

Digitalisation for Agriculture

Module 2.2:
Key Technologies and digital solutions in agriculture

Agenda

Module 2.2: Key technologies

- Mobile services
- IoT
- Blockchain
- Frontier Technologies

Exercise



10 min

Post on a wall D4Ag technologies and/or solutions that you are aware of

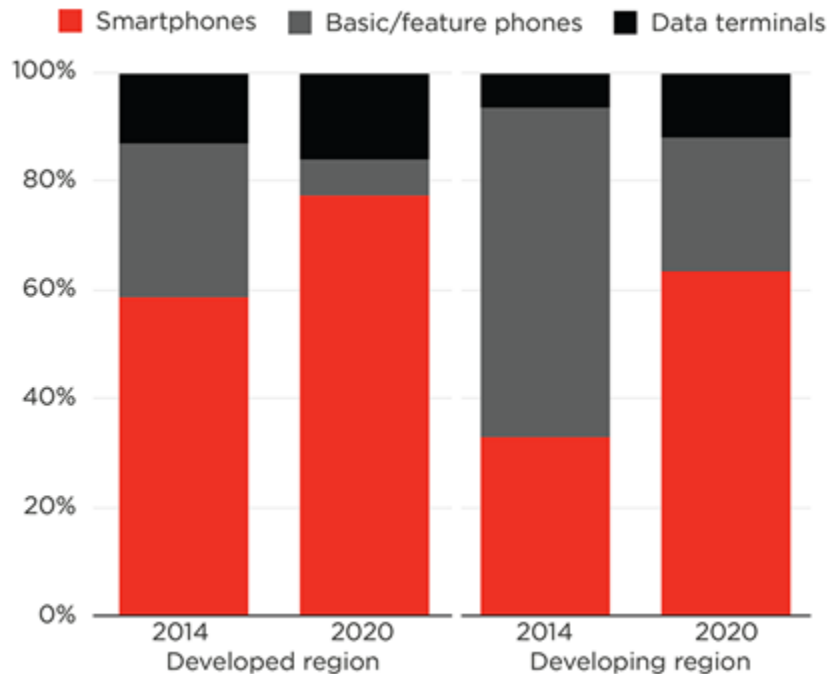
Hint: Think about the sub-sectors we just discussed...

Mobile services

The best gateway to access information (?)

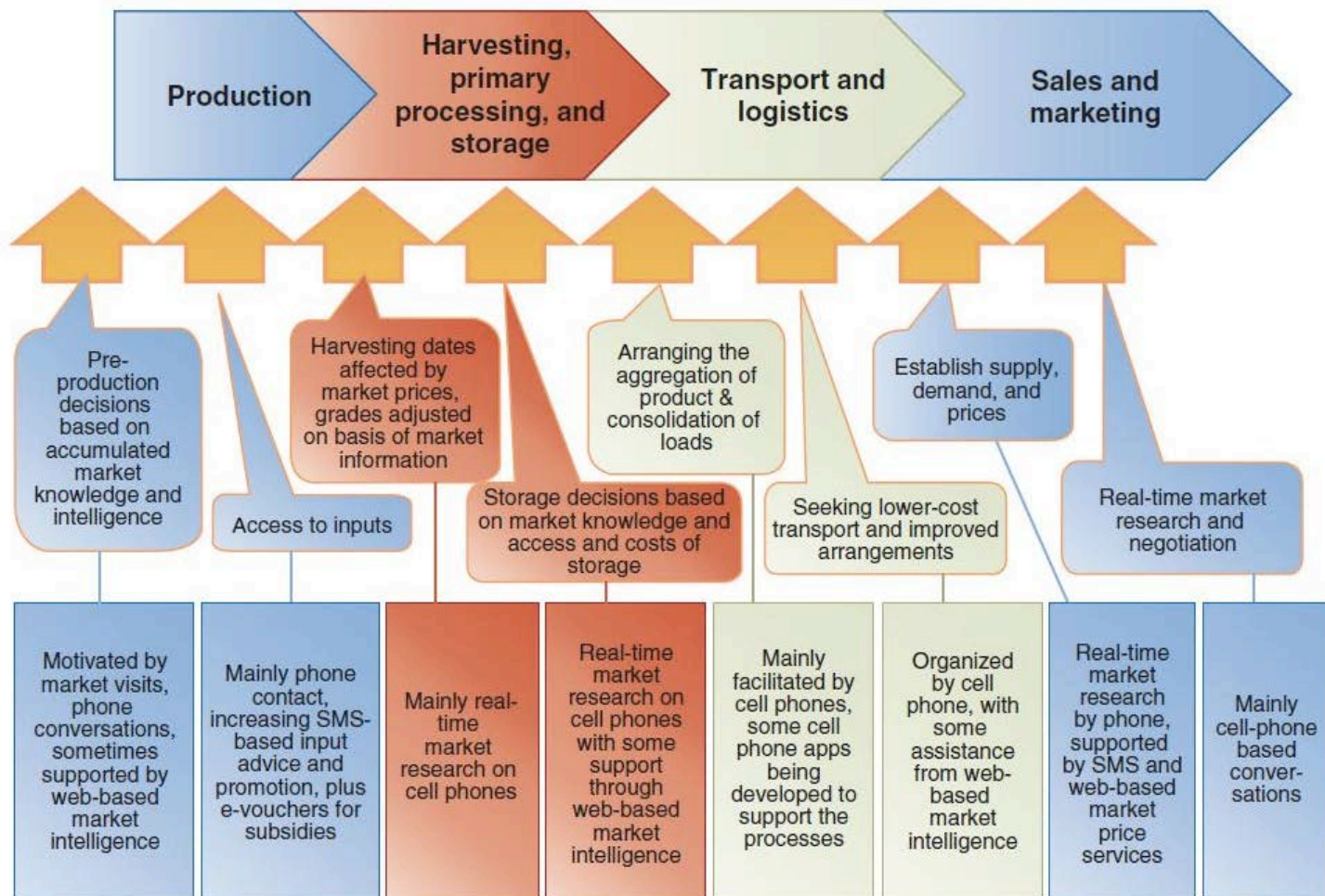
Some issues

- Mobile penetration is high, but for mobile internet there's a long way to go
- Mobile phones are not suitable to perform all the tasks that can be done with a computer
- Rate of smartphones in the developing world as of today 25%



Mobile services

A technological framework



Mobile services

A technological framework

Technology	Description	Availability	Benefits	Drawbacks
Voice	Basic voice calling	Basic phones	Avoids literacy barriers	High host of operation
Short Message Service (SMS)	Text-based messaging	Basic phones	Low cost of operation	Limited to 160 characters
Unstructured Supplementary Service Data (USSD)	GSM mobile data protocol	Basic Phones	Low cost, two-way communication	Limited to 182 characters
Voice-to-text/text-to-voice	Programs that convert voice to SMS	Basic phones	Reduced costs, avoids literacy barrier	Limited capacity, high programming cost
Interactive Voice Response	Computer programs that respond to voice input	Basic phones	Avoids literacy barriers	Potential linguistic barriers, high cost
Wireless Application Protocol (WAP)	Limited web access	Smart phones	Greater information capacity	Limited to smart phones
Multimedia Messaging Service (MMS)	Messaging with image/video	Smart phones	Higher information capacity	Higher per-use cost than SMS
Camera	Image/video capture	Smart phones	Greater ability to capture information	Limited availability
Bluetooth	Data transfer over short distances	Smart phones	Enables local networking	Limited range/capacity
Mobile Web	Full web access	Smart phones	Greatest information capacity	High cost of use, limited availability
Global Positioning System (GPS)	Location-based information	Smart phones	Ability to generate detailed user info	Limited availability

