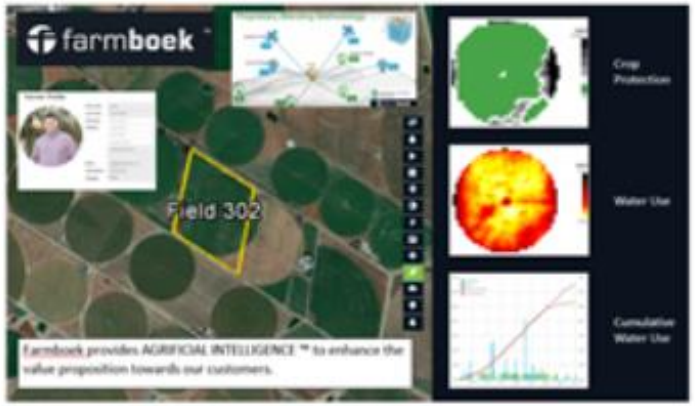
Agri All Africa
Reshaping Agriculture in Africa

Afriota

agbiz

MISA
Mining Industry Association of Southern Africa

Data Management



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PiLog

syngenta

AGRI LIMPOPO

IOTA

TRADESAFE
BUYER AND SELLER SECURITY

COMPRSA

WORLD FARMERS' ORGANISATION

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mAgri

Agri All Africa

Agri All Africa
Reshaping Agriculture in Africa

Agri All Africa

GMPBasic™
Patented Livestock
Management
Identification
Traceability
Solutions

RED MEAT
PRODUCERS
ORGANISATION

RPO

ROOIVLEIS
PRODUSENTE
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Mercedes-Benz

DUPONT

PIONEER

SAKATA

syngenta

Virbac

WUHLF
EQUIPMENT (PTY) LTD.
PREVIOUSLY KNOWN AS

Loskop ICT

PANNAR

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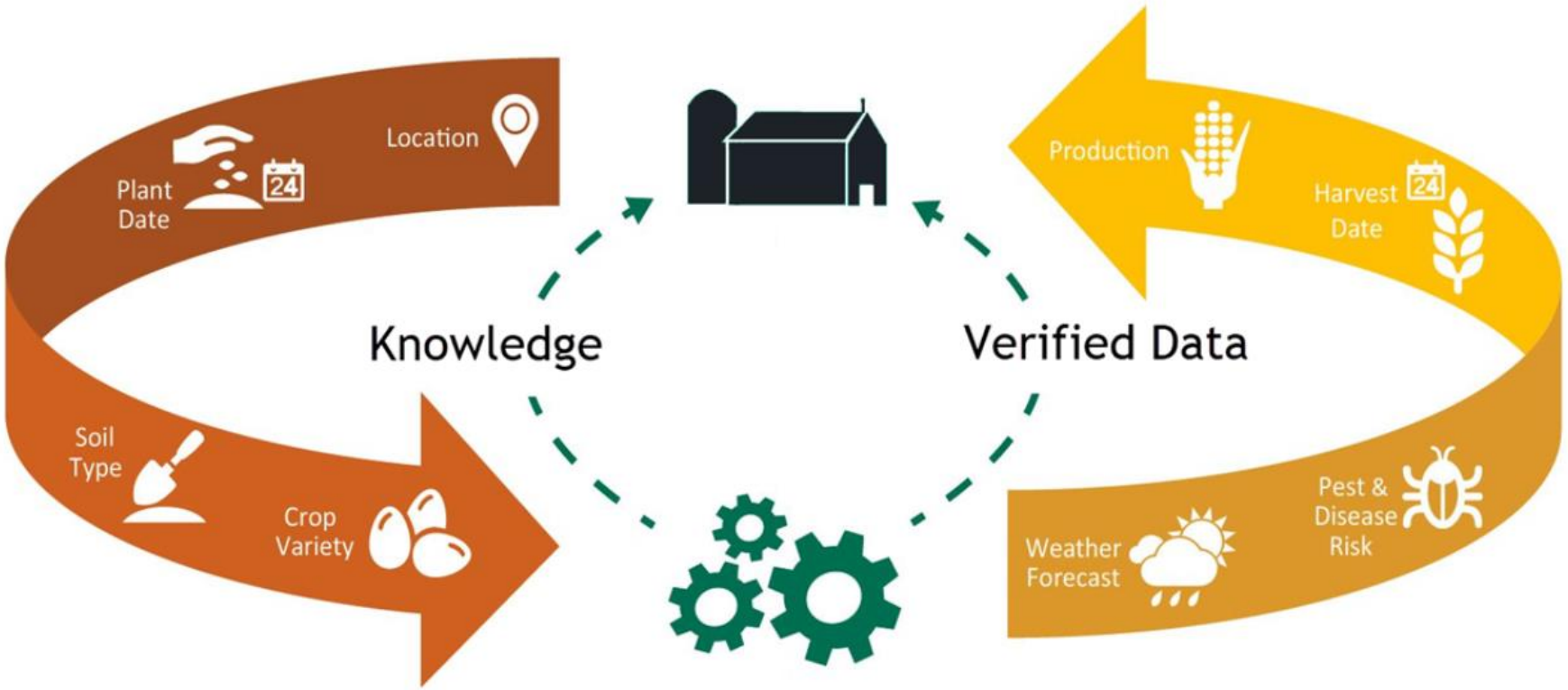
Full Circle



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Symposium - Panel 2

Digital Agriculture - Challenges and Opportunities

Panel chair: Dan Berne

Symposium on Farmers' access to data
Centurion, South Africa, 24 November 2017

Crossing the Donga

Digital Agriculture
Challenges & Opportunities

Dan Berne

Data is the bridge to better agriculture!

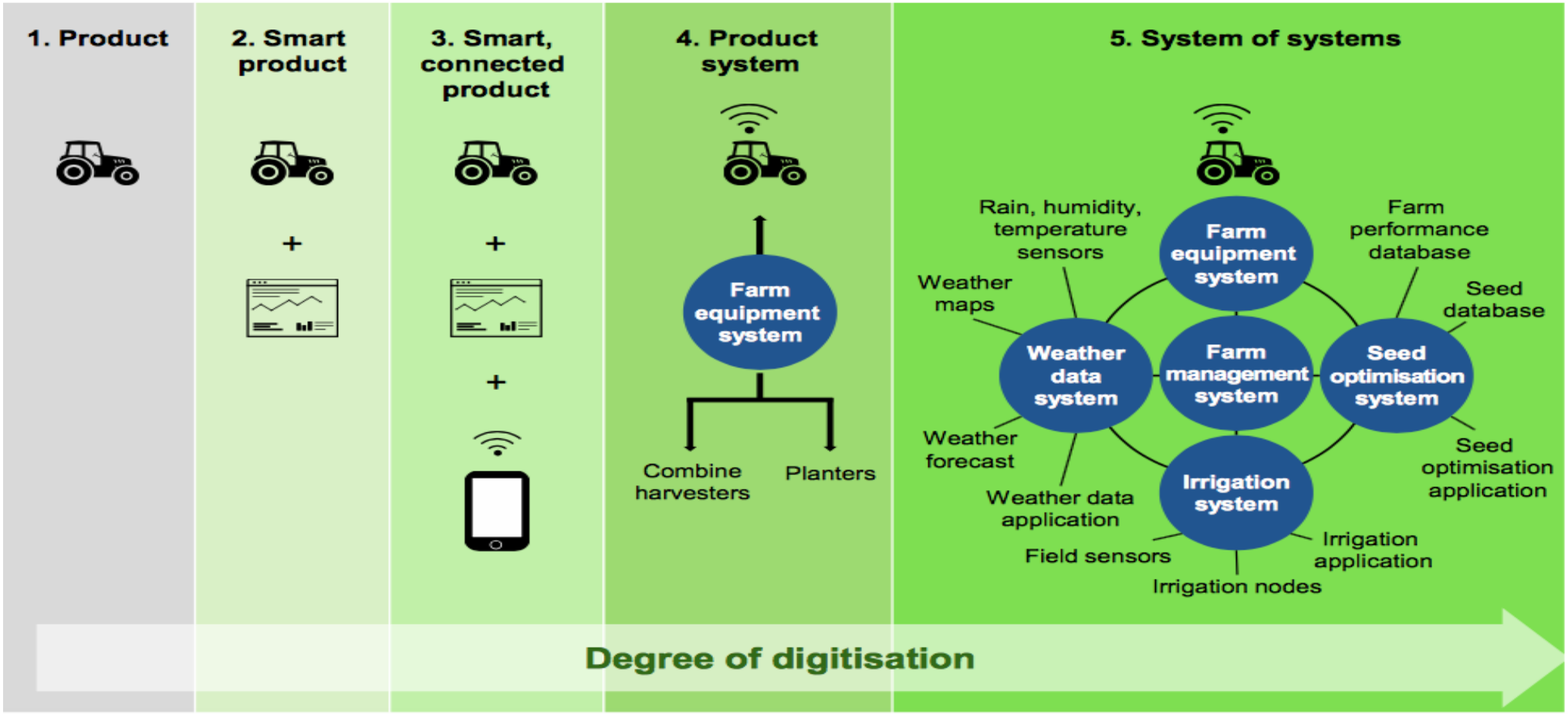
But how?

For whom?

Digital Agriculture Today

- Highly complex system
- Mergers and acquisitions for vertical integration and leverage are driving change
- Competing constraints on resources
- Increased need for tracking and traceability
- Risky business looking for efficiencies
- Substantial investment in ag tech, but specific plans not yet crystallized

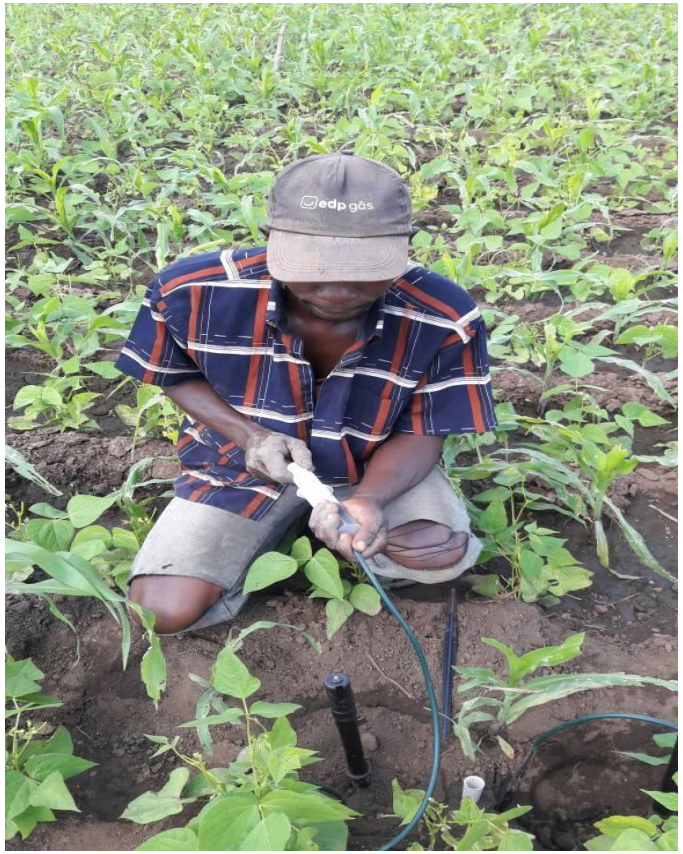
The total market size for digital precision agriculture services is expected to grow at a compound annual growth rate of 12.2% between 2014 and 2020, to reach $4.55 billion[9].



There Are Opportunities

- Open-Source Soil and Land Capability Maps
- Weather and Climate Data
- Open-Source Farm Management Tools

There Are Opportunities



Challenges

Open Source Tools Limited to Specific Regions

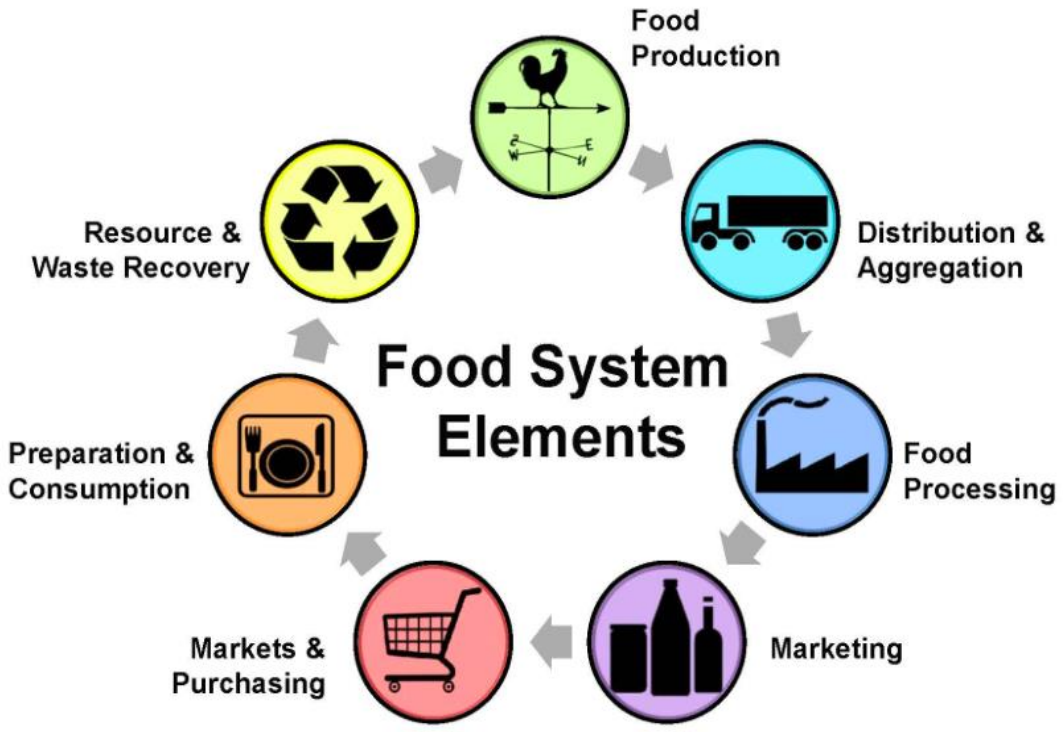
Data itself can be:

- Hard to find
- Expensive and tedious to get
- Inaccurate, incomplete
- Available too late to be useful
- Lacking critical metadata
- Tedious to acquire and transfer
- Expensive to “clean”

It Can Be Overwhelming

Systemic Challenges

- Lack of access across the value chain
- Lack of Up-to-date market information
- Lack of internet access
- Confusing and unenforced policies
- Lack of skills to use data
- “Free” data is so generic or high level as to be useless
- Cultural practices
- Conflicting roles: of Gov’t vs. Private Industry vs. NGOs. Vs. Local Farmers’ Groups



Adapted by Christy Shi, Center for Environmental Farming Systems.
From: Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

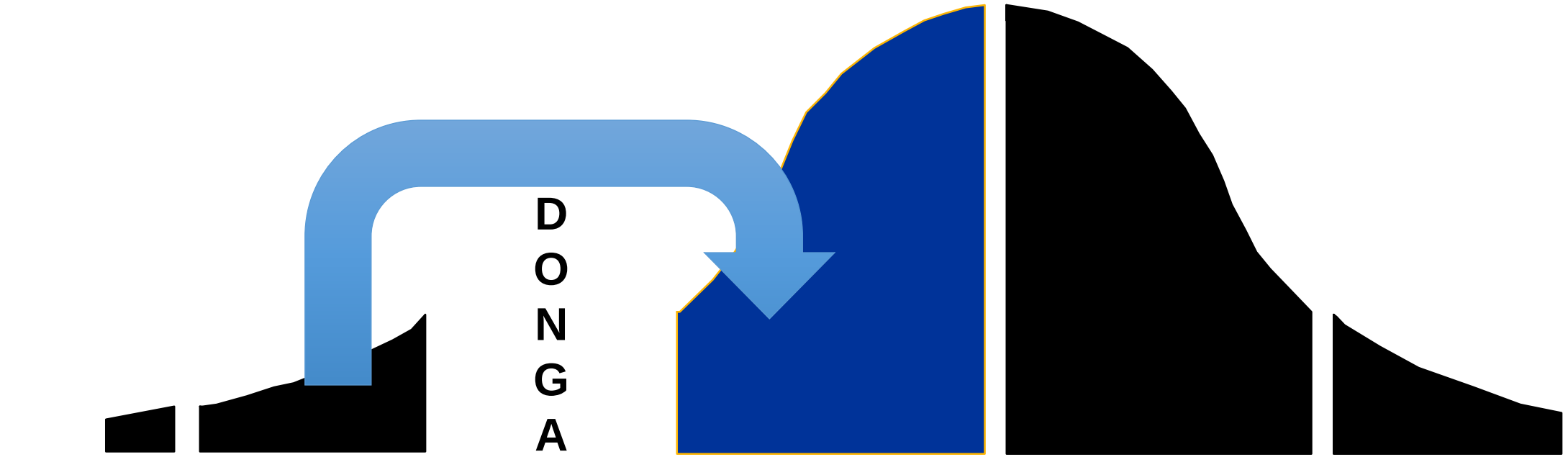
Finding common ground.

- Profitability
  - Moving from sustainability to commercial farming
- Feeding people
- Caring for the environment

- Helping farmers be more productive
- Gaining efficiencies
- Influencing policies
- Solving interesting problems

But there is a Donga to Be Crossed

Adoption Means Crossing the Donga

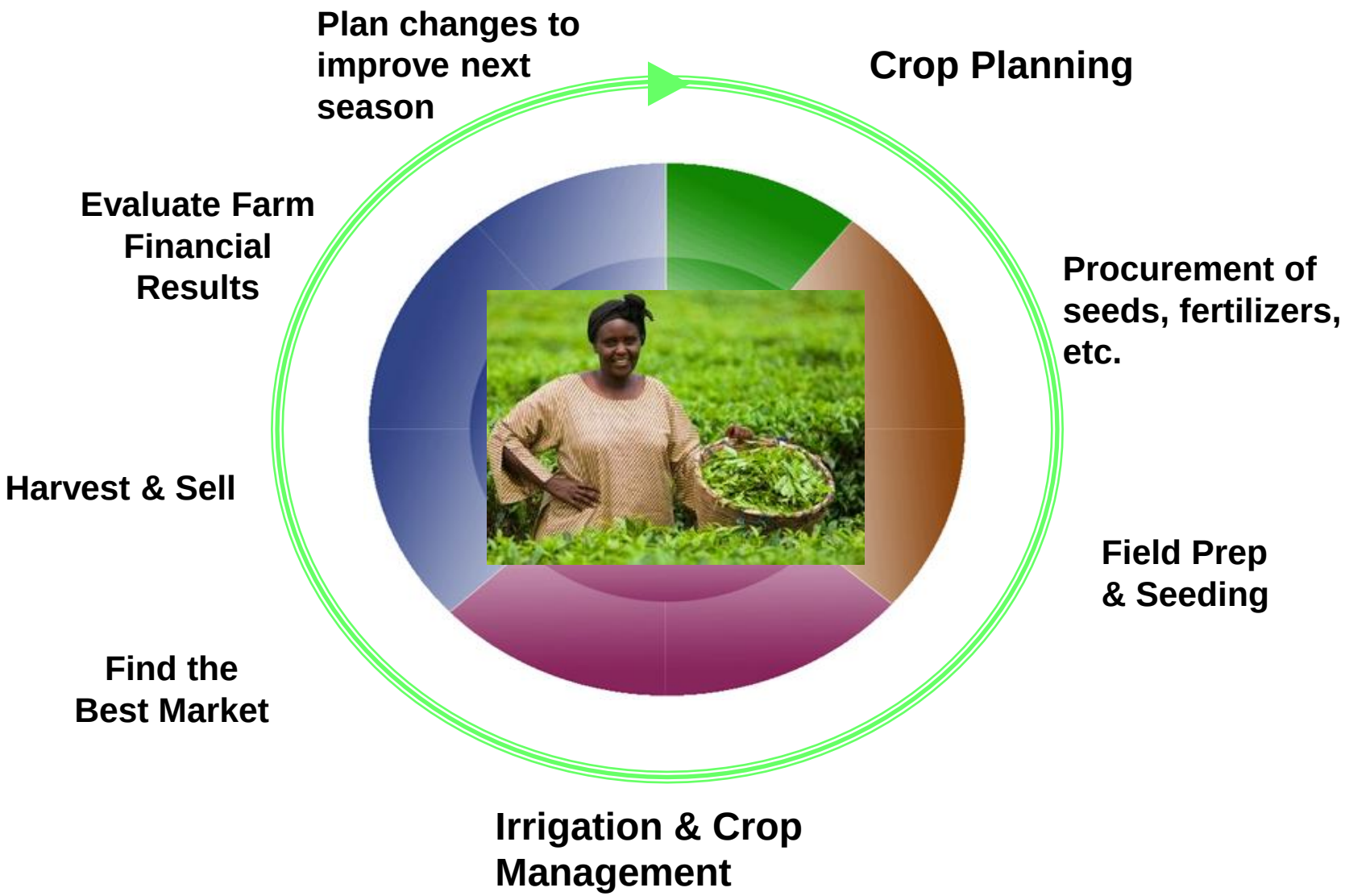


But the farmers are here.