Mobile services

A technological framework for D4Ag solutions

Agriculture issue	Service	Potential outcome
Low access to financial services	Mobile Payment System	Increasing access/affordability of financial services tailored for agricultural purposes
	Micro-Insurance System	
	Micro-Lending Platform	
Lack of agricultural information	Mobile Information Platform	Delivering Information (agricultural techniques, commodity prices, weather forecasts)
	Farmer Helpline	
Low supply chain efficiency	Smart logistics	Optimizing Supply Chain management across agriculture sector & improving transportation logistics
	Traceability & tracking system	
	Mobile management of supply networks	
	Mobile management of distribution networks	
Low access to markets	Agricultural trading platform	Enhancing links between commodity exchanges, traders, buyers/sellers of agricultural products
	Agricultural tendering platform	
	Agricultural bartering platform	



Mobile services

Access to financial services

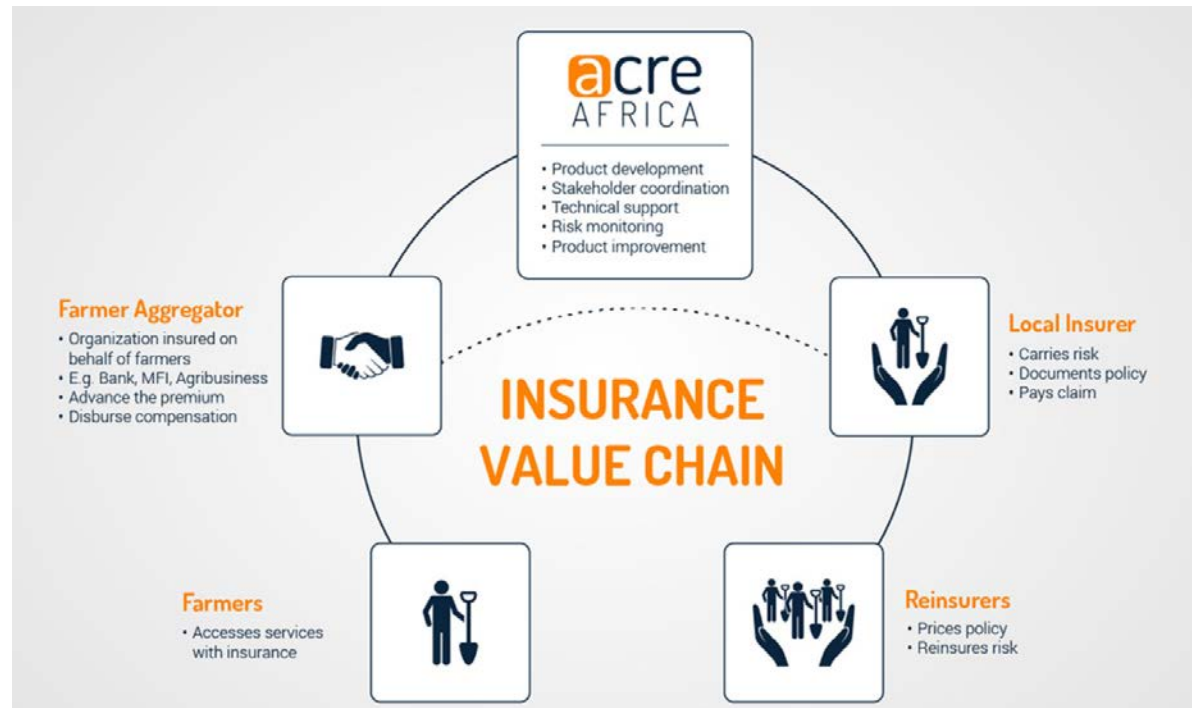
Many applications available in the developing world!

- SMART Money, GCASH in the Philippines
- FarmDrive in Kenya
- Zoono in Southern Africa provides e-payment to unbanked people
- Kilimo Salama (ACRE) provides farmers with insurance coverage

Mobile services

Access to financial services: ACRE

- Micro-insurance for farmers
- Service users invested +20% in production
- Income +16%



Mobile services

Access to advisory services: iCow



www.iCow.co.ke

- Provides integrated services to breeders via mobile+internet
- Among the services: cow calendar, market information, access to extension services
- Available in Kenya on multiple operators via Safaricom, Orange and Airtel
- Platform: mobile phone, SMS, web-based interface, Ushahidi crowdmapping
- Fees: Farmers pay 5 shillings (roughly US\$0.05) per SMS, which amounts to approximately 1,200 shillings annually based on average estimated usage (~US\$

Mobile services

Access to market: ESOKO

- Ghanaian company active from 2005
- Currently active in 8 countries, +200 employed, claim to have farmers' income increased by 10%
- Mobile-enabled platform for farmers, agro-traders, businesses, NGOs and governments.
- Initial focus: market information – e.g. real-time market information, receive price alerts, SMS commodity purchasing, etc.
- Model: Free 1st month (for end users) then sliding scale based on willingness/ability to pay, franchising fees and a share of revenues (for partners)
- Access: Works on basic phones, customers can subscribe via SMS or online Key

Mobile services

Access to market: ESOKO

There is a dark side though...



Surprise! Esoko's Agricultural Market Prices Are Private Sector Failures

By Wayan Vota on January 4, 2018

<https://www.ictworks.org/esoko-agricultural-market-prices-failures/#.WIDcszdG3b0>

Mobile services

Access to market: MOZACAJU

MOZACAJÚ
SHARED VALUE FROM TREE TO TRADE

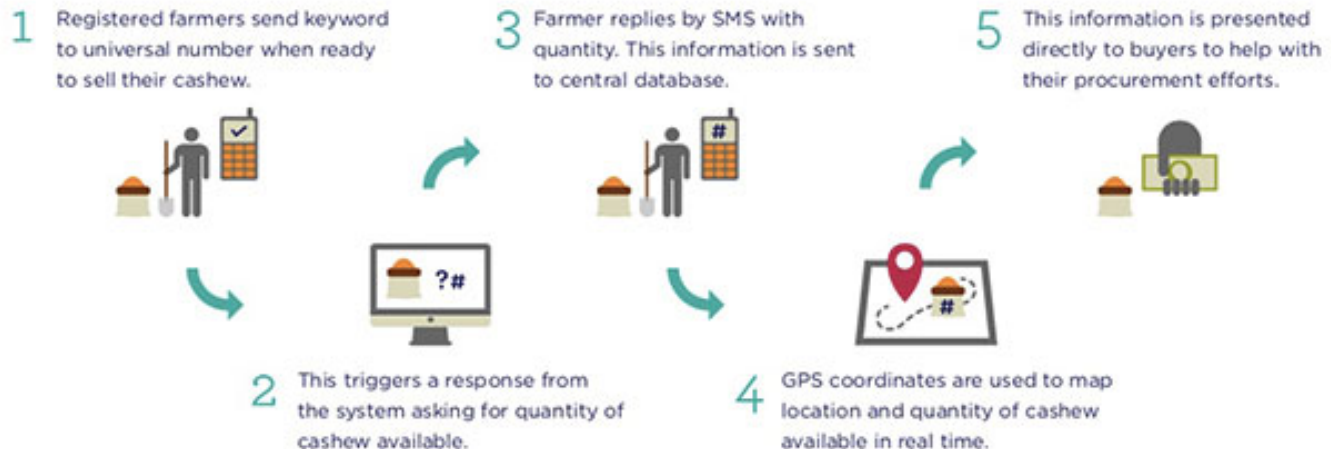
Mozambican Cashew



From Tree to Trade



Premium Markets



Mobile services

Risk Management: Plantix



Health Check

Take a picture of your arable crop by using a simple 3G-enabled smartphone. Plantix analyzes it within the blink of an eye and reports detailed information about the plant's species and its potential disease



Plantix Community

Get in touch with a community of scientists, farmers and plant experts to exchange information about plant issues on a local or global level



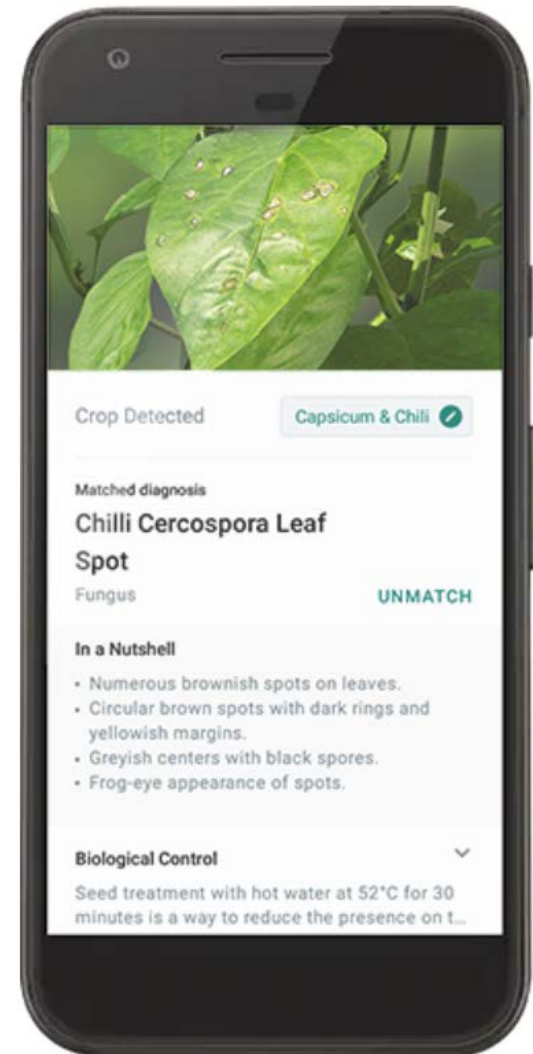
Plantix Crop Advisory

This is the third pillar for multiplying your farming expertise. The Crop Advisory is a holistic tool that reminds you about all the steps necessary for the highest yields and best quality of your farm produce



Disease Library

Plantix provides the largest independent database for plant problems and their treatments



Mobile services

Data collection



Collect

Easy and flexible survey design and data management



Collect Mobile

Intuitive data collection and validation in the field



Calc

Efficient and collaborative data analysis and results dissemination



Collect Earth

Innovative land assessment through freely available satellite imagery



Collect Earth
Online

Online Land Monitoring tool for crowd-sourcing of augmented visually interpreted data



SEPAL

System for earth observation, data access, processing, analysis for land monitoring

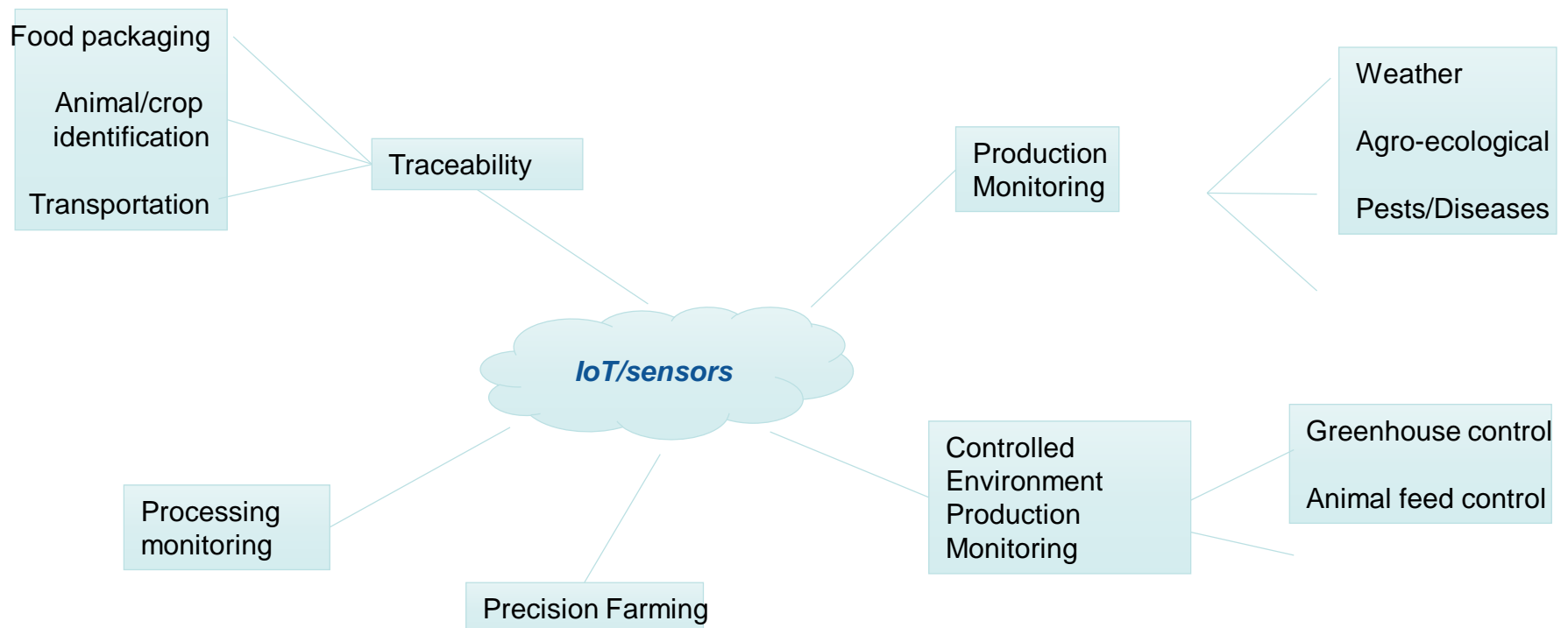
Many mobile-based applications

- RapidSMS
- Ushahidi/Crowdmap
- KoboToolBox
- OpenDataKit
- Freedom Fone
- Open Foris
 - Open Foris is a set of free and open-source software tools that facilitates flexible and efficient data collection, analysis and reporting.

<http://www.openforis.org/>

Internet of Things

Many applications



Internet of Things

IoT & agriculture: a promising sector

BUSINESS
INSIDER

TECH | FINANCE | POLITICS | STRATEGY | LIFE | ALL

PRIME | INTELLIGENCE

Here's how IoT is transforming 6 different industries

Cadie Thompson Oct. 25, 2016, 1:47 PM

Agriculture is embracing IoT in a big way.

According to [BI Intelligence](#), Business Insider's premium research service, IoT device installations in the agriculture industry are estimated to grow from 30 million in 2015 to 75 million in 2020.

Farmers are collecting data about their crops and livestock in a variety of ways. For example, John Deere has started using sensors in its tractors to connect them to the internet so that farmers can easily access data about their crop yields. By combining those sensors with advanced data analysis, farmers can get a sense for the best times to plant crops and how to optimize their yields.

Sectors
Agriculture



Nick Ismail
12 July 2017



7 industries that will be radically changed by the IoT

What will the transformative impact of the IoT be on a number of sectors in the coming years, and in what areas will this impact be felt?

1. Farming

Technological innovation in farming is nothing new, but farmers and agricultural organisations are now turning to the internet of things for greater production capabilities and meet the demands of the world's ever growing population.

Smart agriculture is [already taking off](#) among farmers, with the desire to drive additional efficiencies increasingly making high tech farming the standard across the industry. This is facilitated through devices such as agricultural drones and sensors. The ability to monitor every animal and plant individually and assign each a personalized feeding and medical regime may soon become the norm.