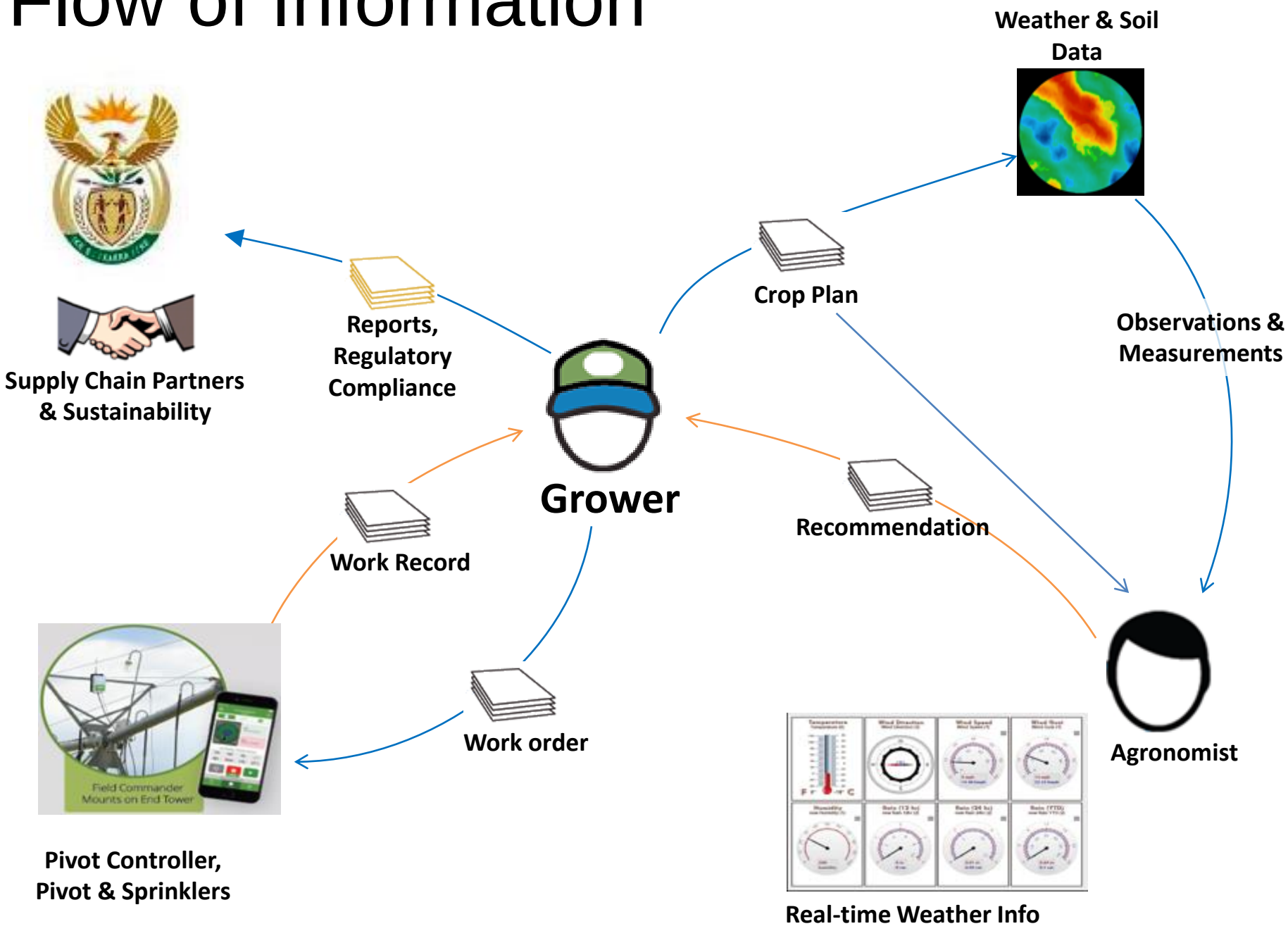
"We love digital agriculture and can't wait to use it!"

Can We Agree?

Spend Time with Farmers & Find the Problems to Be Solved



Map the Flow of Information



Integrate Strategies Across the Value Chain






Production	Harvesting and transport	Primary processing and storage	Secondary processing	Distribution, packaging, and handling	Wholesale and retail markets
• Smallholder farmers • Farmer associations • Input providers	• Smallholder farmers • Farmer associations • Logistics companies	• Primary processors • Machinery suppliers	• Secondary processors • Machinery suppliers	• Packaging companies • Logistics companies	• Grocery stores and supermarkets • Food and beverage companies

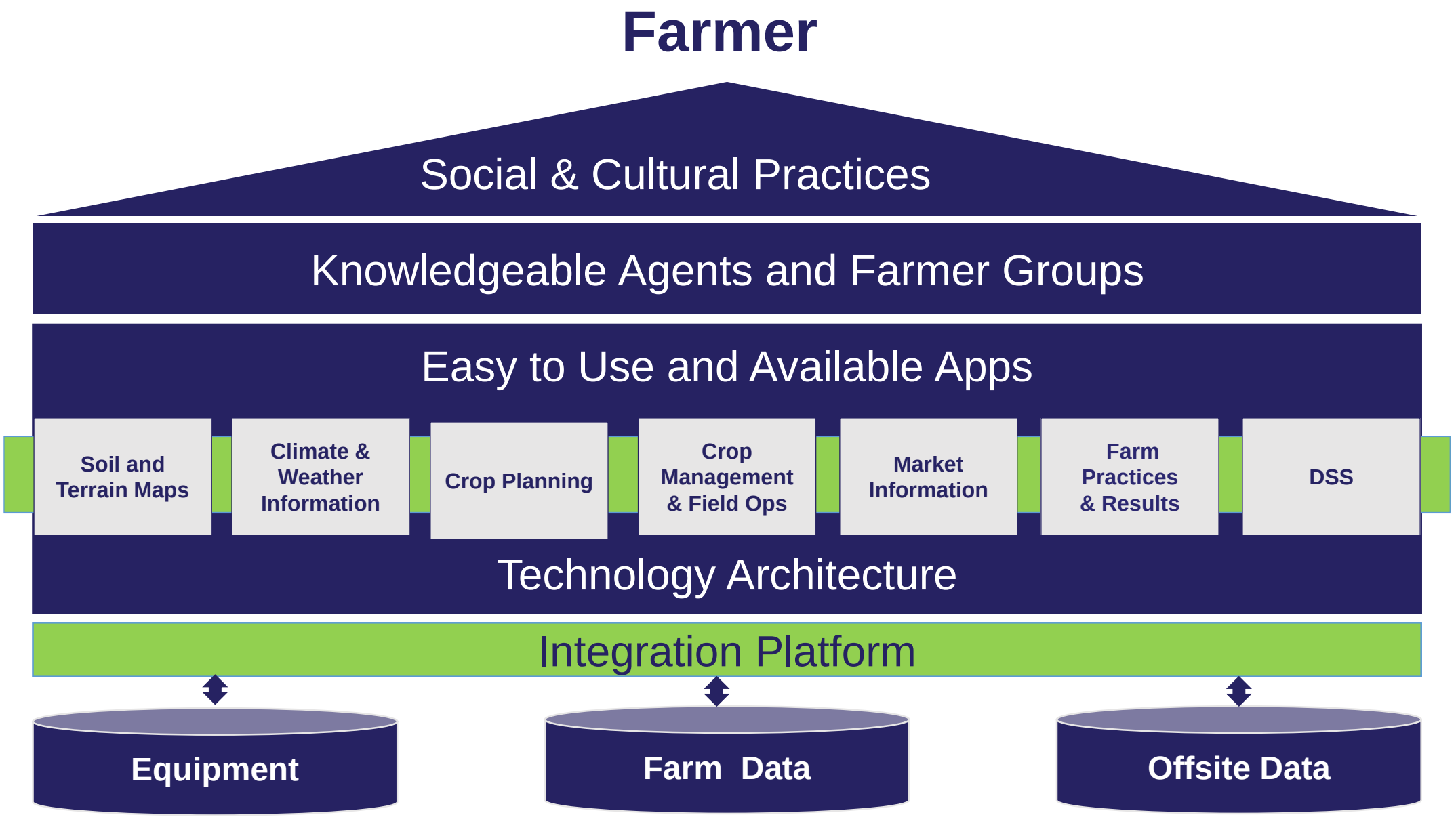
Source: A.T. Kearney analysis

Adopt the Appropriate Standard

New Zealand
Farm Data Standards

AGRICULTURAL INDUSTRY
ELECTRONICS FOUNDATION

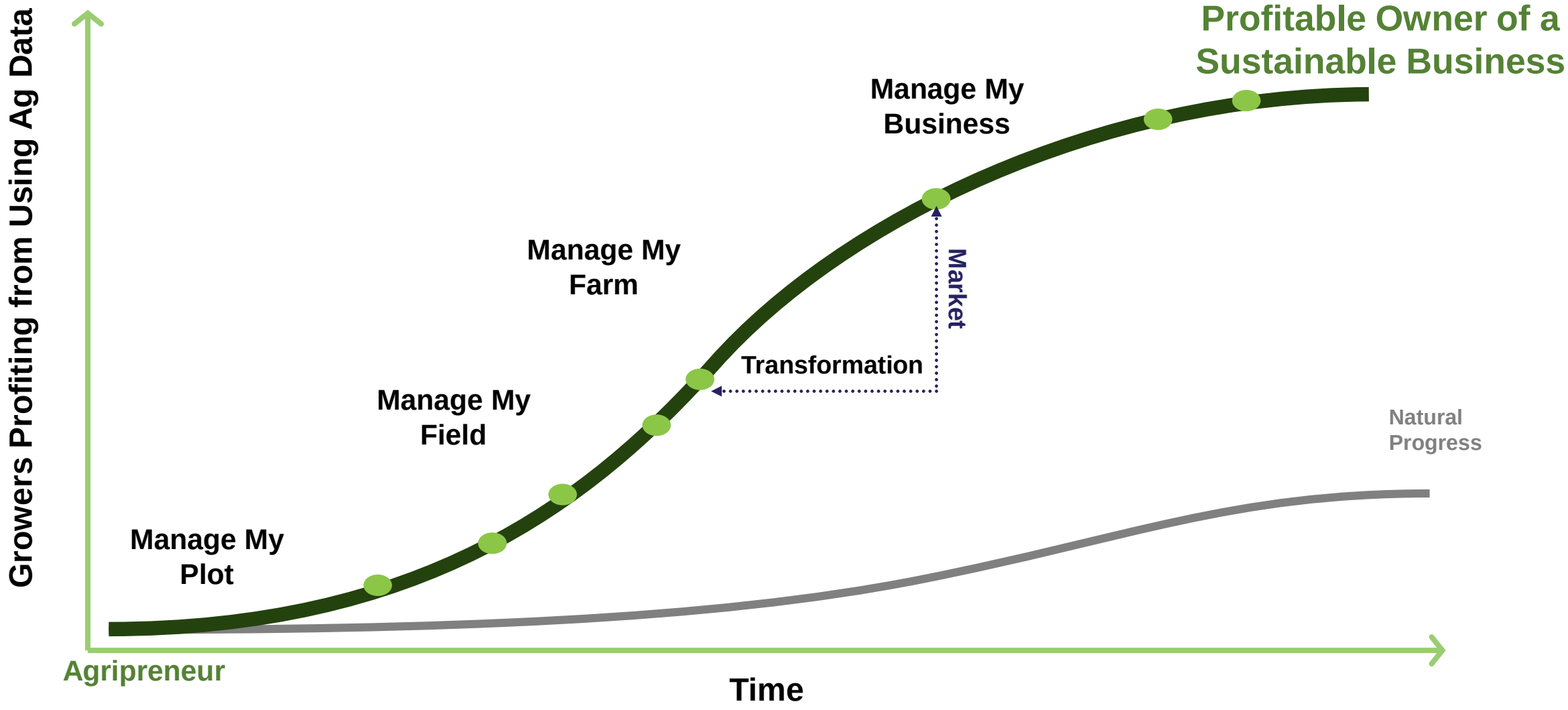
It’s a Complex System



Help the farmer take small steps

Success by One Leads Others to Try

Define Specific Strategies and Actions to Take



International symposium on Farmers' access to data

Centurion, South Africa, 24 November 2017

Extended version of keynote speech 2

"Digital Agriculture – Challenges and Opportunities"

Dan Berne

The solution architecture unifies these elements in a way that is clear and actionable by the farmer. It consists of application specific templates that align the precision ag solution with the specific farmer's needs. It embodies business and farm processes that are specific to that farmer, and communicates the business results of the applied application. It is also understandable and sellable by the consultants and system integrators, as well as the solution sales force. It includes the user interface, as well as instructions and training.

The bottom layer indicates what the farmer already has in place: pivots and other equipment, a local database, as well as offsite data, such as SSURGO soil maps or regional weather forecasts. Above that, the Integration Platform provides a buffer that is familiar to the current generation of farm managers, has proven reliability, probable longevity, and is predictable in its interactions with the equipment and systems with which it interfaces.

No one member of the value chain can deliver all the products and services end-to-end. Typically this requires a company that has a reputation in the solution space that gives it permission to lead, bringing in value-added partners who can complete the solution model.

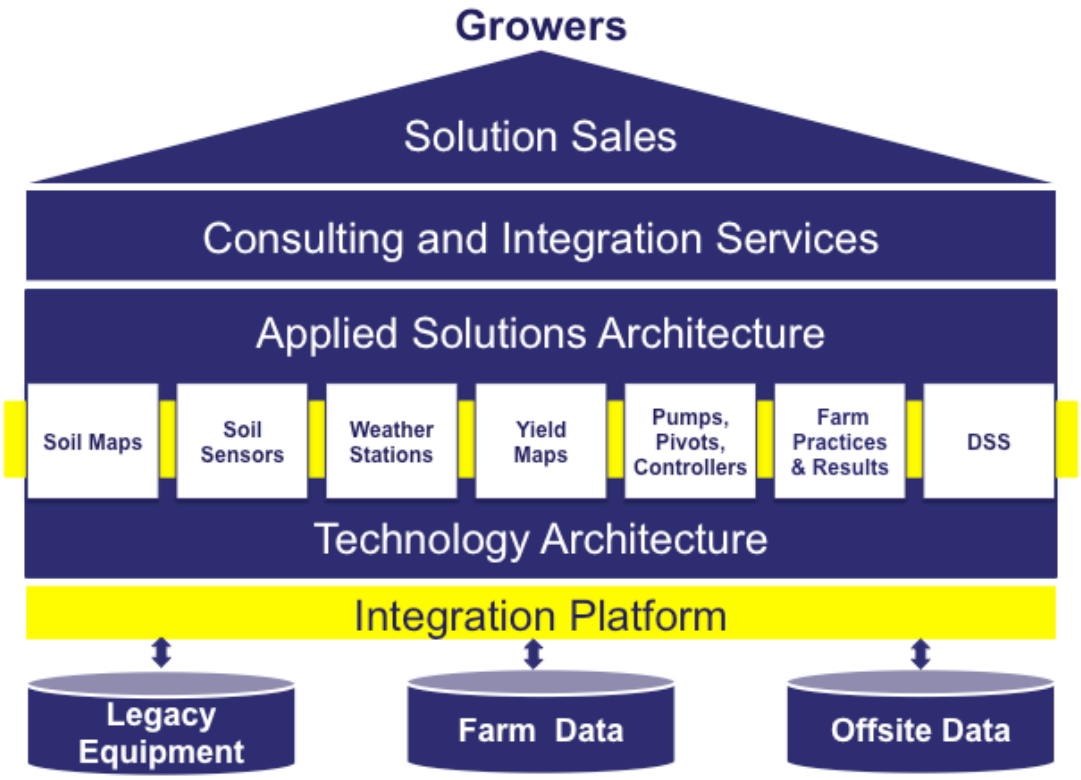


Figure 11 Complex Systems Market Model

The model is organized around the farmer because market success is dependent upon a relatively small set of customers making relatively large purchase commitments. Qualified customers are the scarcest resource in the system. Farmers typically have the power in sales negotiations, and solutions must be customized to fit within their existing farm management processes and equipment infrastructure. No two solutions are identical. Lead times are long.

Solution Sales can be driven from a local sales source, such as an irrigation equipment retailer, or in conjunction with a consulting service. Irrigation consultants can either work directly with farmers or vendors. In some cases, they may be tied directly with a particular pivot or irrigation services provider. Their role is to bridge the specific needs and requirements of the farmer and the core capabilities of the Ag Irrigation solution.

Two sub-architectures surround a set of multiple, disparate elements. These elements are modules that can be used to provide the system's ability to generate irrigation prescriptions and to monitor and report the results. Different vendors often supply them. The system is extensible: new modules can be added. And the system can integrate with other FMIS systems if necessary or desired.

The technology architecture unifies the system on the systems-facing side. It includes common facilities and protocols, such as data standards and data transfer mechanisms. It would also include the business rules for those data standards. The technology architecture enables disparate elements to be swapped in and out to create different solution sets, without having to reconstruct everything from the ground up.

- It is not well-suited for some field operations such as irrigation with center pivots, where irrigated areas have complex geometries.
- Its adoption is not yet universal, and there exists a multitude of proprietary formats for machinery and FMIS that are inherently incompatible with it.

There are literally dozens of data standards groups whose work impacts agriculture, from GODAN to AgGateway to ISO to New Zealand Farm Standards. The temptation is to write one super standard that would umbrella them all, which would undoubtedly become yet another standard. The recommendation here is to identify the data sets that are required to accomplished the job to be done (see above), and determine if any of the existing standards can cover it, or perhaps be extended to cover a use case it does not currently cover before creating a new standard.

A second option is to let the user choose their preferred standard, identifying it in the data message as the source. This approach is very useful with units of measure. There are multiple emergent code sets for units of measure, such as UCUM, QUDT, etc. Large industry companies, such as John Deere, may have their own proprietary standards. If they are market-dominant company, then their proprietary standard can become, in fact, the de-facto standard, and one should accept that fact and allow users to name it. AgGateway's irrigation data standard project has found it a good idea to include in the dataset metadata a reference to the unit of measure authority within their XML schema.

A Market Model for Precision Ag and Digital Agriculture

Developing and marketing precision agriculture solutions that require the data capture, analytics and communications, is not a simple matter. These solutions are not widgets that can be shelved and sold like individual sensors or sprinkler heads. There is a clear distinction between making and selling "widgets" and making and selling integrated solutions (Moore, 2005). Widgets are designed and marketed as as "high volume" items, while the latter are designed as 'complex systems." Complex solutions require the integration of a number of moving parts. If those parts are not under the control of a single entity, such as a company or agency, it becomes very challenging to get them to work together (e.g. vertical integration).