>See also: [How the Internet of Things is impacting enterprise networks](#)

2016/2017



Internet of Things

IoT & agriculture: a promising sector

IoT in Agriculture Market Worth \$48.71 Billion by 2025 at 14.7% CAGR: Allied Market Research



NEWS PROVIDED BY
Allied Market Research →
Dec 06, 2018, 09:15 ET



PORTLAND, Oregon, December 6, 2018 /PRNewswire/ --

Increase in demand for food with rise in global population, adoption of new technologies for improving yield, and implementation of IoT-based technologies to cope up with changing climatic conditions drive the growth in the global IoT in agriculture industry

≡ **Forbes**

2,738 views | Jan 23, 2019, 4:00 pm

Smart Farming Through The Internet Of Things

Lorin Fries Contributor ⓘ

Food & Drink

How technology is transforming food and ecological systems

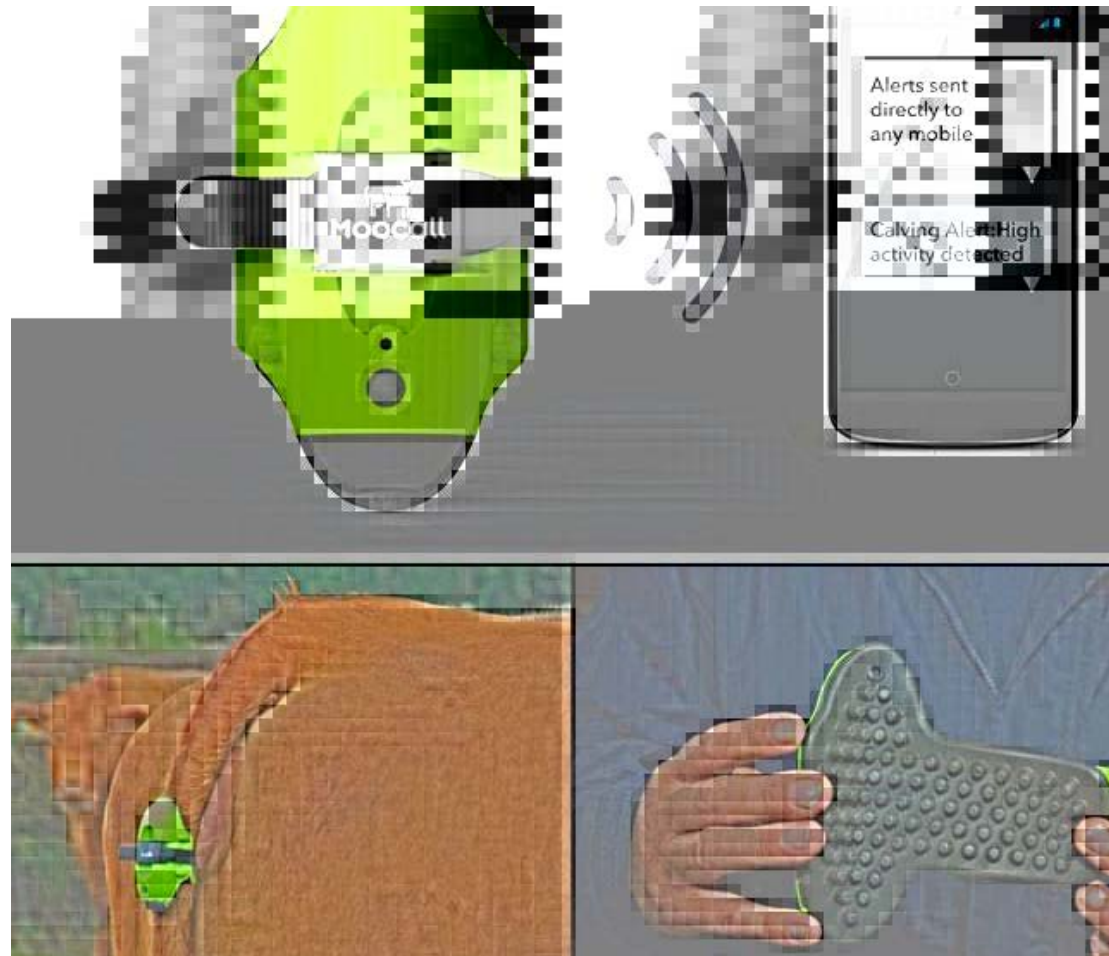
The so-called “smart agriculture” market is [projected](#) to reach \$13.5 billion by 2023. As technologies like the Internet of Things transform business and farming operations from the U.S. to [East Africa](#) and [India](#), there is enormous opportunity to improve the quality and sustainability of our food – not just the volume of yield. I spoke with Tony Franklin, General Manager for the Internet of Things at Intel Corporation, about the trends and examples he sees in this space.

2018/2019

Internet of Things

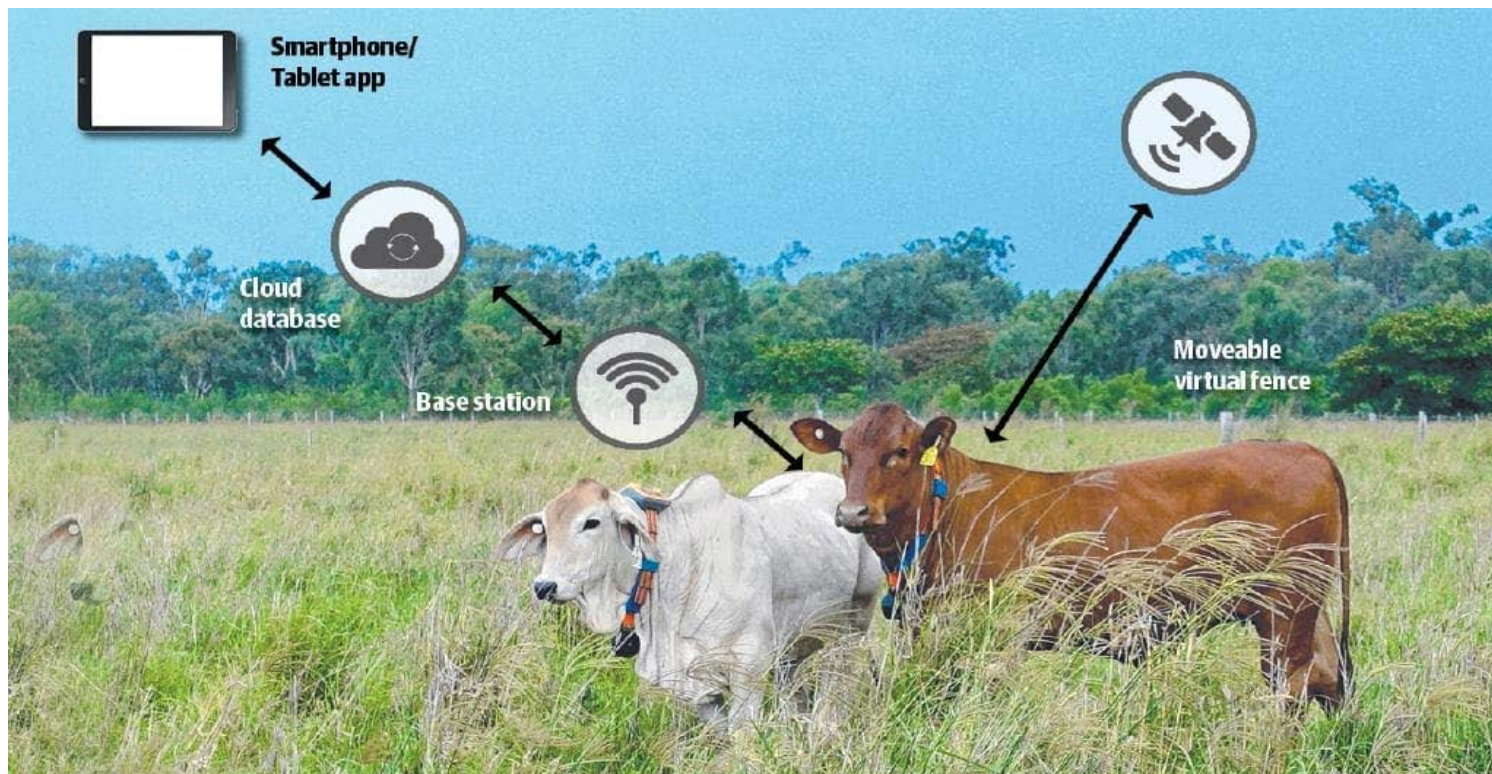
IoT & Livestock

Any idea what this is?



Internet of Things

IoT & Livestock



Virtual fencing (CSIRO)

Internet of Things

IoT & Livestock



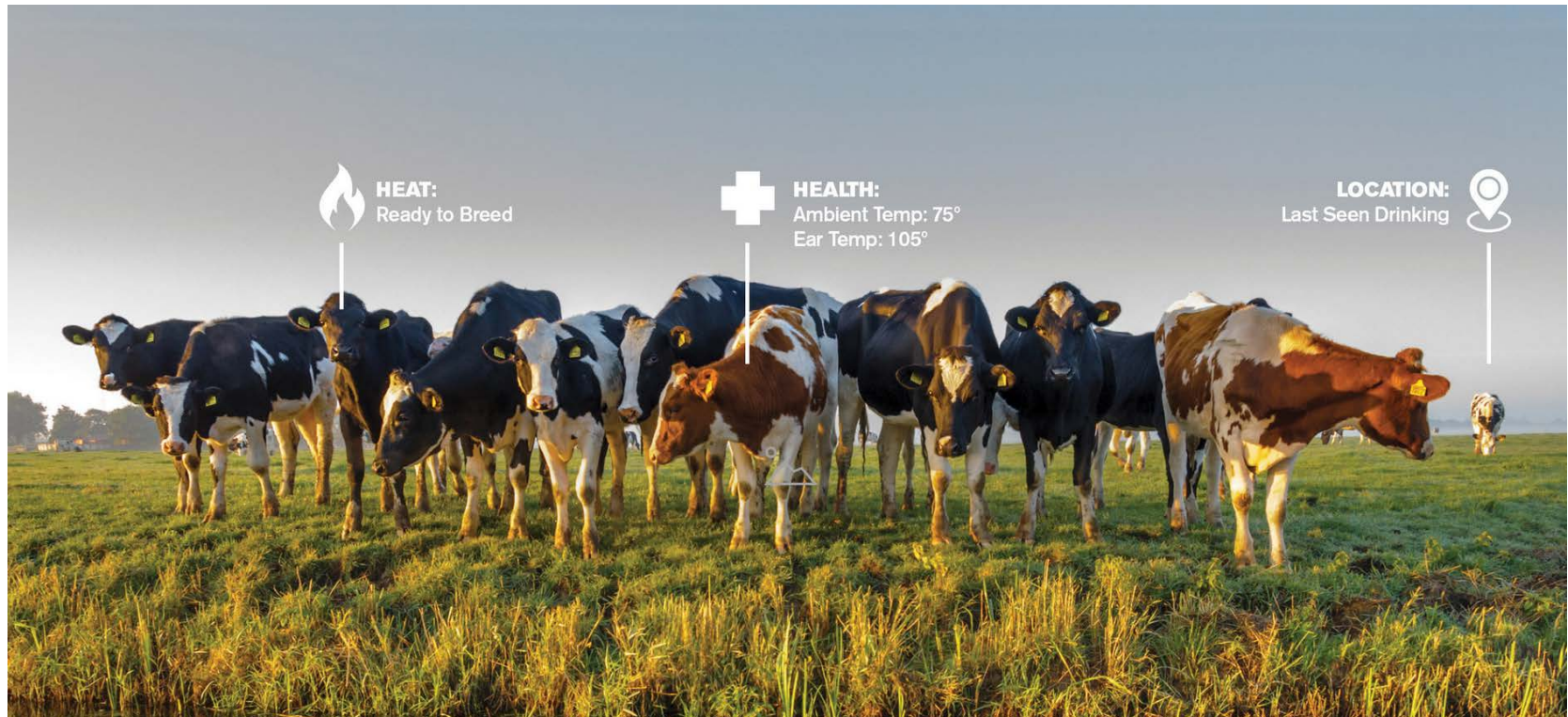
HerdDogg® Starter Kit
\$999

25 DoggTags™
Bluetooth Ear Tags with 2-year Battery

1 DoggBone™
Mobile Base Station with Cellular Connection



















6 Months HerdDogg Service
\$4 Per Month/Animal After First 6 Months

Upload My Herd



Internet of Things

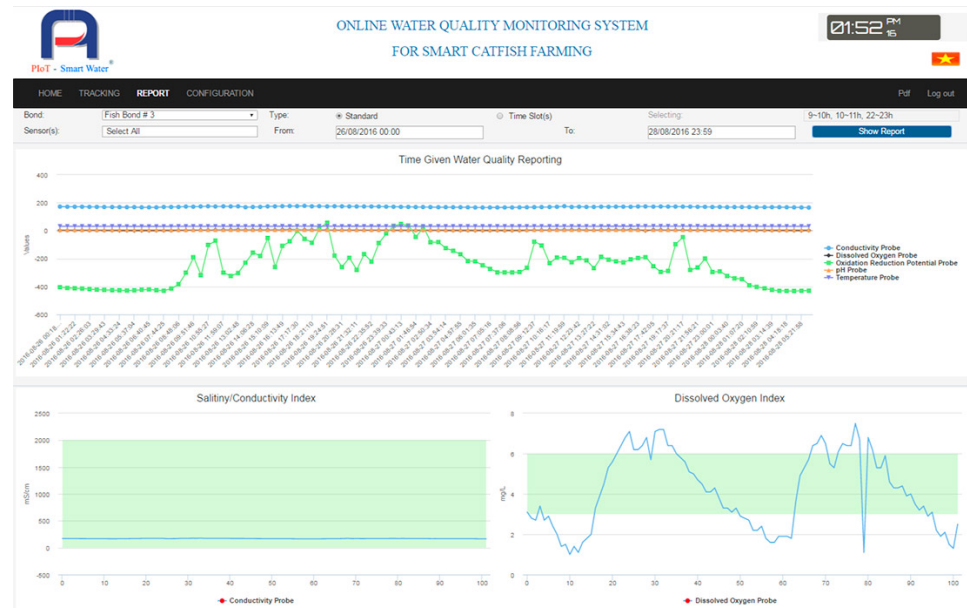
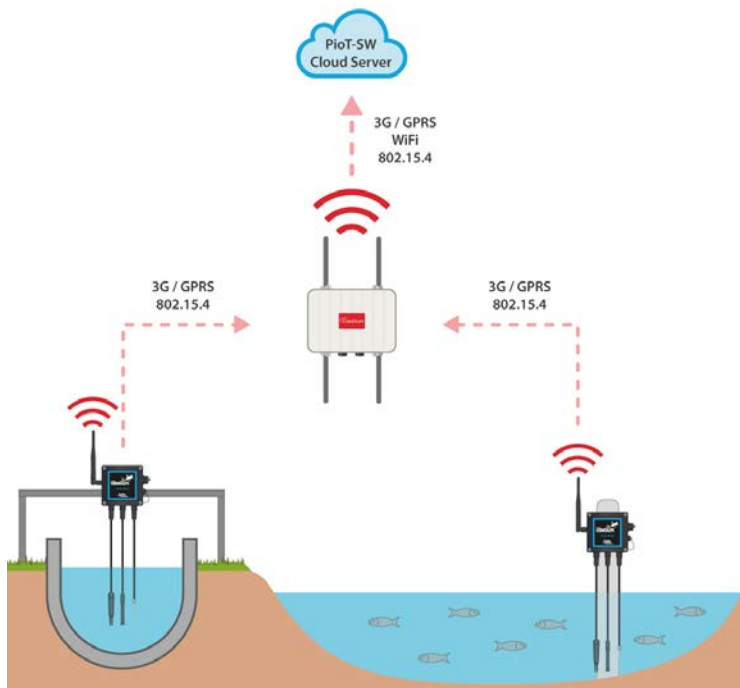
IoT & fisheries: 2 approaches