Figure 11 below shows an adaptation of Geoffrey Moore's model for complex systems (Moore, 2005), as applied to a digital agricultural solution for center pivot irrigation.

5. Help Develop, Promote and Adopt Data Standards

The need to feed an ever-increasing global population with limited resources, in the context of ever-increasing regulatory pressure, supply-chain interest in traceability and sustainability, and market price volatility, requires principled decision-making regarding the usage of crop inputs such as water, fertilizers, and crop protection. Better decision-making requires the capture and sharing of a variety of data across multiple hardware and software platforms; a necessary condition for this greater *interoperability* is the rapid deployment of standard formats for data exchange in agricultural field operations. Crop-production processes must be supported with data exchange, both for coordination among the different actors directly involved in each process, and for communication with information consumers such as trade partners and regulatory agencies.

In field operations, a standardized communication method between inputs for the system and the control devices is needed to maximize the utility, application and desired outcome of advanced, precision agriculture methods and applications. Data exchange standards that enable the free flow of data are fundamental in allowing growers and vendors alike to manage data and to make better decisions that use less resources while protecting harvest yield. Among the benefits they provide there are three that are noteworthy:

- Data exchange standards facilitate broader (i.e., more technologies) and more comprehensive (i.e., greater level of detail and precision) systems integration. This is achieved by reducing development and maintenance costs for data handling systems.
- The standards promote reliable system interoperation: standards-compliant tools are expected to work together; the end user benefits by having confidence that two products from difference sources will work together as expected.
- They lower costs, both for the farmer and for the companies or organizations who develop products and/or services that need to intersect with other programs or across multiple brands.

Another problem in agriculture, however, is a lack of standards to govern this business-process-centric and agronomic data exchanges. A well-respected standard, ISO 11783-10 (ISO, 2015), does exist for a subset of these processes; specifically, for communication between machine and implement control systems (MICS) in the field and an FMIS.

Whereas ISO 11783-10 provides a comprehensive format for representing data being exchanged between an FMIS and machines such as tractors, sprayers and combines, it has limitations:

- It is limited to MICS-FMIS communication in the context of field operation execution, and does not support FMIS-FMIS transactions that may involve additional “documents” (e.g., a recommendation from an agronomist, or data needed to complete a regulatory report) that are not machine-specific and therefore not covered by the ISO 11783-10 format.
- It initially supported locally-scoped identifiers only.

3. Design and Advise So That Farmers Can Take Baby Steps

Farmers juggle a multitude of responsibilities and tasks. They have neither the ability nor the time to make large-scale changes at once. Modularizing digital agriculture solutions so that a farmer can introduce additional components over time can increase the rate of market adoption of such solutions. For example, in its field trials with variable rate irrigation, the Northwest Energy Efficiency Alliance determined a successful approach with farmers that included the following steps:

1. Identify the crop and one or two fields with which to start.
2. Select an irrigation technology that is compatible with the current farm practices and irrigation equipment.
3. Try the technology on twenty-five per cent of the field(s).
    a. Limit the parameters for decision-making (for example, the soil conditions for the majority of the field, crop requirements, near-term weather forecast).
4. Then try the technology on the whole field without over-committing to the entire practice.
5. Record and evaluate the results as inputs for year two, before applying to the entire farm.

4. Assume Three Years to Prove the Value

Because market fluctuations, weather and other "non-controllables" play such a dominant role in farming, farmers are dubious about relying on results from any single year. Reports that tout the advantages of using precision ag and digital agriculture solutions should cover a period of three years and should document the details of changes made to the farming practice, how they were executed, and the yield/profitability results achieved over those three years. Such reports should include:

- The historical results of previous practices (minimum one year) as a baseline.
- The farmer's goals and crop plan, and any changes to these as the seasons evolved.
- Specifics of changes made to the previous practice, including equipment and software/services.
- The conditions under which the farmer made the changes (weather, economics, choice of crops, incentives, etc.).
- The results in application.
- The results in yield.
- The results in terms of economic benefits (profitability, cost reductions, higher-quality and better transactions and/or reputations with buyers).

support their families. As one farmer said, “There seems to be always something around here that needs my attention.” Most farmers wear multiple hats: financial planner, commodity trader, mechanic, field operations specialist, manager, and many more. For these reasons, manufacturers and service providers should work together to reduce the amount of time needed to install and use integrated irrigation solutions.

Limited time also impacts farmers’ abilities to read up on solutions to technical issues or best practices. Their attendance at “off-season” conferences varies based on other commitments they may have, such as working a secondary job. Farmers in the United States cited audio podcasts as their preferred information dissemination method, as they can listen to them in their trucks as they drive from field to field.

Difficulty refers to the frustrations farmers feel when solutions don’t work as well or as easily as they should. Observing how farmers interact with your product or service is an excellent way to look not only for fixing problems, but also for finding undiscovered ways to delight them. Figure 10 below represents work we did with a vendor of weather stations and soil sensors. Note both areas for improvement and creating new solutions.

- -2a refers to anxiety. Farming is inherently a risky business and farmers are naturally risk-averse. Fear surrounding farm and personal data being stolen or used for nefarious reasons cause many farmers to refuse to opt-in for data services. The issues of data ownership are covered elsewhere in this conference, but identify the fears that farmers have on this topic. Recent data breaches from hackers around the world have only exacerbated this fear. Addressing data security, privacy and ownership issues are key to the adoption of digital agriculture solutions.

Figure 10: Mapping Areas for Improvement

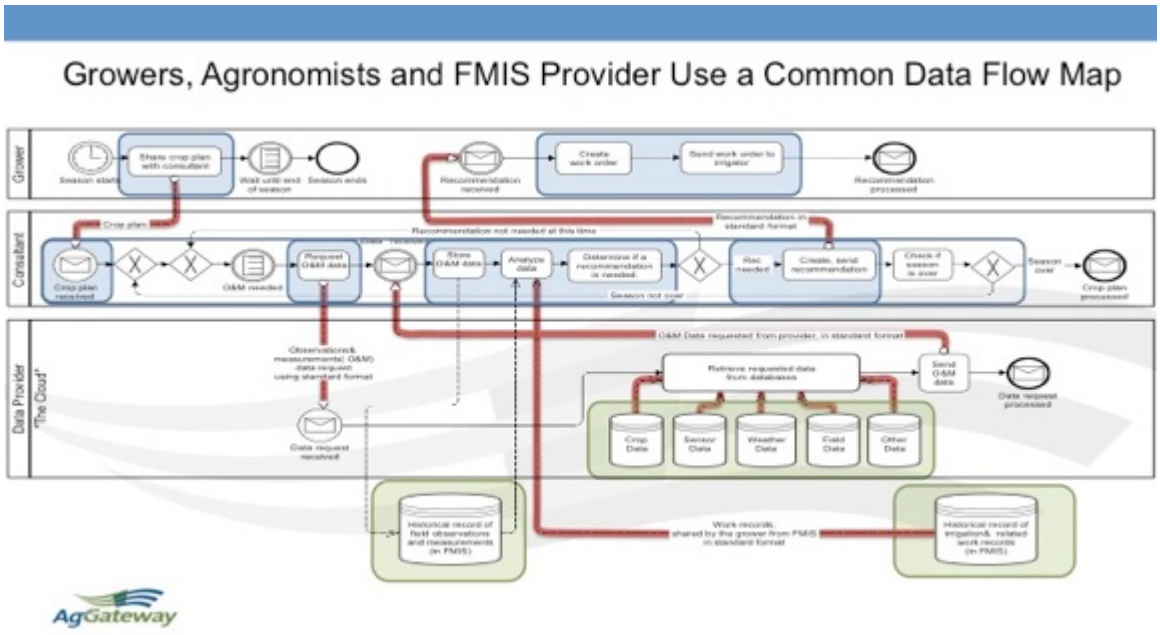


Figure 9: Example BPMN Flowchart for Field Operations

3. Design to Remove the Barriers and Achieve Adoption

The following may be a useful (though in now way mathematical!) heuristic for designing products and services to increase adoption of digital agriculture solutions. This heuristic is adapted from that developed by Market Experimenters (MECLABS Institute).

$$\text{Adoption} = 4m + 3fvp + 2(i\text{-}f) - 2a$$

In the above "formula," the numbers indicate the relative importance of each factor. The factors (letters) themselves include the following:

- M refers to the motivation of the farmer. Does she have a real problem to solve? Is that problem pressing? Is she willing to spend time and money to solve it?
- FVP is the force of the value proposition. Does the data or precision ag solution really solve the problem that is motivating the farmer? Is the value proposition clear to her, or is it rather vague. This is an especially relevant question for "big data." For example, if a farmer views weather data with factors such as rainfall, wind velocity, min/max temperatures, evapotranspiration, etc., how is she to understand this in terms of solving a problem? Instead of focusing your service as "weather data," try wrapping the data around jobs to be done, such as working with agronomists to commercialize an app with seasonal job-specific recommendations based on local, near-term, and climatic weather data?
- 2(i-f) is the impact of incentives minus friction. Incentives may be in the form of government subsidies, dealer rebates, etc. While incentives can be useful in getting farmers to try a new solution, they tend to be unsustainable. Once the money stops coming, the farmer resorts to previous methods and practices. Friction can be in terms of time and difficulty.
  Time is the scarcest resource for most farmers. Many work additional jobs to help

At AgGateway, I have used grower profiles to the team standards development team understand the goals and problems of the farmers that the standards should ultimately serve. Figure 8 below shows one such profile.

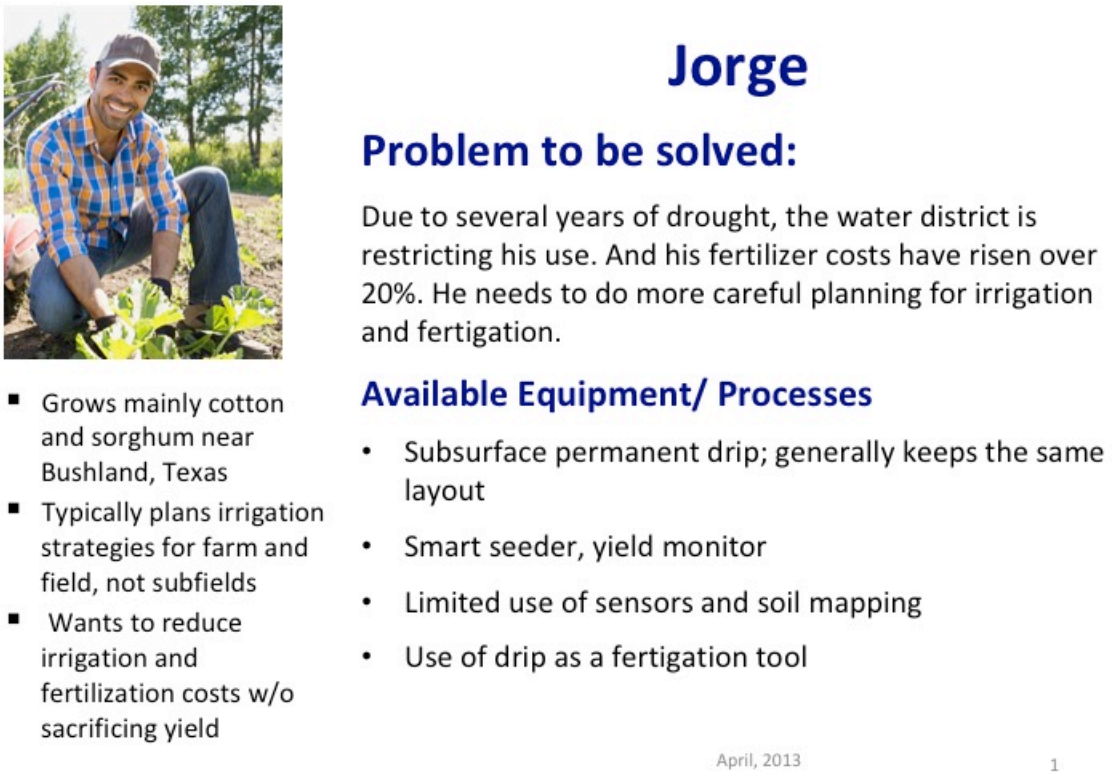


Figure 8: Grower Profiles can help communicate the problem to be solved

2. Map Your Data Flow to the Farmers' Processes

At AgGateway, we have found it very useful to the Business Process Model and Notation (BPMN) method for mapping the data flows that occur among the farmer, her consultant and data provider. Figure 9 below shows a BPMN flowchart for field operations. The flowchart was developed in conjunction with farmers, agronomist consultants, instrument and equipment manufacturers, and data providers. The goal is to make sure the data flow matches real life practices and can work in the real world.

phase. In the early phase the first segment of pragmatists are actively buying a new solution because it solves their problem with a 100% whole product. In the mid and late phases, additional segments loyalty to the solution leads to others to adopt as providers now give them a version of digital agriculture that solves their problem. Thus success in one niche (bowling pin) leads to success in others. (Moore, Eckhart, et al, 2016)

A Path Toward Success

In order to "cross the chasm" from the Early Market into the Bowling Alley requires the targeting of "bowling pins." By this, the model means niche markets, particularly ones that are adjacent, so the members of one niche market can be effective references for the next niche market. Once again, the Bowling Alley is made up of pragmatists who are looking for a proven solution to an important, near-term problem. Vague and/or general statements of benefits, such as "sustainability" are not going to cut it.

1. C**hoose Your Niche Segment and Solve Their Problem with a 100% Solution**

What are some possible niche segments for digital agriculture? Some have suggested crop type, demographic or geographical characteristics, early adopter vs. late adopters, and large farm vs. small farms. But given that pragmatists are looking for a problem to be solved, then that should be the primary consideration. In other words, find the jobs that matter most to the farmer, and discover what the key problems are.

First and foremost, farmers care about yield and quality of crop, both of which drive profit. Yet their day-to-day problems are often centered on tasks – jobs to be done. These may be along the main areas of farm work, such as:

- Planning
- Acquiring seeds and nutrients
- Planting
- Cultivation
- Irrigation
- Weed and pest control
- Conservation
- Harvesting
- Distribution
- Labor management
- Etc.

Which of these are most problematic for any set of farmers? The problems should form the base of requirements for your product or service. The answer to these questions can form a segment. Your goal then is to understand the problem, find a complete solution to it, and message the resulting product as addressing that specific problem. It is tempting to create an "80%" solution for problem, but in the Bowling Alley this can be fatal. The segment of customers using the 80% solution will focus on what's not working when referencing your product or service to others, thus preventing the effect of one bowling pin knocking down another one. Therefore, pick a list of product requirements, including items such as documentation and support, and finish it completely.

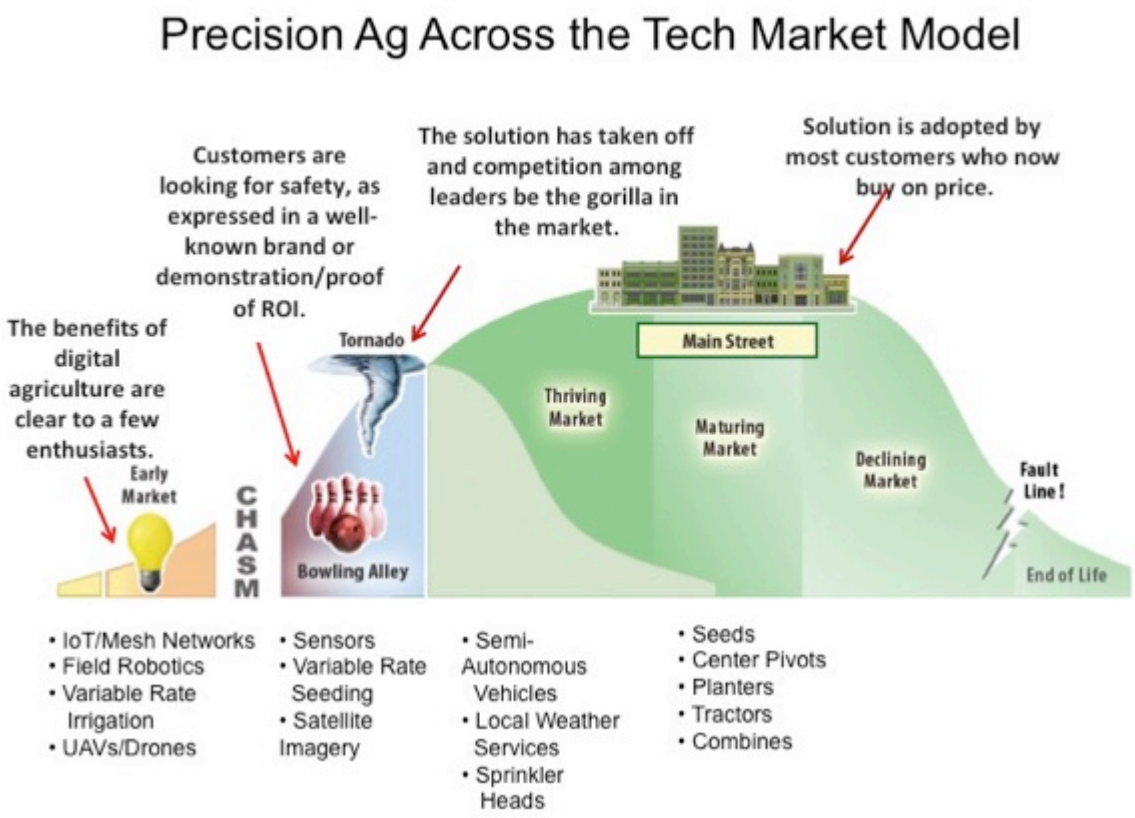


Figure 7: Precision Ag and the TMM

From Early Market to Bowling Alley

In the opinion of this author, most categories surrounding digital agriculture reside in the Early Market phase. Think of IoT, mesh networks, harvesting robotics, etc. The Early Market can be further divided into an early, mid, and late phase. Early on, initial alpha tests are occurring, and only a few technology enthusiasts are seeing the results. In the mid-phase, visionary customers gain enthusiasm and ask to see demonstrations. They discuss if the product is feasible for their business. In the late phase, at least one vendor has developed a solution that is feasible, although it is not a "whole" product and needs additional items, such as special installation and real-time support. The enthusiasts are buying because they like the idea of what it can do for their business, even if it has not yet shown a proven ROI.

The Bowling Alley is the gateway to the main market. Until the majority of pragmatists accept the new digital agriculture solution, the Bowling Alley is the only way to develop a market around this disruptive innovation. The Bowling Alley is characterized by niche markets, each of which must be given a 100% working solution.