	Problem to solve	Sensor implementation	Risk warning	Result
 Shrimp pools	 35° 25° Dissolved Oxygen	 Digital multisensor	 Temperature increases alert	 Control of consumption level
	 Growth of toxic algae		 PH increases alert	 Control of water fertilization
 Field	 Shrimp food in bad condition due to humidity	 Humidity sensor	 High levels of humidity	 Control of water fertilization
 Anti-theft control	 Shrimp theft	 Radio Frequency Transmitter	 Opening shrimp pool gate alert	 Loss control Fraud detection



Internet of Things

IoT & fisheries: 2 approaches



Libellium, Vietnam



Internet of Things

IoT & fisheries: 2 approaches

WAZIUP: A low-cost infrastructure for deploying IoT in developing countries

Congduc Pham¹, Abdur Rahim², Philippe Cousin³

¹ University of Pau
congduc.pham@univ-pau.fr,

² CREATE-NET
abdur.rahim@create-net.org

³ Easy Global Market
philippe.cousin@eglobalmark.com

The low cost way:

<https://wazihub.com/>

Abstract. Long-range radio are promising technologies to deploy low-cost Low Power WAN for a large variety of IoT applications. There are however many issues that must be considered before deploying IoT solutions for low-income developing countries. This article will present these issues and show how they can be addressed in the context of African rural applications. We then describe the WAZIUP low-cost and long-range IoT framework. The framework takes cost of hardware and services as the main challenge to be addressed as well as offering quick appropriation and customization possibilities by third-parties.

Key words: LPWAN; Low-power IoT; Low-cost IoT; rural applications

Internet of Things

Wazi-Up approach in Burkina Faso



Internet of Things

IoT & soil analysis



Lab-in-a-Box

The most complete, fast, affordable and reliable solution to test nutrients on-site



Scanner

A simple, smart and connected way to analyse your crops, raw materials and soil



Scoutbox

Beat the human eye. Digitally determine, count and locate harmful insects.

Product: <https://www.agrocares.com/en/products/scanner/>

Blockchain

Definitions

- **Distributed ledger technology** (DLT) the technology behind bitcoin, ether, etc.
- DLT is a decentralized system for recording transactions with mechanisms for processing, validating and authorizing transactions that are then recorded on an immutable ledger.
- Blockchain is one implementation of DLT.
- Blockchain is referred to as an *“Internet of value”*, meaning a secure way to store and transact value – anything from currency, stocks, contracts and even votes – from one entity to another.

Blockchain

Blockchain and agricultural development



Blockchain

Smart Contracts

- Smart contracts are **self-executing agreements** that are triggered on the basis of predefined and agreed events
 - E.g. Rainfall > 200 mm
 - Market price of commodity > USD 100
- Why **smart**?
 - The clauses in the contract are evaluated and the appropriate code executed without human intervention.
- **Settlements** in smart contracts are automatically triggered if the pre-agreed conditions coded into the contract are met.

Blockchain

Issues and Opportunities in Agriculture

- Blockchain-based implementations still suffer from **traditional challenges** such as a lack of or poor infrastructure, failures of interoperability, and other technology issues.
- Although the trend now is to try a blockchain-based implementation of traditional processes, in most cases this adds **unnecessary overheads** and does not yield any **tangible benefits**.
- What it does promise is to deliver a **transparent, decentralized, secure transaction process** and may reduce transaction costs.

Quick fire round



5 min

What processes in the agriculture domain are suffering from a lack of transparency, would benefit from decentralisation and are now affected by non-secure transactions?

Blockchain

Issues and Opportunities in Agriculture

What's the role of blockchain?

- In agriculture, **self-executing smart contracts** together with automated payments would be the game changer.
- The role of smart contracts especially in **agricultural insurance, green bonds, and traceability** could be very effective.

Blockchain

Issues and Opportunities in Agriculture

What's missing?

- To ensure the maximum efficacy for smart contracts, **frameworks** to support such an innovation, such as high quality data, enabling policies and regulations, should be first addressed.
- The process of designing, verifying, implementing and enforcing smart contracts in traditional agricultural value chains is still a work in progress, with only a few pilot implementations to show **proof-of-concept**.

Blockchain Insurance

Index insurance based on **smart contracts** can automate and greatly simplify the process thereby facilitating instant payouts to the insured in the case of adverse weather incidents.

Automatic data feeds provide continuous and reliable hyperlocal data to the contract thereby eliminating the need for on-site claim assessment by the surveyor.

Blockchain Insurance

How may this work?

Agricultural insurance built on blockchain with **key weather incidents** and related payouts drafted on a **smart contract**, linked to **mobile wallets** with **weather data** being provided regularly by sensors in the field and correlated by data from proximity weather stations would facilitate immediate payout in the case of a drought or flooding in the field.

Blockchain

Land registrations

- Blockchain-based implementations could provide an incorruptible ledger of **land records**
- UNDP in **India** is working with partners to make land registry more reliable by recording each transaction throughout the sale of a property.
- Land-ownership authority of **Sweden** has piloted land registry and property transaction on blockchain.
- **Georgia** is experimenting on the use of the bitcoin network to validate property-related government transactions.
- **Honduras** started as well in 2017, but the project collapsed

Blockchain

Supply chains

- A blockchain can assist in providing an immutable record from the provenance to the retail store of a product.
 - Increase consumers' trust in the products that they buy
 - Reward the producers who employ good agricultural practices
 - Overall support sustainable farming and responsible consumption

Blockchain

Supply chains

- Italian pasta and pesto sauce manufacturer, **Barilla**, has teamed up with **IBM** to tackle transparency and traceability in its pesto production cycle.
- All details related to cropping, harvesting, transportation, storage, quality control are tracked and made available on a blockchain system that the customer can verify by scanning the pesto's QR code.

Anticontraffazione. All'insegna di tracciabilità e trasparenza

Cioccolatini e pesto Così il made in Italy entra in blockchain

Con Perugina e Barilla l'alimentare è hi-tech

Pierangelo Soldavini

Il Bacio esce dalla fabbrica della Perugina e non viene perso di vista neanche un secondo, lungo tutto il viaggio che lo porta all'estero, garantendone così la qualità e, soprattutto, assicurando che si tratta effettivamente del vero Bacio e non di un prodotto contraffatto. Intanto nei campi viene seguita la crescita delle piantine di basilico, dalla semina fino alla raccolta per proseguire con la consegna al trasportatore fino allo stabilimento Barilla, pronto a essere trasformato in pesto. Anche in questo caso non c'è un passaggio in cui ciascun singolo lotto possa sfuggire al controllo di qualità dell'azienda emiliana.

All'insegna di tracciabilità, trasparenza e fiducia il "made in Italy" alimentare sposa la tecnologia blockchain e lo fa con due marchi iconici come il Bacio Perugina, oggi controllato dalla Nestlé, e la Barilla con i suoi sughi. Con l'obiettivo dichiarato di rafforzare l'immagine di qualità della materia prima lungo l'intera filiera e il controllo anticontraffazione.

La nuova frontiera della tecnologia che è alla base del bitcoin inizia a mantenere le sue promesse di innovazione "disruptive" sbarcando nell'economia italiana con due progetti che realizzano il tracciamento sicuro e trasparente della filiera produttiva. Barilla ha avviato

con IBM Italia una sperimentazione in cui è coinvolto un singolo produttore di basilico con una tracciatura "dal campo alla tavola": il produttore ha già inserito nella blockchain, appoggiata sull'infrastruttura cloud di IBM, tutti i dati relativi alla coltivazione, dall'irrigazione agli antiparassitari per garantire l'effettiva sostenibilità; poi al momento dello sfalcio, ogni singolo lotto sarà seguito fino alla consegna. «Barilla è un'azienda

certificare la tracciabilità delle esportazioni del Bacio Perugina dalla fabbrica italiana agli importatori e distributori globali, grazie a un progetto pilota in partnership con Microsoft: anche in questo caso la blockchain integra le informazioni dei diversi attori coinvolti nella filiera estesa delle esportazioni, produttori, trasportatori, spedizionieri, operatori portuali, importatori e distributori.

Microsoft ci ha messo l'infrastruttura cloud di Azure, sono qualche decina i progetti pilota che l'azienda sta studiando per aziende italiane. «Si tratta di progetti snelli anche dal punto di vista dei costi - spiega Fabio Moiola, direttore Enterprise Services di Microsoft Italia - il vero costo non è la tecnologia in sé, quanto la realizzazione dell'ecosistema dell'intera filiera».

La scommessa di Barilla e Nestlé testimonia che la blockchain può rappresentare una grande opportunità: «È uno strumento che può certificare il "made in Italy" rispetto a quello che non lo è: la firma digitale diventa garanzia di fiducia - afferma Alessandro La Volpe, vicepresidente IBM Cloud -. Come hanno già dimostrato colossi come Maersk nella logistica e Walmart nella supply chain si tratta di una responsabilità condivisa tra tutti gli attori che si trasforma, grazie alla tecnologia, in sicurezza, trasparenza e tracciabilità».

L'ECOSISTEMA
Alessandro La Volpe
(vicepresidente IBM Cloud):
«La firma digitale diventa
garanzia di fiducia
lungo tutta la filiera»

alimentare di marca che vive grazie alla fiducia dei clienti e garantire in maniera sicura e trasparente l'assoluta qualità della materia prima è un nostro obiettivo fondamentale e stiamo sperimentando la tecnologia blockchain per perseguire tale obiettivo», spiega Roberto Magnani, vice president logistica di Barilla Group, anticipando che, se si verificherà, il progetto potrà essere esteso a tutti i prodotti del gruppo, a partire dal grano, dai pomodori e dal latte.

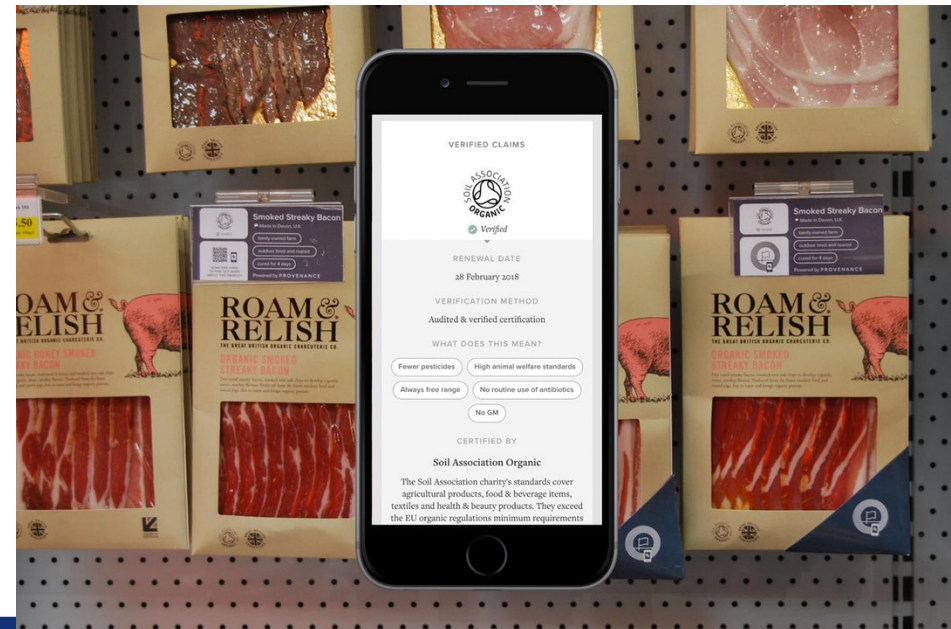
Anche Nestlé Italiana sfrutta il valore della blockchain per

Blockchain

Supply chains

- **Provenance** works on enabling businesses to build trust in their goods and supplychain by using mobile, blockchain and open data supported software.

→ This ensures food safety



Blockchain

Supply chains

- In **India**, a research on the use blockchain technology for **fertilizer subsidy disbursements** to farmers have been implemented
 - Streamline the distribution of subsidy payments to farmers without the need for documents or multiple points of authorization.

Blockchain

Forestry, Environmental management

- In **China**, a company aims to use blockchain for forestry economic development and rural poverty alleviation.
- In **Spain**, the Ministry of Agriculture, Fisheries and Food also plans to apply blockchain technology to develop the forestry industry.
- Companies such as Poseidon are developing blockchain-based systems to **track individual/company's carbon footprint** and then providing opportunities to offset it.
- IBM works with Veridium to **tokenize carbon credits** that are verified by third parties according to international standards.

Blockchain

Fisheries

- Blockchain can be used to **track and deter illegal**, unreported and unregulated fishing (IUU)
- **WWF** is developing TraSeable, an application to stamp out illegal fishing and human rights abuse in the Pacific Islands' tuna industry.