The goal is to enter the Bowling Alley phase, rather than fall into a never-ending chasm. As in the Early Market the Bowling alley can be divided into an early, mid, and late

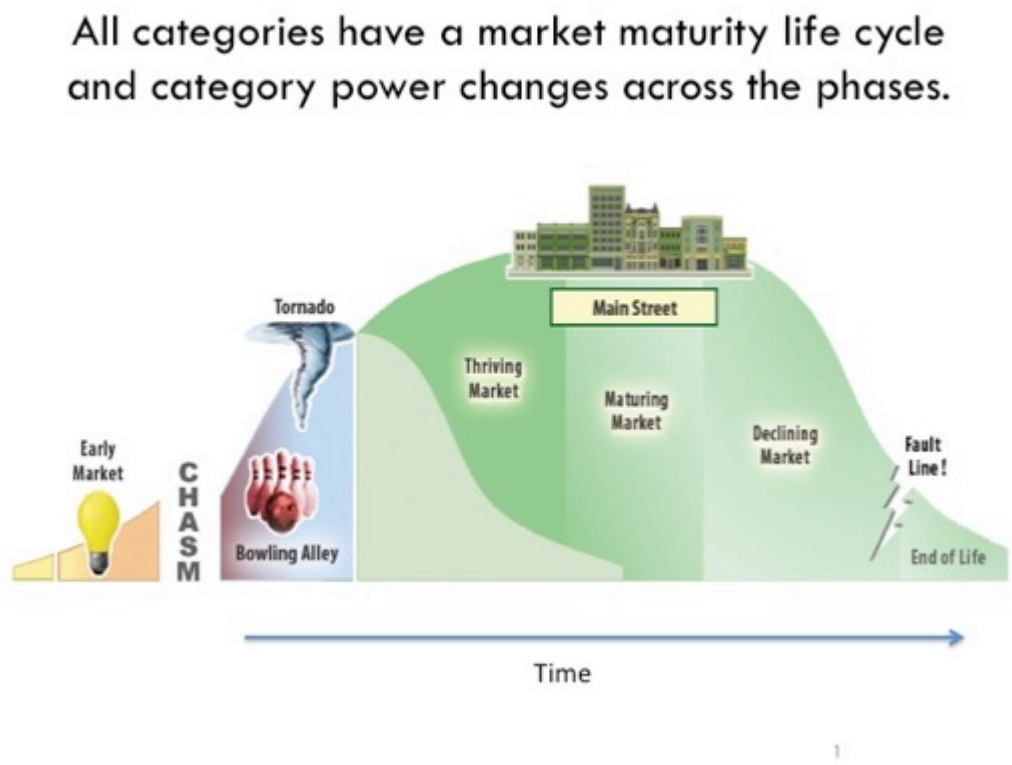


Figure 6: The Tech Market Model

An extremely important note is that companies and organizations do not get to decide where their product or service is on the Tech Market Cycle. The customers decide. Additionally it is not where a single product is but where its category is. A single company or organization can have multiple products on multiple phases, because the category, not the individual product or brand, drives the placement.

Given all of the above, how can the digital agricultural industry understand how to increase adoption and use of potentially game-changing solutions? This author suggests that some insight resides in the application of the Tech Market Model to digital agriculture.

The Tech Market Model and Its Application to Digital Agriculture

The Tech Market Model (TMM) is an evolution of the original Technology Adoption Life Cycle (Moore, et al) developed by Geoffrey Moore. Like its predecessor, the Tech Market Model consists of distinct phases of technology products and services. It is a useful tool for predicting how market priorities (including key product strategy, product features, channel, pricing, messaging, and support) must change through the phases (Eckhart, et al). These phases include:

- **Early Market**: Customers are visionaries under the influence of technology enthusiasts. The product is immature. A "whole product" has to be built for each customer. It represents less than 10% of the market.

- **Chasm**: Disparate pilot projects and demonstrations yield weak traction. But Pragmatists do not see the value of the solution or a whole product that would make a safe buy. Sales cycles are extended and most contracts are for pilot projects. This cycle can last anywhere from nine months to forever.

- **Bowling Alley**: The product is endorsed by pragmatic customers within the confines of one or more niche markets. Sales within these are stable and predictable, with good margins. There is highly focused demand. Only 15% of sales reps can sell here. Some categories remain in the Bowling alley forever, but make enough profit to stay healthy. The Bowling alley can also serve as a renewal spot for mature products. The Bowling Alley consists of early pragmatists. Together with the Tornado phase, it represents about 40-45% of the market.

- **Tornado**: The category has taken off. Virtually anyone can market and sell if they can fill the pipeline. Fierce market share battles. The winner establishes de-facto standards and enjoys higher margins. The Tornado consists of late pragmatists. Together with the Bowling Alley phase, it represents about 40-45% of the market.

- **Main Street:** Era of hyper-growth is over. Margin pressures on the market leader. Others compete by niche marketing, mass customization, or on price alone. Main Street is usually extended over years or even decades and can be divided into thriving, maturing and declining markets as time goes on. It represents 45% of the market

- **Total Assimilation**: The category is replaced by newer technology.

Expectations vs. Reality

Farmers need to feel confidence in the recommendations made with digital agricultural systems. In studies conducted on farmer adoption of digital agriculture solutions for the Northwest Energy Efficiency Alliance, the author discovered that as farmers began to use the precision ag solutions, and the more they relied upon data collection and analysis, the more questions they had. The biggest challenge was to answer these questions and confidently set future directions. This issue faces many farmers who have invested time, energy and money into PA and can result in a slump in motivation.

Likewise, the promise of advances through precision ag technology has been marketed for over a decade. Yet many farmers have not realized a strong ROI on their investments. This is having an impact on the actual use of advanced precision and irrigation products and services. For example, in 2017, it is expected that ag drone use will fall from the peak into the trough, as most farmers realize that investing a $1,000 to discover a wet spot their field (that they already knew was there) was not a particularly good return on investment after all. While aerial scouting provides value to farmers, it is doubtful that the ag drone revolution is going change agriculture overnight (note that drone manufacturers and suppliers tend to dispute this).

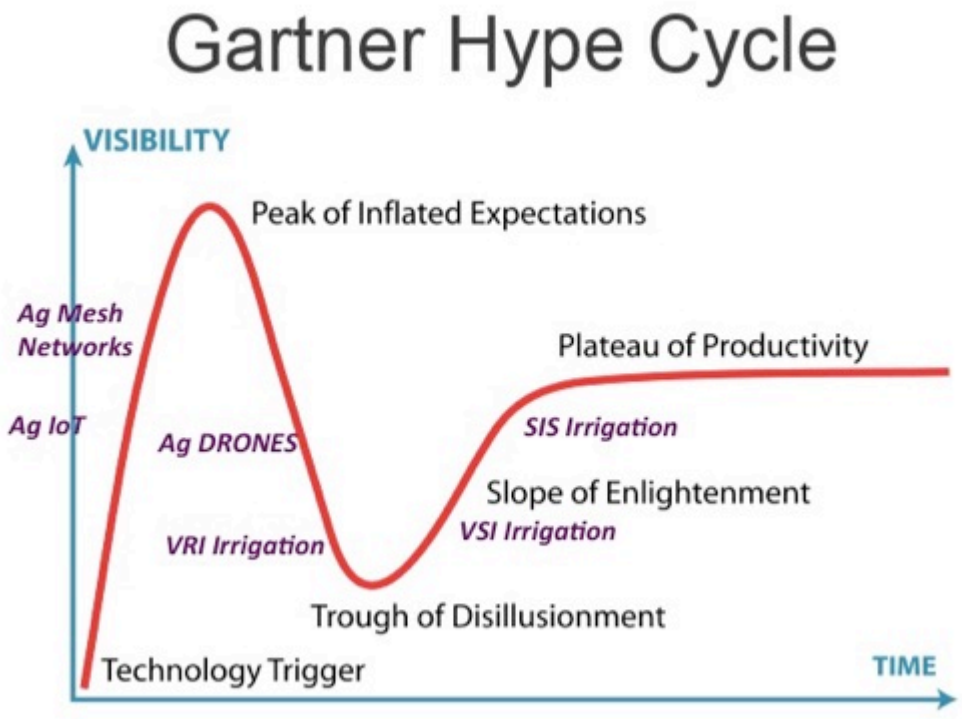


Figure 5: Precision Ag and Ag Data on The Gartner Hype Cycle

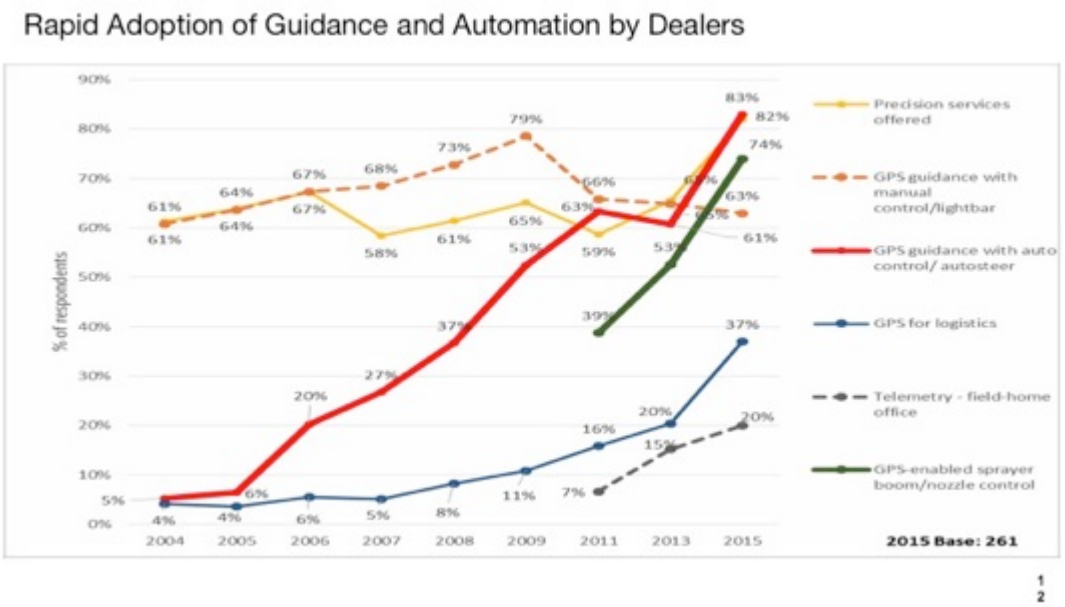


Figure 3: Adoption of GPS Dependent Solutions

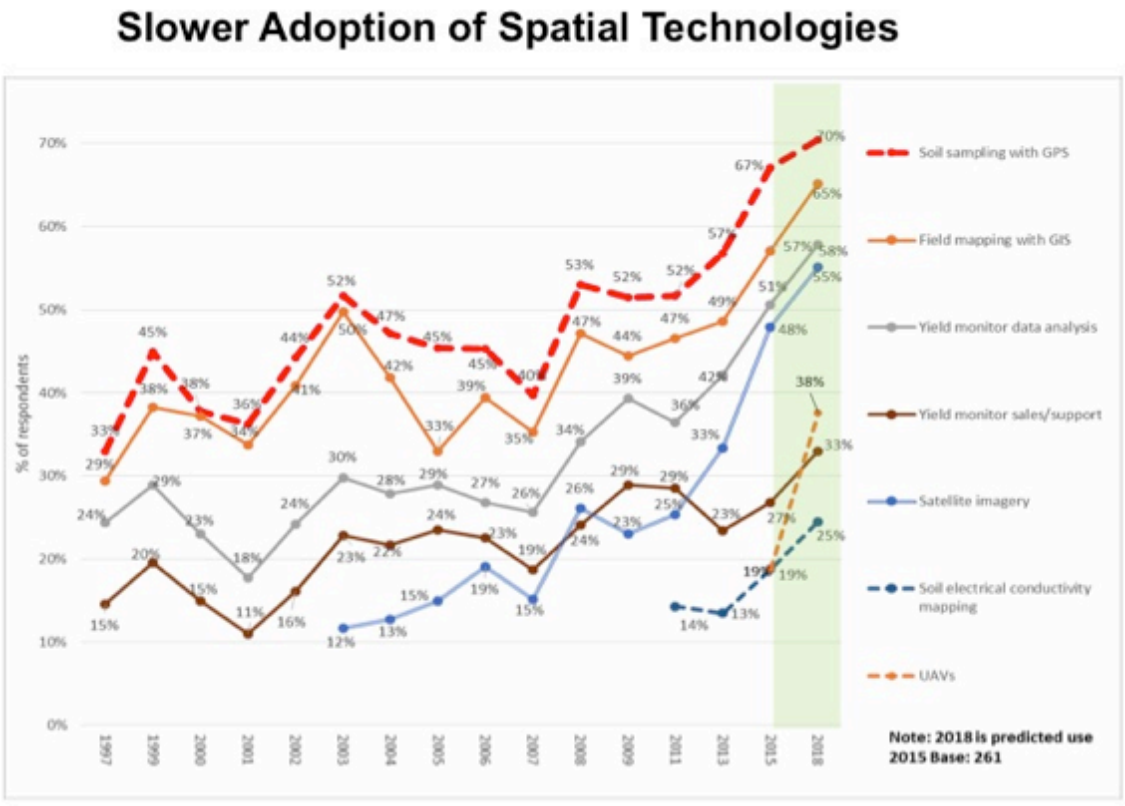


Figure 4: Adoption of Solutions Using GPS and Field Data

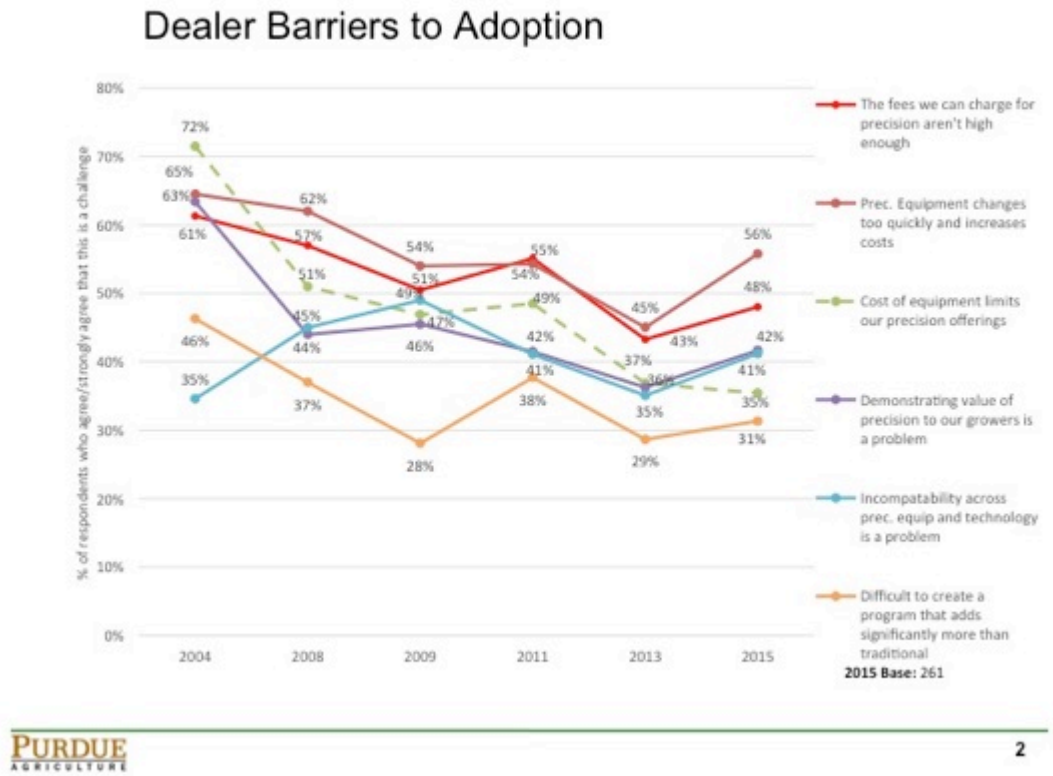


Figure 2: Dealer Barriers to Adoption

In the same study Purdue researchers found that position-dependent systems, such as guidance section controllers, have a higher rate of adoption by dealers than systems that depend upon both GPS positioning and data. Position dependent systems depend only on field positions to make decisions and can easily demonstrate a labor cost savings. Position and data dependent solutions (e.g. soil mapping, yield mapping, and variable-rate technologies) depend upon both field positioning and field characteristics, such as field soil composition and plant water availability. The potential benefits of cost savings and yield increases are more difficult to prove on a specific farm locale. Additionally the time and difficulty of data capture and analysis, especially across multiple brands of field equipment, makes it difficult to sell and service these solutions.

Lack of support is not expected to improve any time in the near future. According to Jack Zemlicka, Managing Editor of *Precision Farming Dealer*, there is a critical lack "precision ag" experts working at dealers to help farmers install, use and trouble shoot precision agricultural products.

While this percentage is on the rise, Fulton says continued growth will depend in part on farmers' commitment to a systematic approach. He charts this through an evolutionary process starting with precision farming, moving to prescriptive farming, then enterprise agriculture (a combination of precision and prescriptive farming to improve asset management) and finally, digital farming.

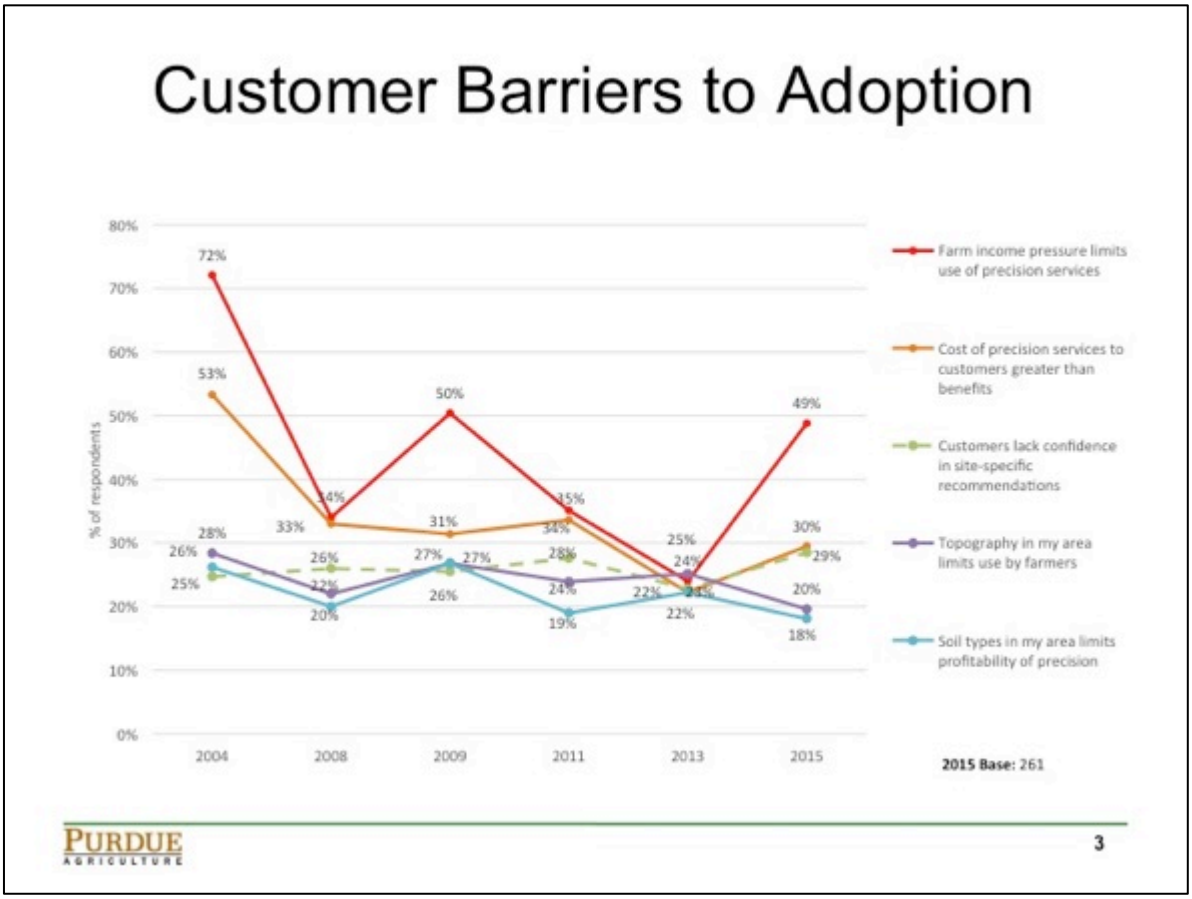


Figure 1: Costs vs. Site-Specific ROI Still a Major Barrier for Farmers

Complexity is also a Barrier to Adoption by Dealers

In their survey, Purdue researchers discovered that technologies involving position-dependent solutions were readily adopted by dealers.

boost feed efficiency in livestock production (Faulkner and Cebul, 2014; Lesser, 2014). There is the potential for digital architecture to vastly improve crop yields while improving sustainable farming practices. Digital agriculture is set to impact the entire agricultural value chain, from filed inputs through the end consumer. Food processors, grocers, and distribution centers are tracking food from field to store.

Major companies are acquiring smaller vendors to provide a complete (and often proprietary) digital ag system. CEO's are touting a bright future of growth. A corporate executive at Verizon sees huge growth in digital agriculture, stating that, "The agricultural industry is proof that soon, every company will be an IoT business."

But some see barriers that must be overcome. Hendrik Hamann of Bayer Crop Science notes three major hurdles:

1. The cost of sensing in agriculture is still too high. And it is the lack of standards and interoperability that prevent cost reductions. (In Texas and Louisiana the cost of sensors is why rice growers using wet/dry irrigation refuse to use them to monitor their irrigation practice, as requested by their crop insurance company.)
2. Agricultural data is complex, vast, and difficult to exploit. Hammand states: "Take, for example, the growth of critical weather-related information. Today, hundreds of terabytes of weather data are generated daily. Remote observations from drones or satellites can provide information about vegetative growth, irrigation, pests, and more. Governments and private entities are launching more and higher resolution satellite constellations. Despite the richness of all this information, which is growing by the hour, it is highly underutilized for many reasons. First, it is distributed widely among the many public, private, and non-profit entities that generate it. Second, it comes in a variety of formats: projections, resolutions, and reference systems, to name just a few. Third, and perhaps most importantly, the data is often too large to be downloaded in time to be acted upon."
3. Agricultural analytics are too narrowly focused on specific domains and therefore not scalable.

source:

https://www.cropscience.bayer.com/en/blogs/corporate-blog/2017/hendrik-f-hamann-how-to-turn-the-promise-of-digital-agriculture-into-reality

The Slow Rate of Adoption

Adoption Trends

Ohio State University ag engineer John Fulton offers some adoption estimates for precision ag practices. He suggests that precision farming touches about 70% of all U.S. farm acres. But as Fulton notes, today's technology is only as good as the information it collects and ultimately, and how it is used to make better on-farm decisions. This is clearly a work in progress, and Fulton estimates that only about 15% of U.S. farms utilize "prescriptive farming" practices, which includes working with third-party service providers for data management and analysis.

Digital Agriculture: Challenges and Opportunities

Summary

The advent of "big data" in agriculture not only promises to provide more efficient and profitable farming practices, it is expected to dramatically alter the entire agricultural value chain from inputs to the farming process through the processing, distribution and consumption of farm products. Companies large and small are investing in data-driven technologies, such as the Internet of Things (IoT) and cloud computing, linking these to operational solutions, such as drone imagery and autonomous vehicles, as well as supply chain operations. Yet many of the current precision ag solutions have found less-than-expected adoption and use by farmers.

In many ways, the agricultural data market can be mapped along the Technology Market Model, first developed by Clayton Christensen and refined by Geoffrey Moore. Many of the precision ag and big data products and services must "cross the chasm" if they are to be used by a majority of farmers. The design and development of digital ag platforms must take a broad focus in order to be scalable, farm operations applications must start with the farmer in mind, focusing first on the "jobs" to be done. Non-farm operations data should also be clear about their core target audience and the jobs to be done by them. The recent spate of mergers and acquisitions in the ag industry suggest that many large companies are opting for proprietary, vertically integrated solutions. Open data standards are vital for FMIS and machine interoperability across different systems and different brands. All of the above leads to the fact that digital agriculture services are part of a complex market, and thus a complex market model is needed, connecting the disparate parts. The model starts with the grower and moves from development through the sales process.

Introduction

Modern farming depends upon data to meet the goals of high yields, efficiency and sustainability. For example, in the case of precision irrigation, numerous software tools exist for deciding when and how much water to apply. However, rarely do these tools interoperate effectively. Data must be moved manually from one application to another and the burden is on the farmer to do the data management. Today we have a market where more and more pieces of equipment are fitted with data capture capability, data that is sent to the cloud to be analyzed and reports sent back to the farmer.

Yet Digital Agriculture is rapidly evolving to become a major disruptor in the evolving agricultural market. Some call it "Ag 4.0" Opportunities for Big Data applications in agriculture include observations through mesh networks of sensor networks and analytics, predictive modeling, and using better models to manage crop failure risk and to

Symposium on Farmers' access to data
Centurion, South Africa, 24 November 2017

KEY DATA FOR FARM MANAGEMENT

Stephen Kalyesubula
@kal_stephen

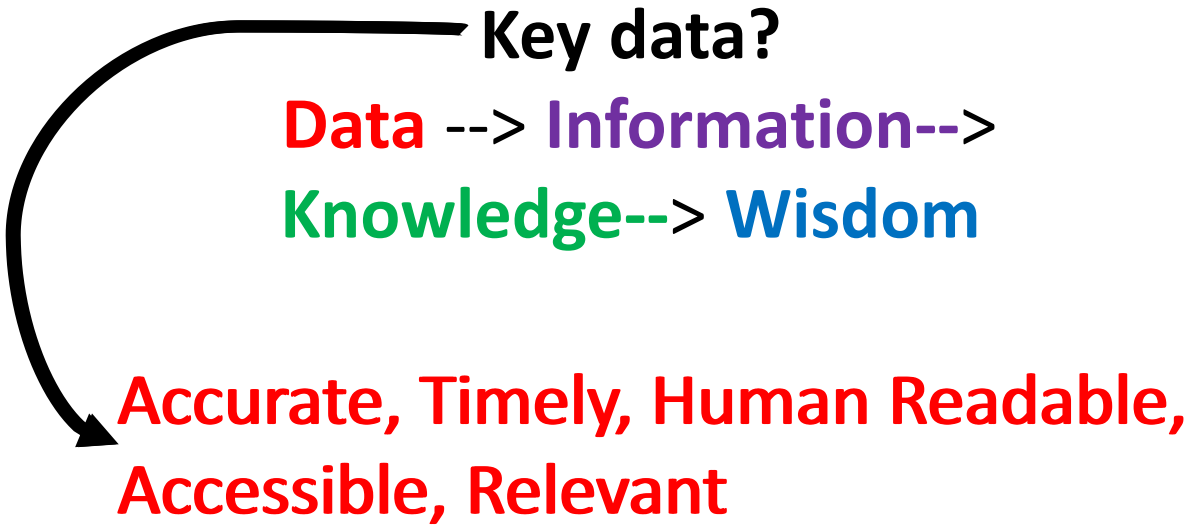
GFAR-ITOCA Farmer's Access To Data Training & Symposium, 20TH – 24TH NOV.2017
Centurion, South Africa

KEY DATA FOR FARM MANAGEMENT

Who is a Small holder Farmer?

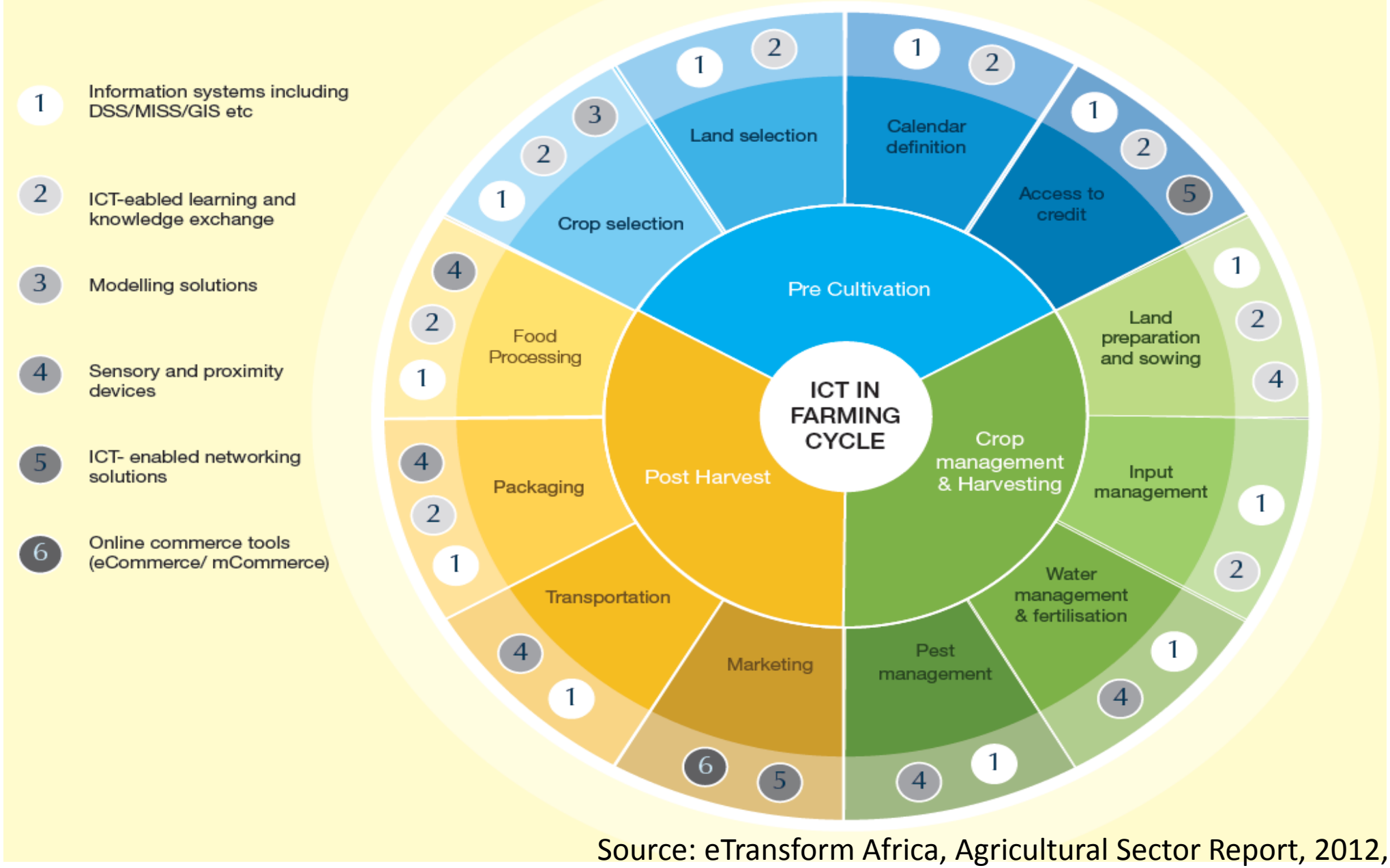
-Own Small based plots of land

- Generally less resourced
- Primary producers and produce small volumes
- Suffer terribly incase of outbreaks..



Key Data	Feature/Use	Gap/challenge
Weather/Climate Data (Area Specific)	- Rainfall partners for designing cropping calendar (planting and harvesting seasons) - Real Time Humidity and Temperature parameters for clear projections	- Weather patterns are available but inaccurate, not timely, globalized, Abstract, Integration, Climate change, Costly to access the data.
Soil Data Index (low, medium, high, excess) - Roots take up plant-available nutrients as + and – charged ions. - Sample soil correctly	- Define the crop and its specific soil property req. - **Major Ones.** Average Moisture content, pH (Strongly acidic <5.1, Moderately Acidic 5.2-6, Slightly Acidic 6.1-6.5, Neutral 6.6-7.3, Moderately alkaline 7.4-8.4, Strongly Alkaline >8.5). - Nitrogen (N), Phosphorous (P), Potassium (K) - **Mainor ones**; Magnesium, Copper, Zinc, Calcium etc. - Fertilizer distribution index per hectare or square mile - Best Nutrition fertilizers and reliable/quality suppliers	- Global Soil data sets are available but not accurate enough and they are area specific. Abstract. Not user friendly, - Secondary soil data is present from google search engines, research projects, journals and articles but not reliable - Climate change - Inconsistent and not area specific - Important soil data for various crops is still **locked up** in institutions

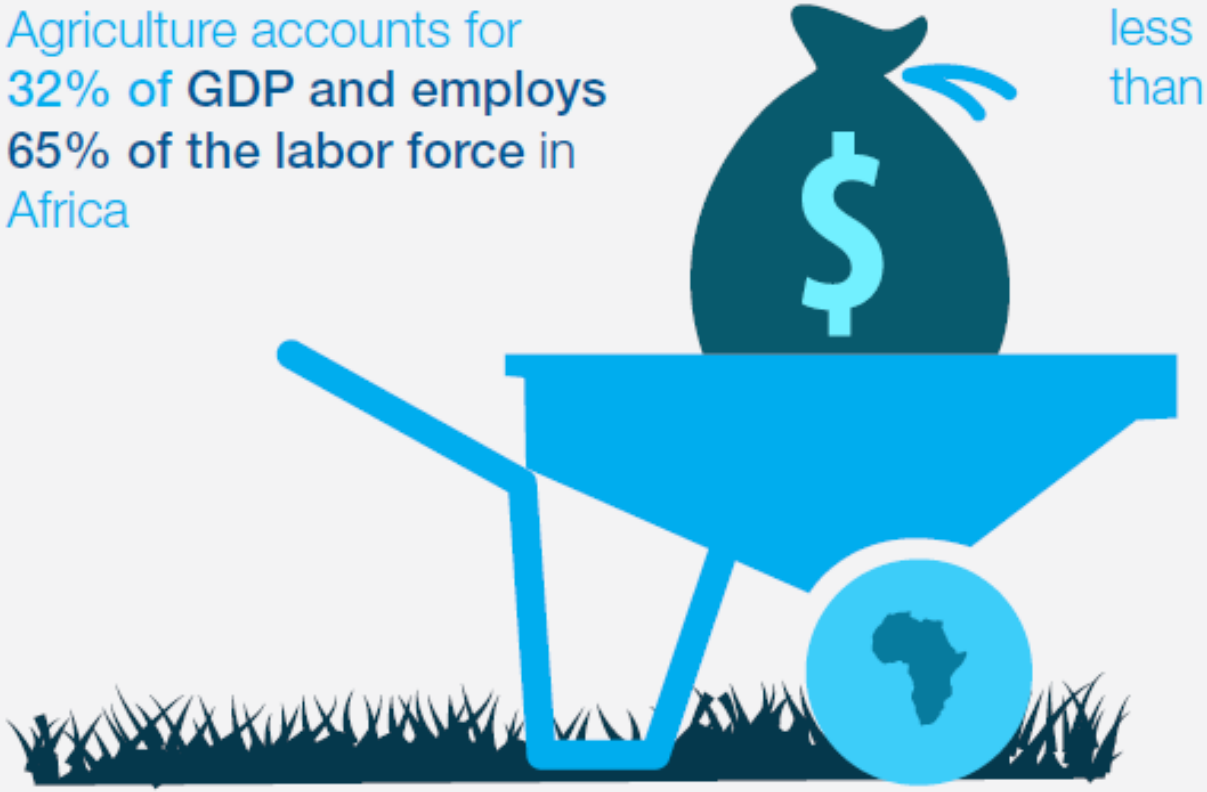
Key Data	Feature/Use	Gap/challenge
Feeds, Pests and Disease Control	- What disease/pest?/identify the disease by using signs and symptoms - Which pesticide or drug to end the infection? - Spraying guides? - Where the best and quality feeds?	- **Data is available only that it is not centralized** - **Data has to be organized to link to information and knowledge**
Post Harvest Data. (Marketing, transportation, food processing)	- Where and Which market has the best prices? - Who is paying the highest price? - Who sells more or less at market? - How can I participate in the gov't credit program? - Compare market prices/demand/supply to guide the farmer where to market? - Where are the best, affordable and genuine farm tools? - How to package/brand/process/transport means around me?	- **Market Data is available and accurate, however not timely** - **Credit information is missing** - **Food storage/how to preserve yields for future consumption?** - **Tracking yields or ready farms for harvesting** - **Pollution control practices for live stock**
Renewable energy	**- We need to convert waste to energy and wealth.**	



Source: eTransform Africa, Agricultural Sector Report, 2012, Deloitte

Agricultural commercial lending

Agriculture accounts for 32% of **GDP and employs 65% of the labor force** in Africa

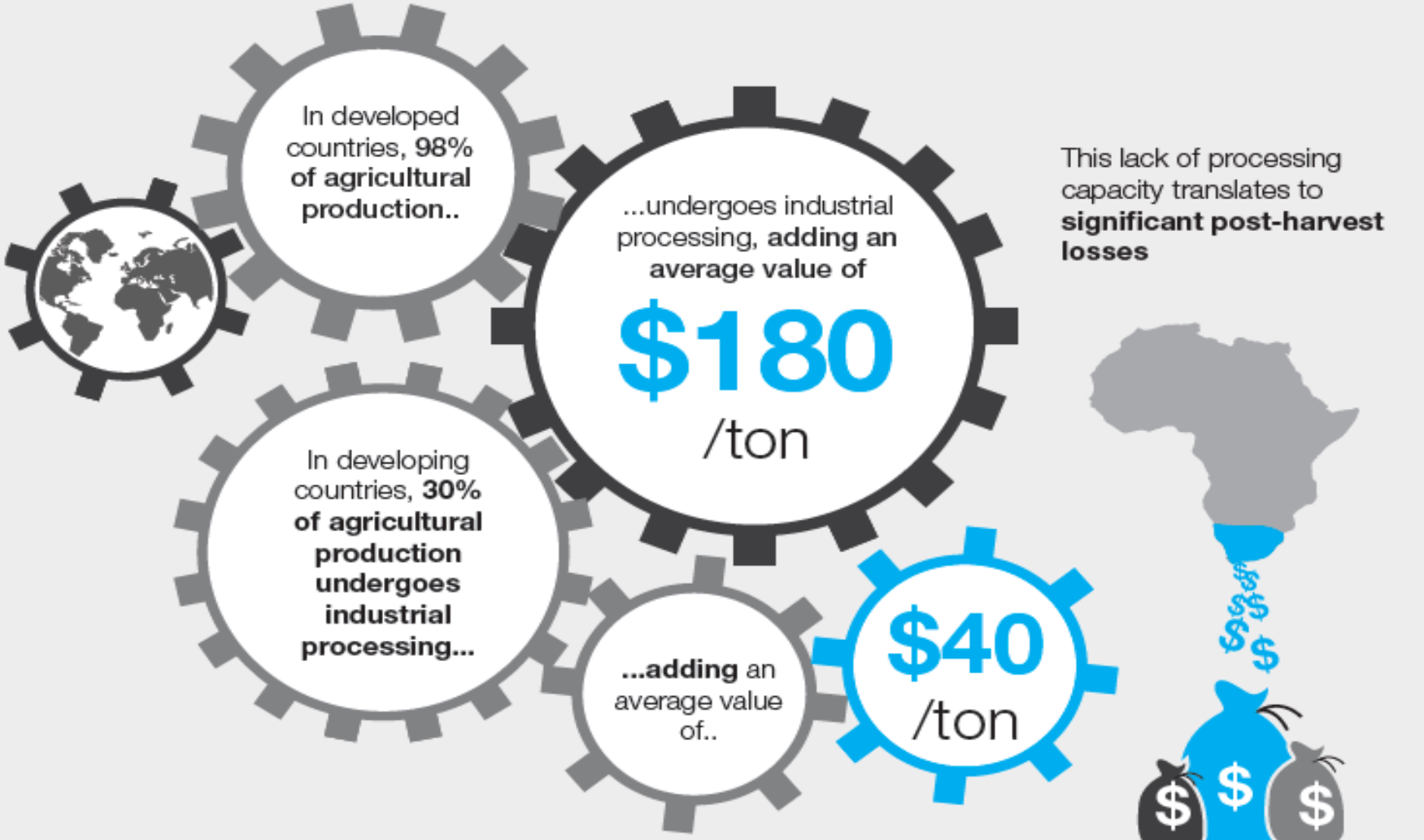


less than **1%** of commercial lending goes to agriculture

Morever, most of the loans to the sector go to large scale farmers, **leaving smallholder farmers underserved**

Source: African Development Band and World Bank

The value of processing



Source African Development Bank

Food Security Measures

- Affordable Food storage systems (Silos)
- Agro-smart traceability (Soil Monitoring, Livestock management with RFIDs)
- Value addition measures
- Pollution Control Measures

Micro Weather Sensor

- Rainfall levels
- Temprature
- Humidity

[1]FARMER'S NEEDS IN AFRICA

Chat bots/Applications/FMS

- Demand/Supply at mkt
- Price levels/Finacial Services
- Cropping Calender
- Crop yield estimations as a fn (Weather,soil & choice)
- Disease/Pest Control
- Most Nutrious foods
- Alternative feeds for livestock
- Eary warning Systems (Sensors,RFID,UAV,GPS,GIS)

Soil Meters (Soil Health & Nutrients)

- pH
- Moisture Levels
- NPK Levels
- Recommended fertilizers
- Recommended Crops

1. Create Agriculture Information Service Centers in Communities
2. Create Baseline Surveys for Nutrional Data

“**Feeding** a global population of just over 9 billion in 2050 will require a **70% increase in global food production**.