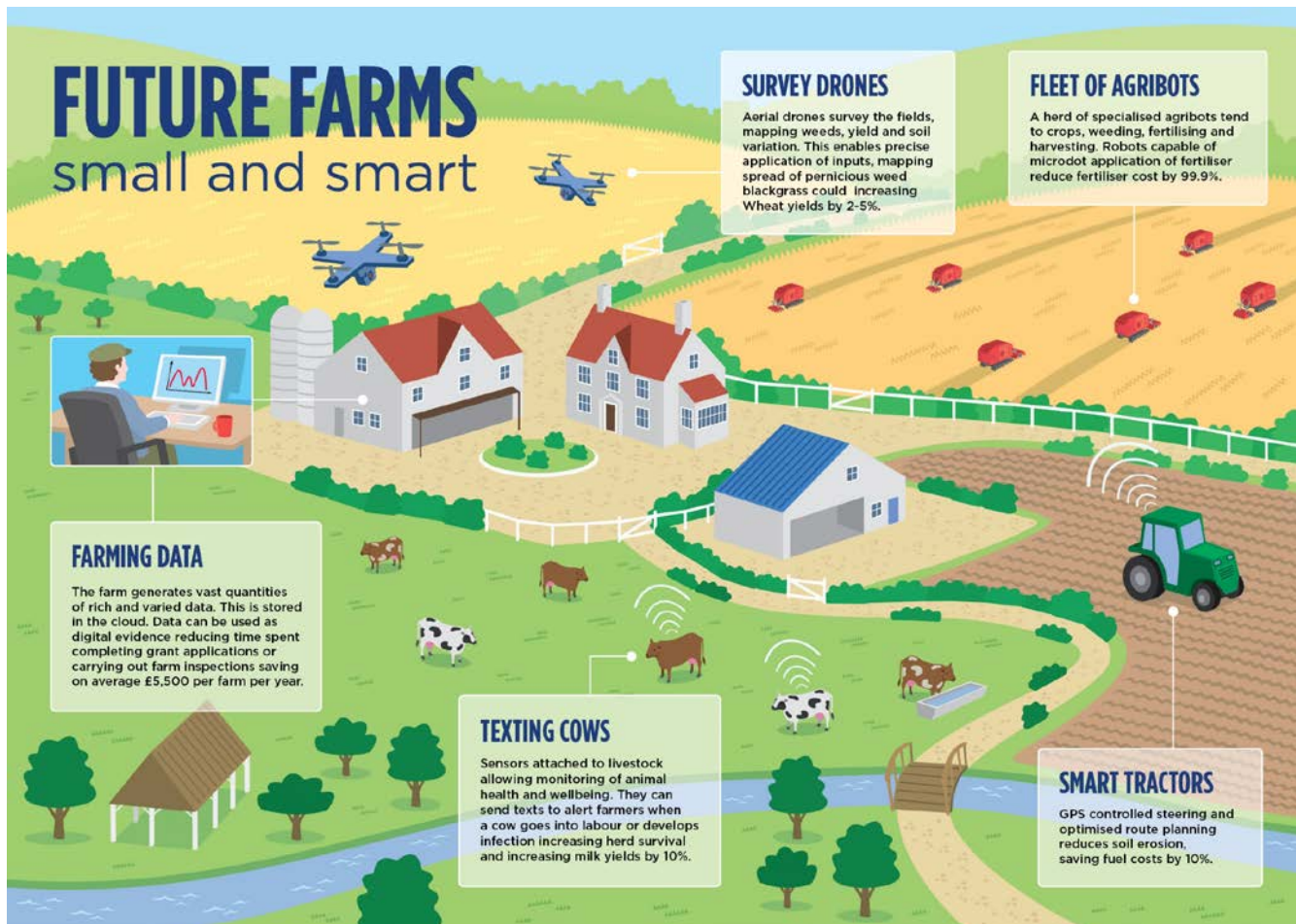
Frontier technologies

How could a future farm look like?

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Frontier technologies

How could a future farm look like?



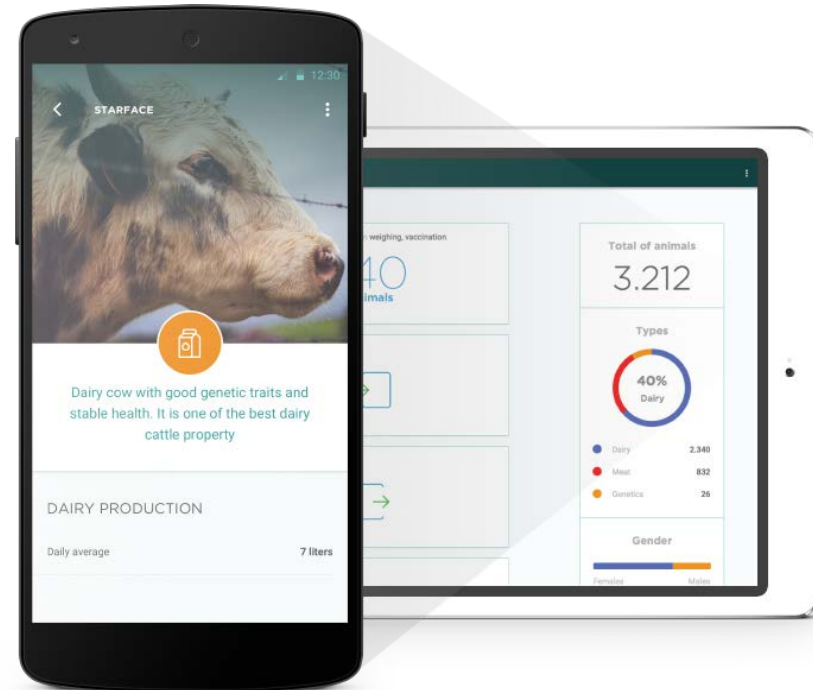
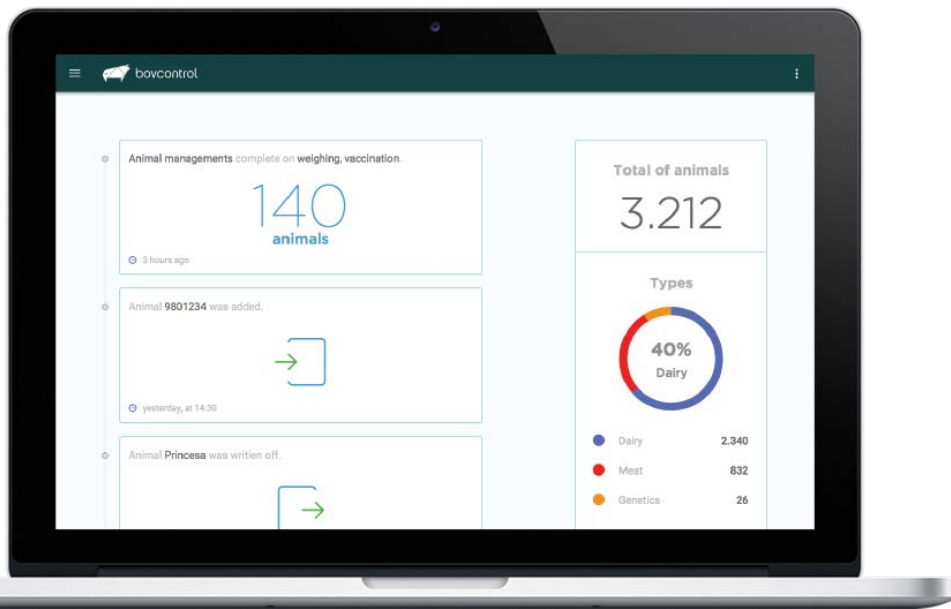
AG TECH: 100+ TECHNOLOGY COMPANIES CHANGING THE FARM

Do you know any among them?



Big Data + IoT + machine learning

Smart farm management



<https://www.bovcontrol.com/en/>

Big Data + IoT + machine learning

Smart farm management



AUTOMATED DATA COLLECTION

Automatize the data collection of your animals through identification devices. Ear rings, chips, smart scales and much more.



MEAT EXPORTING MADE EASY

Certifiers may approve your order more rapidly with precise data declared on BovControl. More business, less paperwork



LIVESTOCK INVENTORY

The one and only animal inventory your farm needs to ensure good efficiency on all the production activities



SOURCE AND DESTINY

Demonstrate the origin of your products to offer more reliability to all destinations. From commercial partners to the end consumer, more professionalism and appreciation truly trackable.



NUTRITIONAL AND SANITARY CONTROL

Register nutritional, sanitary, vaccines, disease controls activities and get notifications on periodic events. Healthy livestock produces much more.



WORKS OFFLINE

BovControl works even without a phone or internet connection. All the data will be synced the next time you get online. BovControl stores your data safely so you don't have to worry about it



SPREADSHEET EXPORTING

If you like, keep you records on spreadsheets too. Just export to Microsoft Excel™ everything saved on BovControl. Super spreadsheets to help out.



FULLY INTEGRATED

BovControl offers integration to other livestock management systems available on the market. Get in touch to know which options are currently available.

Robots



Home-garden automated production
(Farmbot)



Autonomous robot to harvest soft fruits
Dogtooth Technologies

Big Data + machine learning

Cloud-based genomic platforms

CropOS™ allows researchers to:

- predict
- select
- control

desirable traits, bypassing generations of experimentation to bring crop and ingredient improvements to market faster.



Genome Editing



Benson Hill Biosystems
Product Development



Computational Breeding



Food & Crop
Improvement



Trait Discovery



Partner Product
Development

Group work



15 min

An area in the country where you work is affected by soil degradation issues, as the local population carries out bush-burning and tree cutting. You are designing a project proposal to support and facilitate access to agricultural information among these farming communities, covering an area with three local groups, each speaking their own language. Literacy rate is around 60%, and mobile phone ownership is 36%.

Question: Which D4ag solution could you use in this case?