This will require that Agriculture particularly **smallholder agriculture** plays a much more **effective role**’ *IFAD*

“The **People** who are **Crazy** enough to think they **can** **change** the **world** are actually the **ones who do**”.

Steve Jobs.

GFAR

Global Forum on Agricultural Research and Innovation

GODAN

Global Open Data for Agriculture & Nutrition

Supports global efforts to make data relevant to agriculture and nutrition **available, accessible, and usable for unrestricted use worldwide.**

CTA

CTA is at the forefront of the fight against poverty and for sustainable food security…

INFORMATION TRAINING AND OUTREACH CENTRE FOR AFRICA

ITOCA

YITEDEV UGANDA

Twitter: @kal_stephen

Training course on Farmers' access to data
Centurion, South Africa, 20-23 November 2017

RAIN FOR AFRICA PROJECT (R4A)

How to benefit from weather and agri information when every raindrop counts

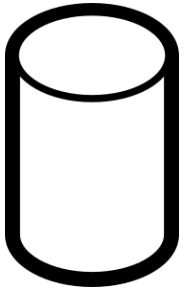
Nico Kroese
South Africa Weather Service
nico.kroese@weathersa.co.za

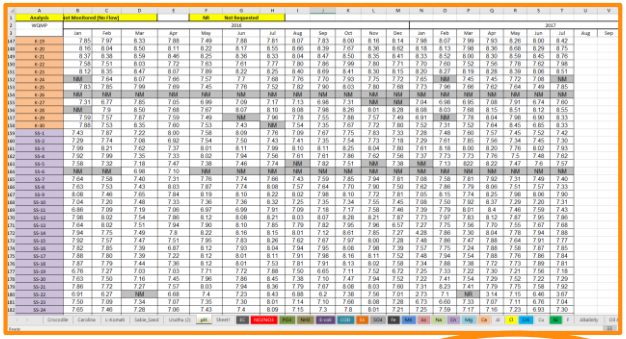
Content of presentation

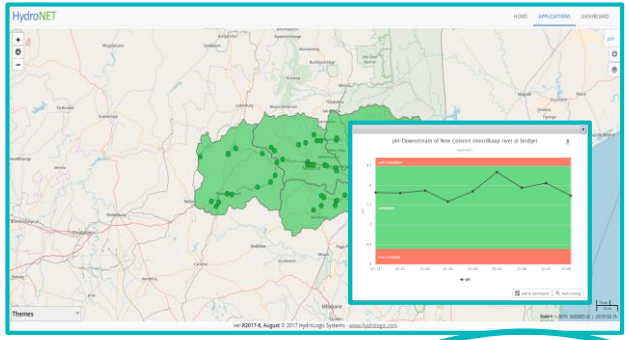
- Data!!!
- Rain for Africa Project
- Objectives of R4A
- Planting App
- Crowdsourcing
- Conclusions

- No data? No information…
- No information? No knowledge…
- No knowledge? No good decisions…

It all starts with data





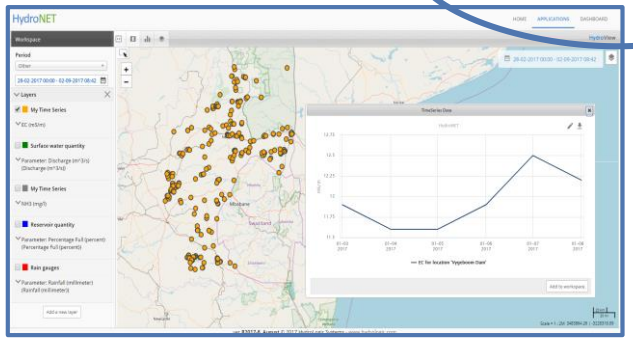


Data

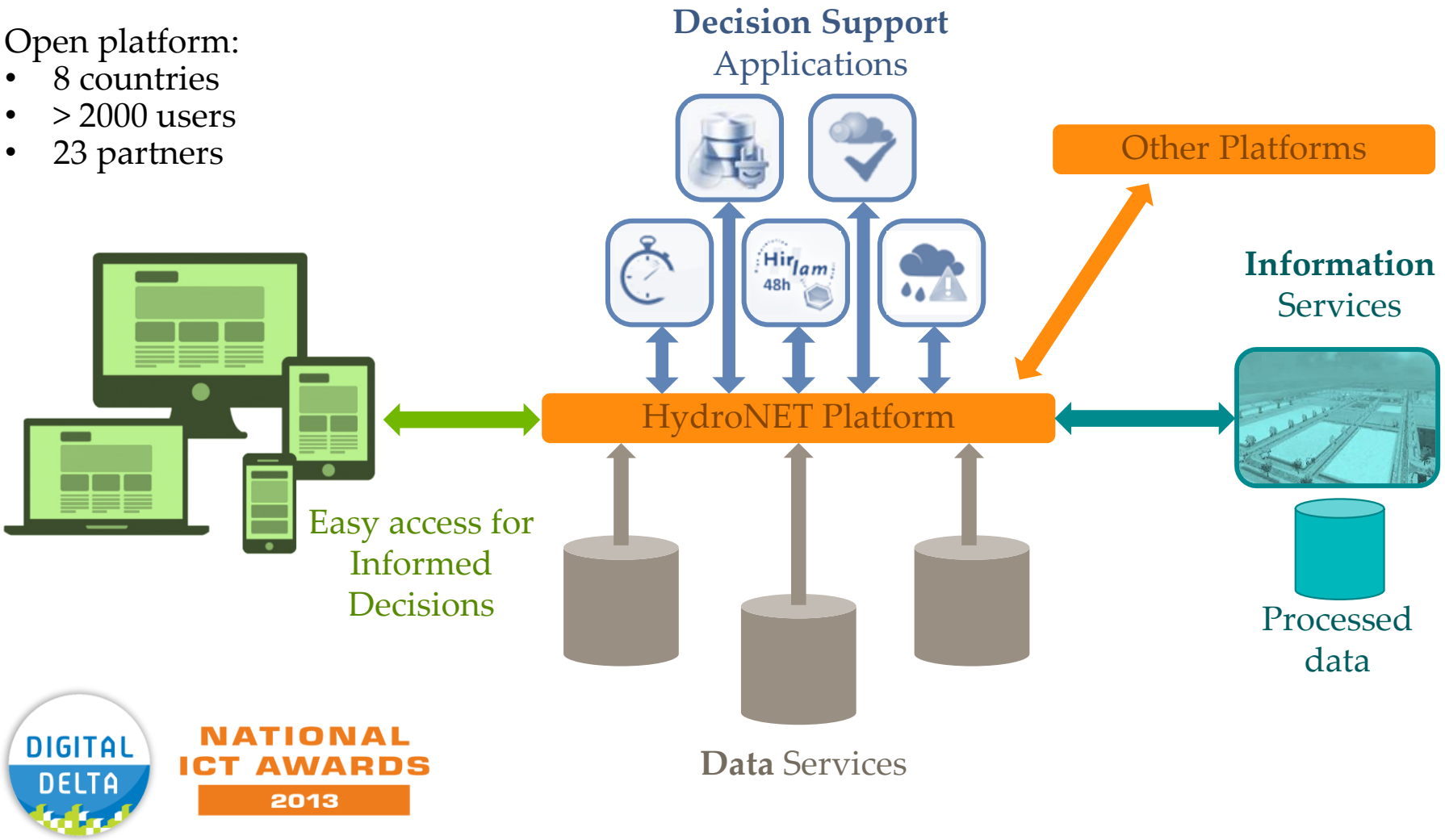
Information

Knowledge

Wisdom

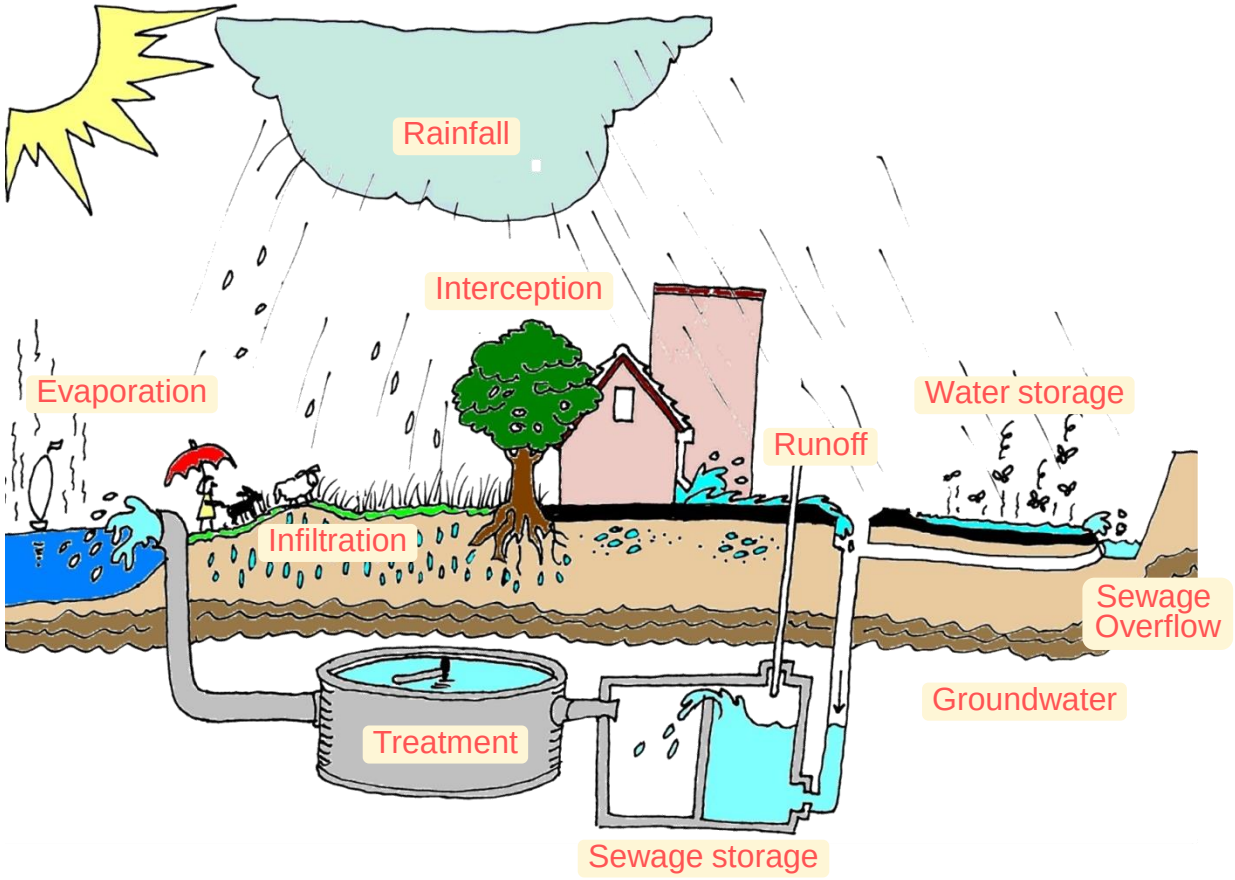


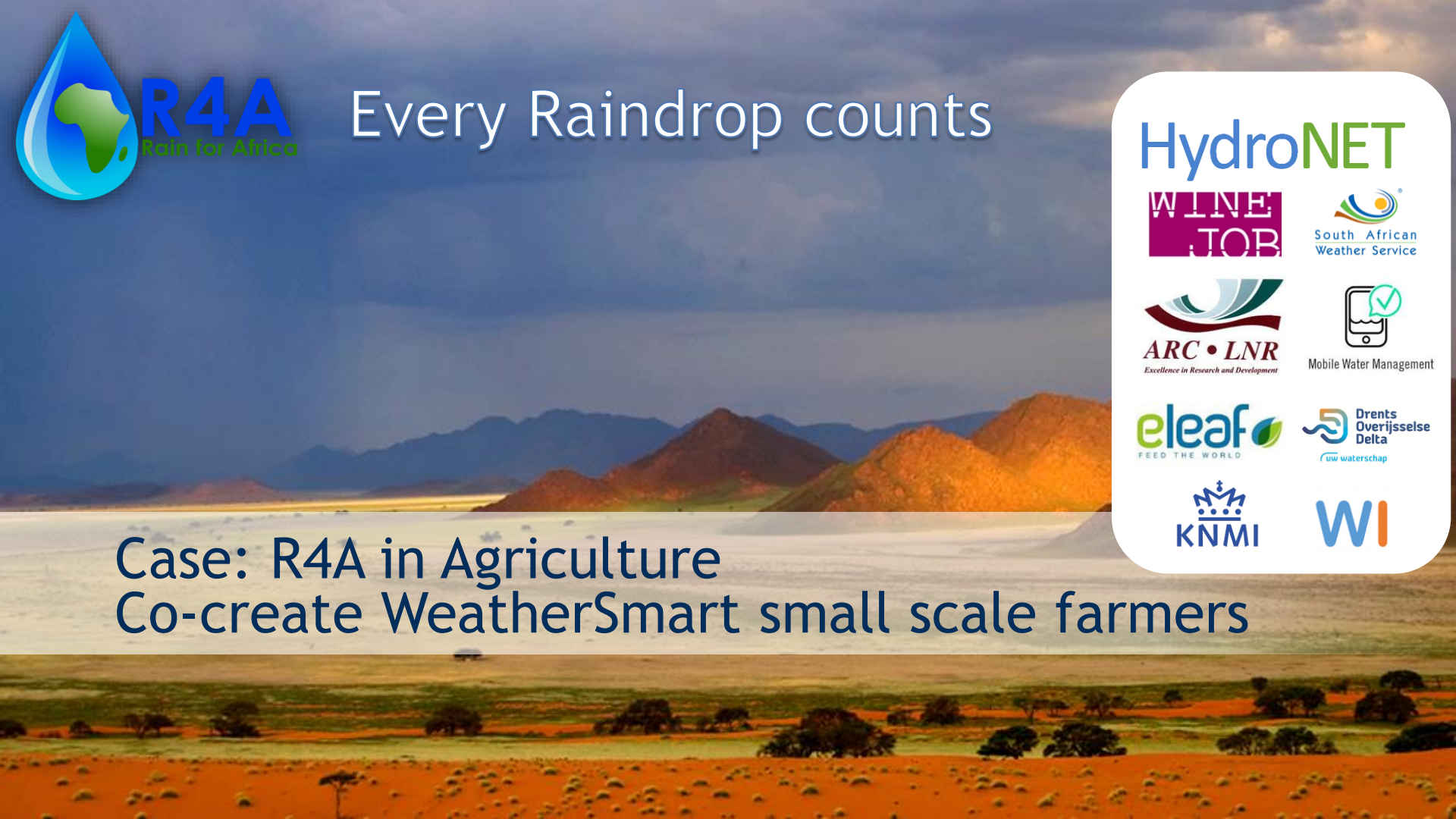
Open platform:
- 8 countries
- > 2000 users
- 23 partners



DIGITAL DELTA
NATIONAL ICT AWARDS 2013

It all starts with rainfall information




R4A
Rain for Africa
Every Raindrop counts
HydroNET
WINE JOB
South African Weather Service
ARC • LNR
Excellence in Research and Development
Mobile Water Management
eleaf
FEED THE WORLD
Drents Overijsselse Delta
uw waterschap
KNMI
WI
Case: R4A in Agriculture
Co-create WeatherSmart small scale farmers

Reach 125.000 (small holder) farmers via the R4A app

Provide FREE decisions support to:
Increase food production >10%
Reduce use of resources >10%

Improve weather information

Provide easy access to weather and climate data for local application developers to reach other weather sensitive industries

- Improve data quality and availability
- Improve data accessibility
- Automate backend processes
- Improve revenue via services for weather sensitive industries

Objectives of R4A (continued)

- Use best available weather & agricultural data to provide a timely service to small-scale farmers (125,000) via cellular technology using applications.
- Develop smartphone application: (10% improvement)
  - Provide planting / sowing advice
  - Spraying advice against pests and diseases
  - Weather forecast
  - Collect rainfall data = crowdsourcing.

ARC • LNR
South African Weather Service
HydroLogic
Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment
Groot Salland Waterschap
HydroLogic RESEARCH DELFT
Mobile Water Management
eleaf FEED THE WORLD
Weather Impact Forecasting weather hazards
WINE JOB
R4A Rain for Africa


R4A
Rain for Africa
ABC
02:40 PM
Jennifer
Registration
Farming guide
Advisories
Weather
MyRainGauge
R4A Message to you!
Launch in Jan 2018!
Version 2 in June 2018!

Planting App- Concept

- Farmers make decisions about when to plant maize every growing season.
- Many factors influence such a decision
  - past experience;
  - current information;
  - climatic conditions;
  - logistics & availability of resources.

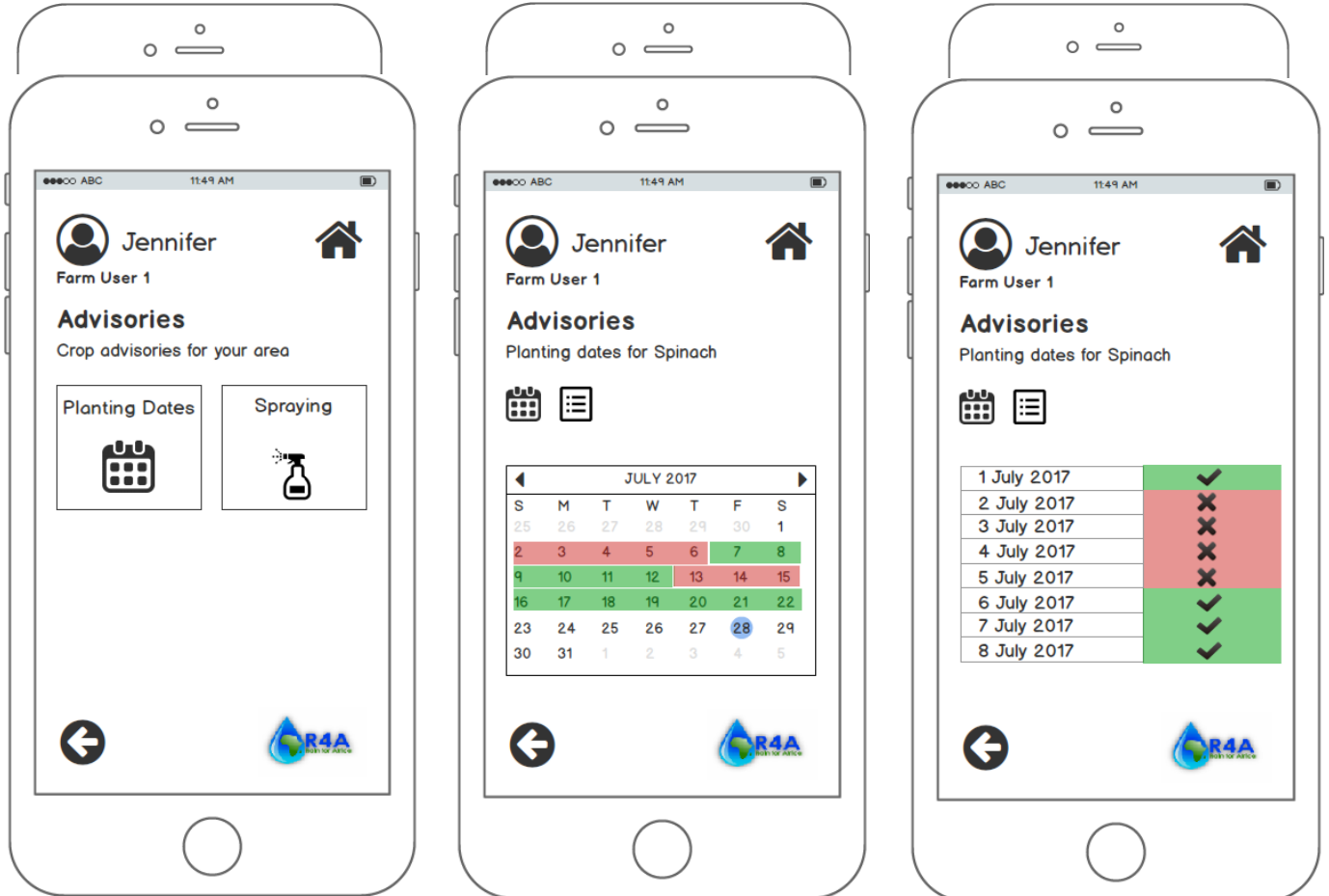
In Rain for Africa (R4A) project, a mobile phone 'Planting App' is being developed

- to address gaps in information available to small-scale farmers in South Africa.

Methodology

- Climate data grid for maize growing regions from ARC-ISCW & SAWS & NASA.
- Define start of planting window by long-term last frost date.
- Use 25 mm rainfall received within 20 days as criteria for good planting conditions.
  - Previous 10d from measured rainfall received
  - Future 10d from ECMWF rainfall forecast
- Indicate good time to start planting maize

Mock-up of R4A Planting App



Communication (Dissemination) methods

- Delivered via cellular telephone:
  - For smart phone – use “app” or website
  - For simple phone – use interactive “USSD”

    (Unstructured Supplementary Service Data)
- Targeting both farmers and extension:
  - Free system via feedback credits
  - Individual subscription
  - Commercial subscription
  - Government bulk subscription

Technical Aspects

- Service provider develop “App” & “USSD”
- ARC – Develop & provide advisories
  - via API (Application Programming Interface)
  - using *REST* web services
    (Representational State Transfer)
- *USSD* service provider access web services to supply info in a *SMS*
    (Short Message Service = text message of 160 characters)
- Smart phone App download or via WWW

Crowdsourcing

Objectives of R4A data collecting component:

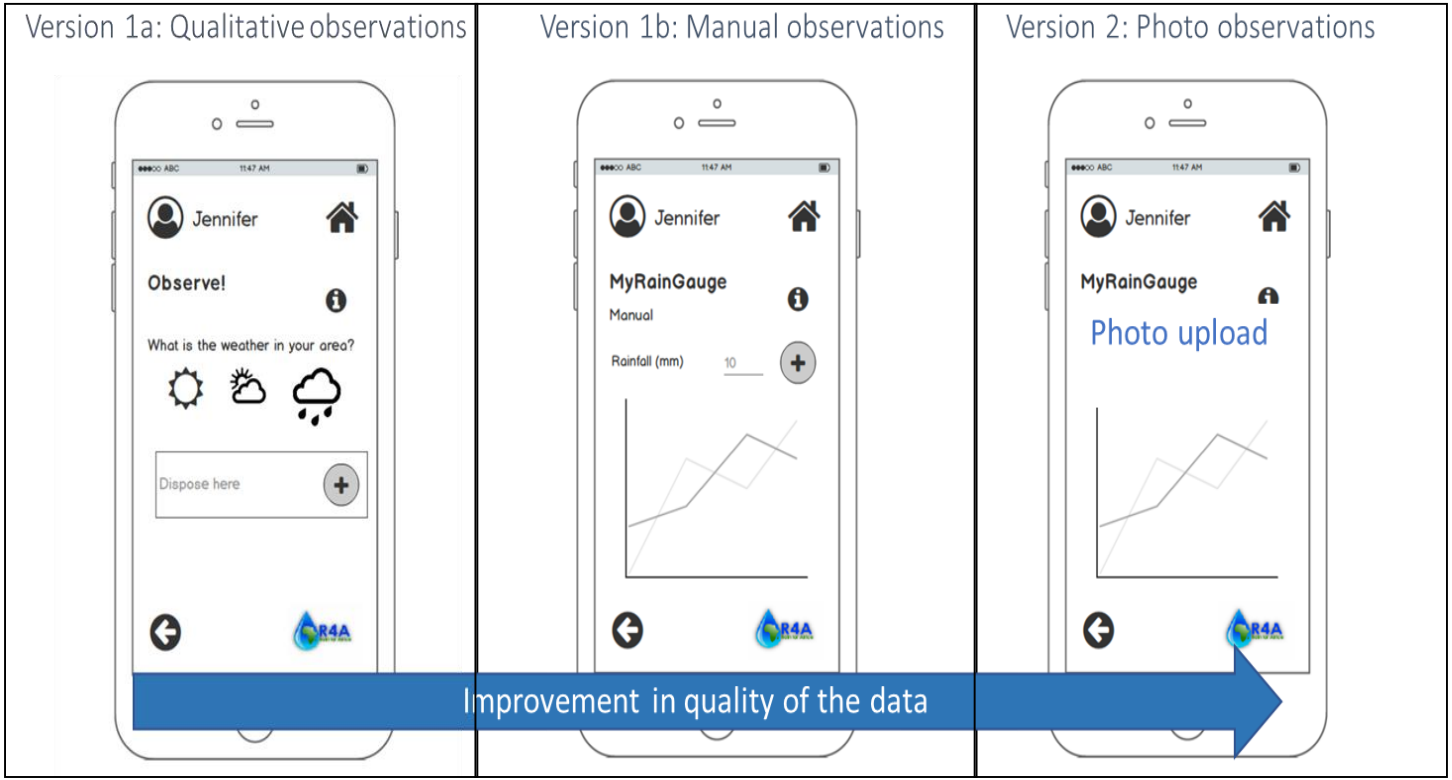
- To empower small-scale farmers (SSF) improve farm management by using weather info.
- To engage SSF & extension in R4A project.
- To improve weather data quality by providing local info to weather forecasters

R4A
Rain for Africa

Crowdsourcing

- Farmers & extension register for use
- Contact database with:
  - Cell phone number for farmer or extension worker
  - Coordinates = specific location of farm
  - Rainfall measurements
  - Credits accumulated
- Collect weather info via:
  - Qualitative observation using symbols
  - Manual measured rainfall amounts
  - Possible use electronic device
    - ‘sound’ or ‘photo’
- Provide local info to weather forecasters

Collection of weather data



Credit system

- To incentivise users to make observations.
- Incentives can include:
  - **Direct reward for using app** = only gain access to app functions after submit observation.
  - **Indirect reward** = earn credits used to 'buy' an upgrade with additional functions & information.
  - **Commercial reward** = earns credits use to 'buy' other services like airtime or seeds/fertiliser sponsored by outside entity via partnership.
  - **Competition** = credits as benchmark for allocating an award. e.g. R4A farmer of month or year.

END

- *Data to Information*
- *Training : Interpretation of information (knowledge and wisdom)*

http://www.hydronet.co.za/rain-for-africa-project-r4a-2/

Symposium - Panel 3

Beyond Ownership and Access: Benefit Sharing in Open Data

Panel chair: Jeremy de Beer

OWNERSHIP OF OPEN DATA:

Problems, Causes, Solutions, Examples

Professor Jeremy de Beer

with Jeremiah Baarbé

The problem is that data collectors have most of the power:

> Ownership rights, or the lack thereof, are a major factor in the power dynamics of open data for agriculture and nutrition.

Contributors

Collectors

Consumers

Open data problems have technical, social, and legal causes:

Sources of data

- Satellite imagery
- SMS and apps
- Internet
- Drones
- Gov statistics
- Communities
- Farmers
- Precision agriculture

Sources of ownership

- Copyright
- Database rights
- Digital standards
- Trade secrets
- Personal privacy
- Patents
- Contracts
- Indigenous knowledge

Solutions to promote fair and equitable benefit sharing:

Inter-Institutional Cooperation

Providing spaces to debate and study the future of open data.

Social Certification

Using a recognizable mark for data services to promote best practices.

Model Frameworks

Passing national laws and policies that support open data.

International Agreement

Creating international agreements for fair use of open data.

Examples of social certification marks:

FAIRTRADE FOUNDATION

FSC FOREST STEWARDSHIP COUNCIL

KILIMOHAI ORGANIC

SGS ORGANIC

ecospecifier global GREEN TAG CERTIFIED SOUTH AFRICA trust brands

openAIR AFRICAN INNOVATION RESEARCH

GIFS

GODAN Global Open Data for Agriculture & Nutrition

Jeremy de Beer, *Ownership of Open Data: Governance Options for Agriculture and Nutrition* (Wallingford, UK: GODAN, the Global Open Data for Agriculture and Nutrition Initiative, 2016)

Jeremiah Baarbe, Meghan Blom, and Jeremy de Beer. "A Data Commons for Food Security". (Working Paper 7, Ottawa, ON: Open AIR, 2017)

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Thank you to Meghan Blom for her research assistance.

uOttawa

Social Sciences and Humanities Research Council of Canada | Conseil de recherches en sciences humaines du Canada

Canada

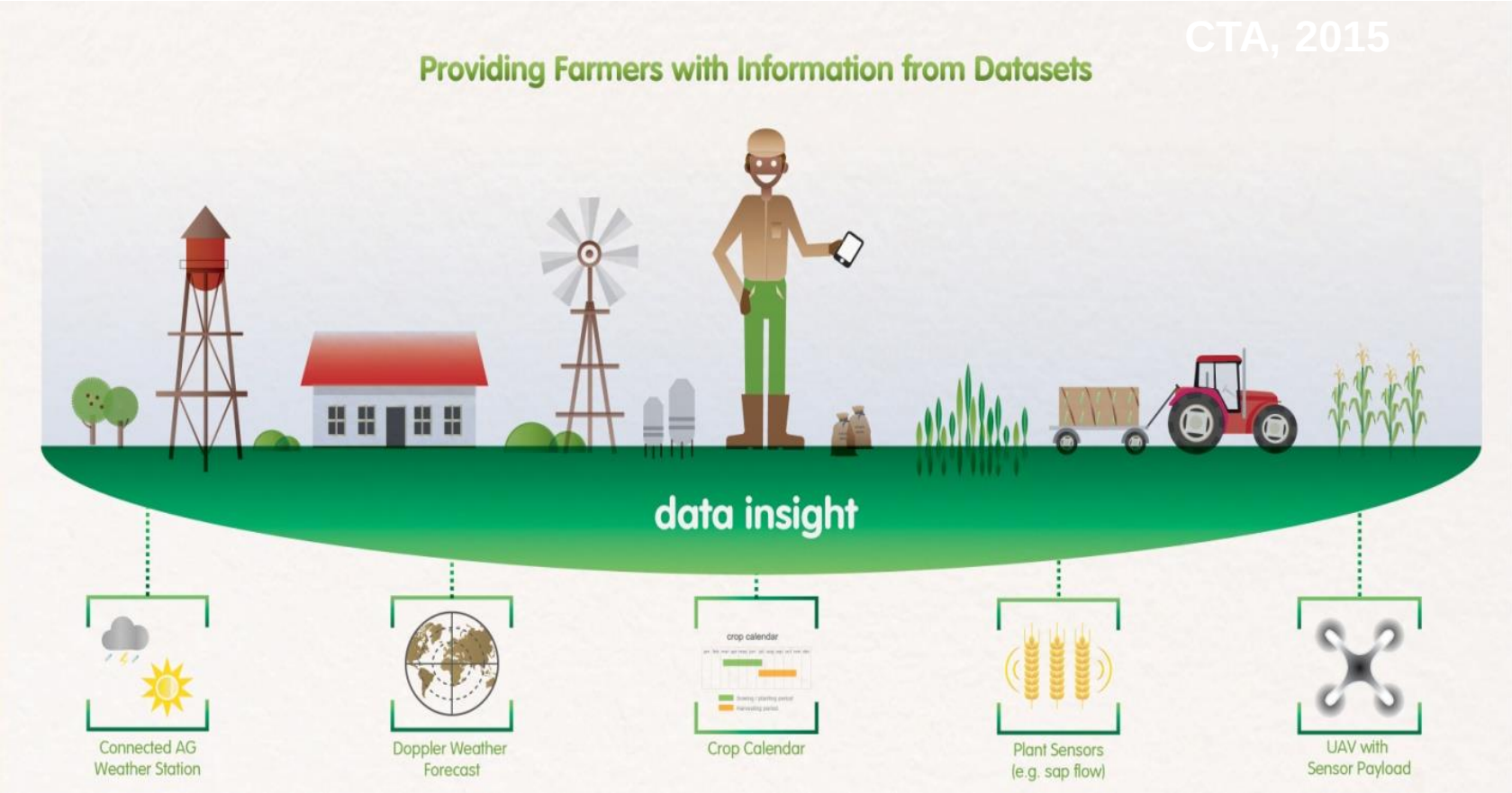
IDRC | CRDI International Development Research Centre / Centre de recherches pour le développement international

International symposium on Farmers' access to data
Centurion, South Africa, 20-23 November 2017

Role of mobile phones in enhancing farmer access to data and information

Moses Odeke

As a public/private sector entity or farmer what can you do today to enhance farmer access to data and information?



Can open data improve food and nutrition security in Africa?

- Agric accounts for 32% of the GDPs in most countries in SSA & employs close to 65% of the population in these countries (World Bar 2015).
- Credible data is critical for agricultural investment and transformation in sub Saharan Africa (AGRA, 2015; CIAT Big Data Initiative, 2016).
- Access to data and information by small holder farmers still remains a major challenge
- Mobile phone technology remains a potential delivery mechanism for enhancing access to data & info
- Public- Private or Private-Private Partnership arrangements

What challenges do farmers face in Accessing data and information?

- Limited financial resources to pay for the data services
- Significant capacity issues- Limited technical knowhow for applying/using technologies needed to access data
- These technology applications are often too complex and sophisticated for smallholder farmers to use, which has limited their adoption and impact
- Issues of remote sensing/GIS and data analytics are too complex for most smallholder farmers
- For these farmers, services available through less high-tech devices, like mobile phones, are the only best bet option for enhancing their access to data (World Bank, 2011)

Data most frequently requested by farmers (Palmer 2014; GSMA 2015)

- **Market and crop advisory information frequently requested by farmers (GSMA; 2015).**

- **Cropping information: Most small-scale farmers would like information on: (i) what crops to plant and when, (ii) improved seed varieties that are drought tolerant and high yielding, (iii) fertilizer application recommendations, (iv) market prices, and (v) plant disease and (vi) pest control.**

- **Weather information: Key weather and climate information throughout the crop cycle from planting, timing of planting operations- when the rains start**

- **Harvesting; storage and Post harvest handling**

What is Big Data?

- **Data with high volume, velocity, variety, and variability (Laney 2001)**
- **High-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation (Gartner, 2012)**

- **Harmonized, interoperable, and contextually integrated datasets and publications from multiple disciplines relevant for CGIAR's research and development goals (CGIAR, 2015a).**

- **Large volume of *data* – both structured and unstructured that has potential to be mimed for information (WhatIs.com, 2017)**

What is Open Data?..... (1)

- Data that can be freely used, reused and redistributed by anyone – subject only, at most, to the requirement to attribute and share alike (CTA 2015; Opendefinition.org)
- Key attributes of open data (Open Knowledge Foundation, 2012):

a) **Availability and access**
   - The data must be available as a whole but also at a reasonable, reproduction cost, preferably by downloading over the internet.
   - The data must also be available in a convenient and modifiable format

b) **Reuse and redistribution**
   - The data must be provided under terms that permit reuse and redistribution including the combining with other data sets

c) **Universal participation**
   - Everyone must be able to use, reuse and redistribute
   - There should be no discrimination against persons or groups.
   - For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes are not allowed

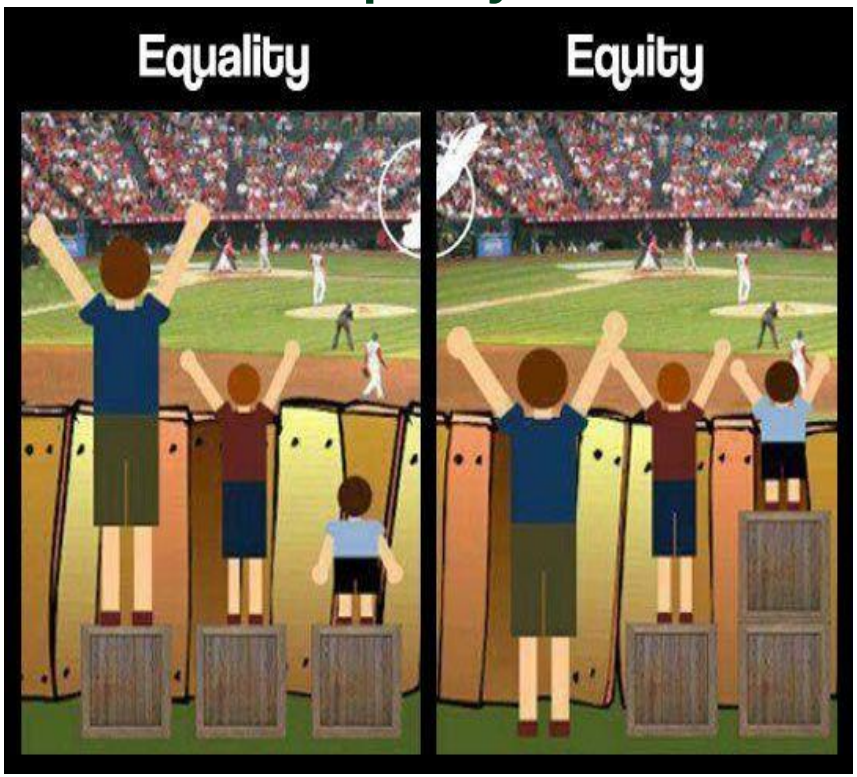
What is Open Data?..... (2)

To be able to use open data effectively, it needs to be available and accessible in a timely, fair and equitable manner. Open Data must also be affordable, relevant, useful and trustworthy

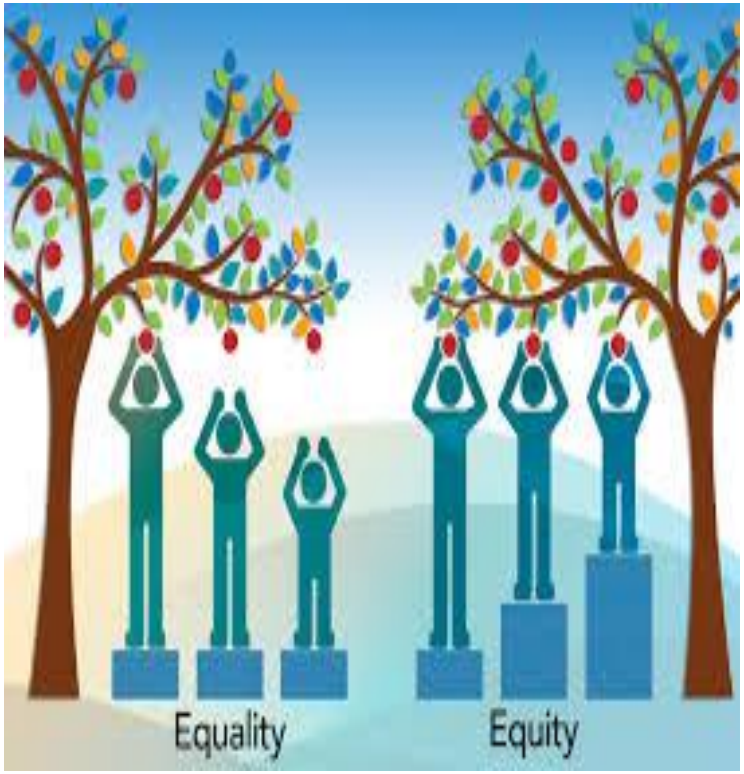
- **Sharing data more openly has the potential to provide farmers with better services. For example:**
  - **Access farm inputs and market produce**
  - **Access to agro-meteorology (timely planting, mitigating against pests and extreme weather, monitoring water supplies, and anticipating changes brought on by climate change).**

Equality + Equity = Fairness

Equality



Equity



Equality=Treating everyone the same

Equity =Resources allocated fairly without discrimination

What is Fair and Equitable Open Data?

- **Data, information and knowledge generated, shared and exchanged in which the key stakeholders (farmers) participate in the decision making process**

- **Farmers are not only providers and recipients of data, but also contribute traditional knowledge, innovations and practices important for food production and agriculture.**

- **Farmers have the right to give prior informed consent for accessing and using their knowledge, innovations and practices,**
- **And to benefit from the use of their knowledge, innovations and practices in a fair and equitable way**

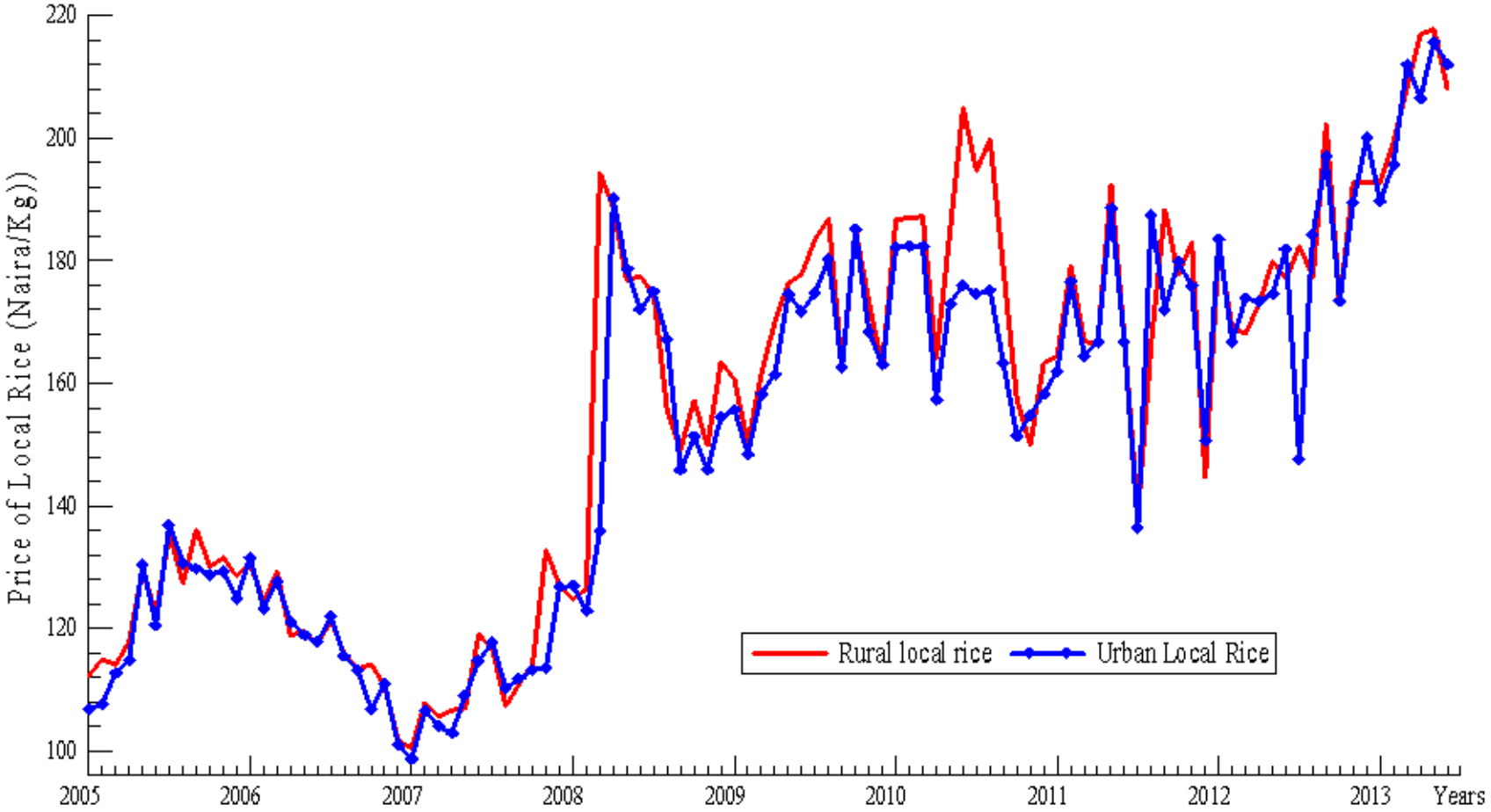
Use of mobile phones expanding (CTA, 2015)

- Great potential in using mobile phones to provide smallholder farmers with relevant agricultural information due to their widespread use of the technology.

- Mobile phone penetration rate in SSA is estimated at of 69 percent
- Mobile phones can therefore play a critical role in information dissemination

- Mobile phones have been previously used in providing farmers with price information, money transfer, and mobile banking etc

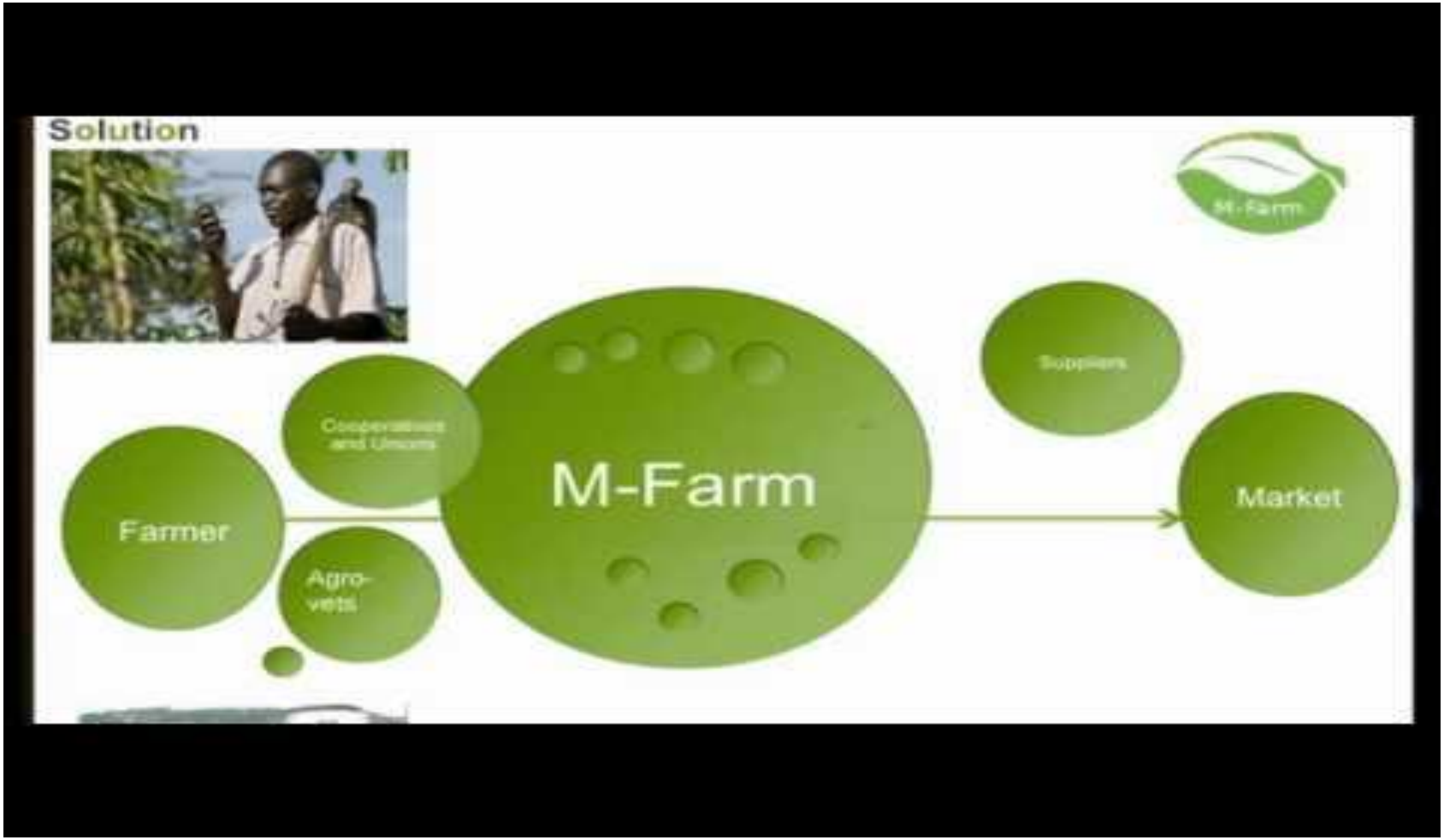
Mobile phones have been successfully used to deliver agricultural data and information



Top 10 successful mobile phone apps in Africa

S/N	Mobile service	Information provided	Geog. Coverage
1	i-Cow	Prompts to farmers to collect and store milk; best dairy practices	Kenya
2	Vet Africa	Disease diagnosis, prescriptions for farm animals, monitoring and recording animal data.	East Africa
3	M- Farm	Market information	Kenya
4	Esoko	Agricultural content, marketing, advisory and monitoring services for farmers and potential investors	9 Countries in Africa
5	EZ Farm	Real time data on current and predicted soil moisture levels	
6	Agro-Hub	Source, manage and disseminate information on agric production.	Cameroon
7	Cocoa Link	Practical agric. Information at no cost.	Ghana
8	Kilimo Salama	Up-to-date climate data via text message. Information on ways to increase productivity, protect their crops.	Tanzania
9	Kuza Doctor	Crop growth, soil and other general questions through SMS. Supposed to help farmers grow better crops by employing environment-friendly techniques.	Kenya
10.	Modisar	Farm records, cattle herds, farm costs and sales. Sends advice to farmers on animal vaccinations, feed and nutrition also, they receive instructions on finance via text messages. This app won the Orange African Social Venture award in 2014.	Botswana

1. M- Farm: Connecting farmers to the market in Kenya



M-Farm connect farmers to the Market

- M-Farm uses SMS technology that provides farmers with current market prices for specific crops

- Users only send an SMS to the number 3535, which then connects them to whatever resource they need
- Reaches over 80,000 farmers in 17 countries (NASA, 2014b)
- NASA and AGRA planned to deliver satellite data to farmers through M-Farm Platform

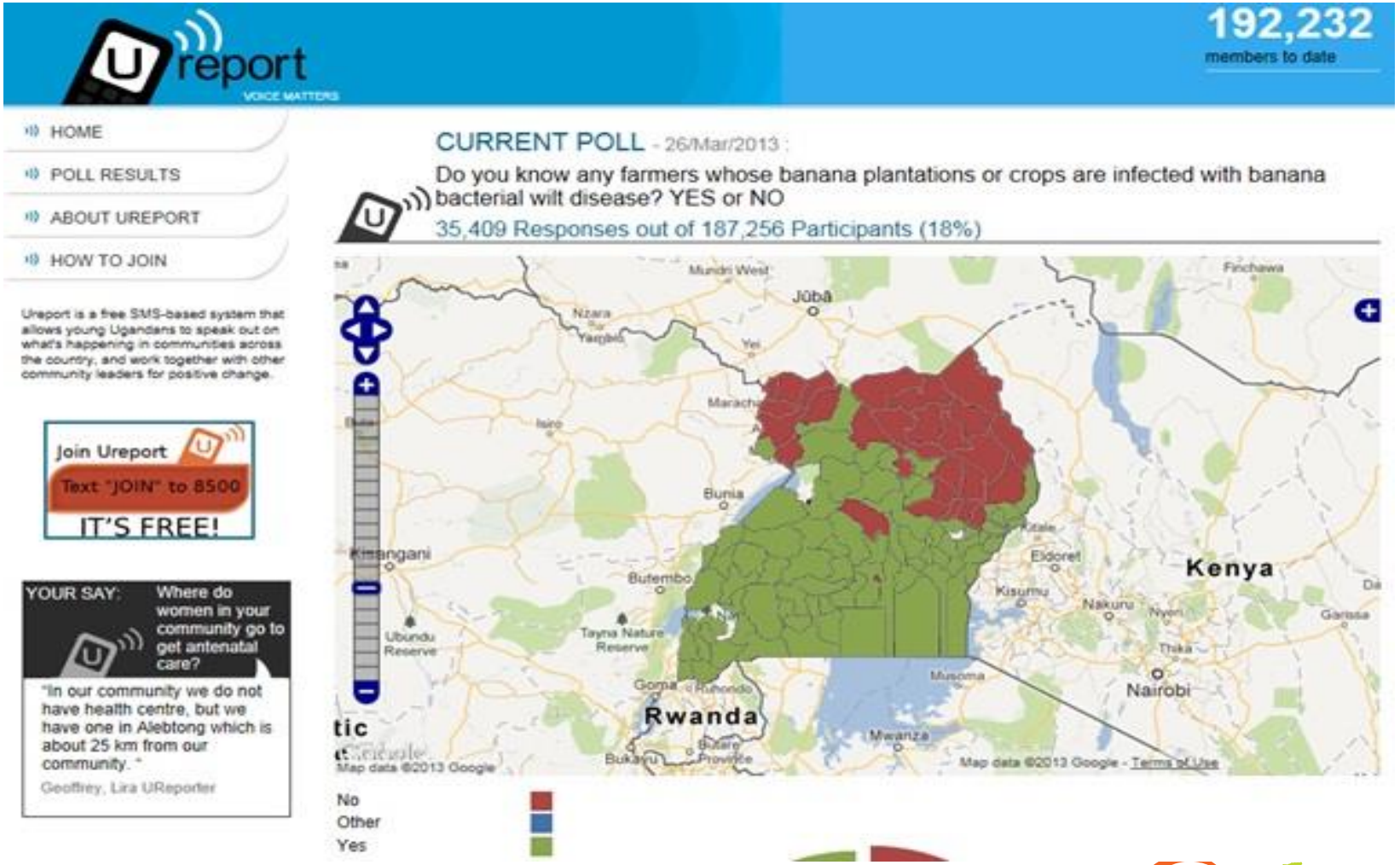
2. Esoko: The market on your mobile

- Provides market data via SMS
- Also agricultural, weather advisory and monitoring services are provided to farmers and potential investors.
- 10% increase in revenues for farmers utilizing Esoko SMS services
- Covers 9 countries across Africa (GH, KE, BE, BF, NIG, ML, MAD, ZIM)

3. Digital Toolkit: Enhancing smallholder access to agricl information, crop finance, farm supplies and training in Tanzania

- **The digital toolkit allows farmers to pre-pay for the inputs via mobile money at discounted prices.**
- **Provides farmers with a customized inputs package based on their crop and production goals**
- **Delivers mobile-phone based farming advice to ensure the best use of those inputs.**
- **Expected to build farmers' resilience by enabling them to buy quality inputs in time (with discounts up to 30%) through their mobile wallets/e-savings.**

4. U reporters- Open data: How mobile phones saved bananas from bacterial wilt in Uganda



The power of mobile phone- saving Ugandan's Banana

- **WB teamed up with U reporters (network of volunteers who use SMS to report on various issues)**

- **U-reporters provided information about banana bacterial wilt via SMS (World Bank, 2013).**

Irrigation moisture sensor- Chameleon

What is the role of private sector?

- Generation and making available all data & information in open formats for the overall benefit of society

- Packaging of data in user friendly formats that can promote effective use of data
- Delivery of data to the final consumers using user friendly mechanisms (mobile voice data, SMS, language issues, web based platforms, innovative tools- for example the VIA)

- Relay feed back on data from the final consumers to data generators
- Private sector investments in expansion of mobile services and connectivity
- Seek collaborations with multi-national companies as well as DPs to support sms start ups with the overall aim of driving down data & access costs

Issues to consider in enhancing data and information access to

- What does the public/private sector need to do in order to drive down costs for accessing data an information at all levels?
- What can the public/private sector need to do in order to ensure that data and information are made freely available to the data users?
- What can public/private sector do in order to advance capacity building for the different stakeholders (extension agents, farmers) to be able to access and utilize the available data and information?
- How can the public/private sector ensure that farmers and other actors on the data value chain get more accurate information?
- What are the policy issues that need to be considered in order to ensure that there is an enabling environment to facilitate data access at all levels

Thank You

International symposium on Farmers' access to data
Centurion, South Africa, 20-23 November 2017

FAIR AND EQUITABLE OPEN DATA

JUANITA CHAVES POSADA

SOUTH AFRICA, 24 NOVEMBER 2017

Issues affecting farmers' access to data

- Policy issues
- Technical issues
- Ethical and legal issues
- Capacity

RECOGNITION OF RIGHTS – UNBALANCED SITUATION

Convention on Biological Diversity (1992)

International Treaty on Plant Genetic Resources for Food and Agriculture (2001)

- **Approval and involvement**
- **Equitable sharing of benefits**
- Protection of traditional knowledge
- Participate in decision-making

UN DECLARATION OF THE RIGHTS OF PEASANTS AND OTHER PEOPLE WORKING IN RURAL AREAS (DRAFT)

- States shall ensure meaningful participation, directly and/or through their representative organizations, of peasants and other people working in rural areas in decision-making processes with regard to… data identification, research, analysis and interpretation of findings

- Peasants and other people working in rural areas have the right to seek, receive, develop and impart information

Article 13: Right to information in relation to production, marketing and distribution

- the right to full, transparent, timely and adequate information about the factors that may affect the production, processing, marketing and distribution of their products.

- States shall ensure that relevant information may be adequately disseminated and appropriated by peasants and other people working in rural areas.

APPROVAL AND INVOLVEMENT

Free, prior and informed consent for accessing their knowledge, innovations and practices

Fair and equitable sharing of benefits

Reporting and preventing unlawful appropriation of traditional knowledge

MO'OTZ KUXTAL VOLUNTARY GUIDELINES, 2016

Free, prior and informed consent

Free: Not under pressure, manipulation or intimidation

Prior: Sufficiently in advance of any authorization to access traditional knowledge, respecting decision-making processes

Informed: Providing all relevant information (intended purpose, duration, scope, potential risks, procedure of access, benefit-sharing arrangements)

Fair and equitable benefit-sharing

Most of the times is merely rhetoric and unrealized in the field

Significant inequities in knowledge and power between indigenous peoples and local communities, including smallholder farmers, and companies

Monetary and non-monetary benefits

Main benefit arising from accessing and using knowledge, innovations and practices – open access to data/ capacity and technology transfer

Preventing unlawful appropriation of traditional knowledge

- Capacity-building
- Awareness-raising and information-sharing
- Codes of conduct and best practice codes of users
- Minimum standards for access and benefit-sharing
- Development of appropriate policy and legal frameworks

THANK YOU VERY MUCH FOR YOUR ATTENTION

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