SMALL FARMER BIG DATA

WHY THIS INFOSHEET?

Agri-food technology is developing at such a fast pace that it is almost impossible to keep up with all the new knowledge and insights coined by tech pioneers. This info sheet aims to collect current challenges and share possible solutions, in order to create a shared learning curve within the Blockchain for Agri-Food community, an initiative by Fairfood and CTA.

HOW CAN SMALLHOLDER FARMERS CONTROL AND MONETISE THEIR DATA

Smart farming to optimise agri-food systems is on the rise. The development of digital innovations in agriculture is phenomenal, offering farmers many new opportunities, such as macro agri-intelligence, market linkages, advisory services and transparent supply-chain management. With these new technologies, farmers can now share their own localised, personal and transactional data in order to receive support or access to services. But the question is how the agri-food sector can safeguard that data, to make sure that the farmer's privacy is respected and all necessary measures for data protection are taken, especially for smallholder farmers in low and middle-income countries. This info sheet aims to explore the potential application of technologies such as blockchain to bring farmers into control of their own data, so that they can ultimately own, protect and monetise it.

CTA

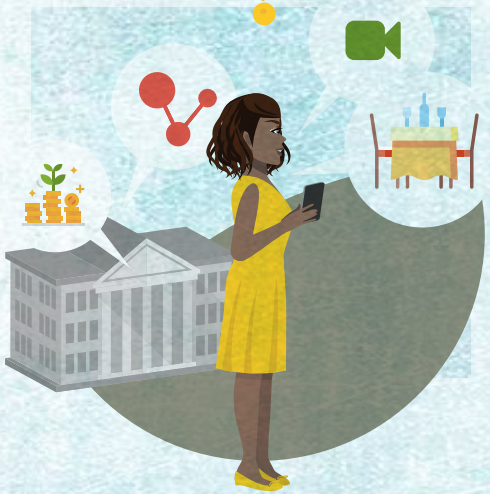
FAIRFOOD

2025: MEET SMART FARMER ROSE, UGANDA

Rose gets up at 5 o'clock in the morning. First, she checks her phone for today's updates. As the rainfall is getting less predictable each year, she depends on daily satellite-based weather reports. Her e-payment account sends a notification ping of a new payment from a buyer. Rose verifies the transaction in her blockchain-based dashboard. Now she can trace her batch of maize all the way to the end customer, as it begins its digital journey through the supply chain.

A video message comes in from Rose's daughter Esther, who lives in a nearby city. The online market platform that Esther has developed with some tech-friends is now in the testing phase. 'Hi mom, can you upload a picture of today's harvest?'.

The start-up Esther works for also uses drones to monitor the health of crops and land. Real-time data collected by the drones helps Rose to use fertilisers and other inputs more effectively and allows her to automatically sell her data to the highest bidder when she turns 'sell data' on. Rose's data about yields, quality, inputs and payments are highly valuable to banks and other institutions for the optimisation of their services.



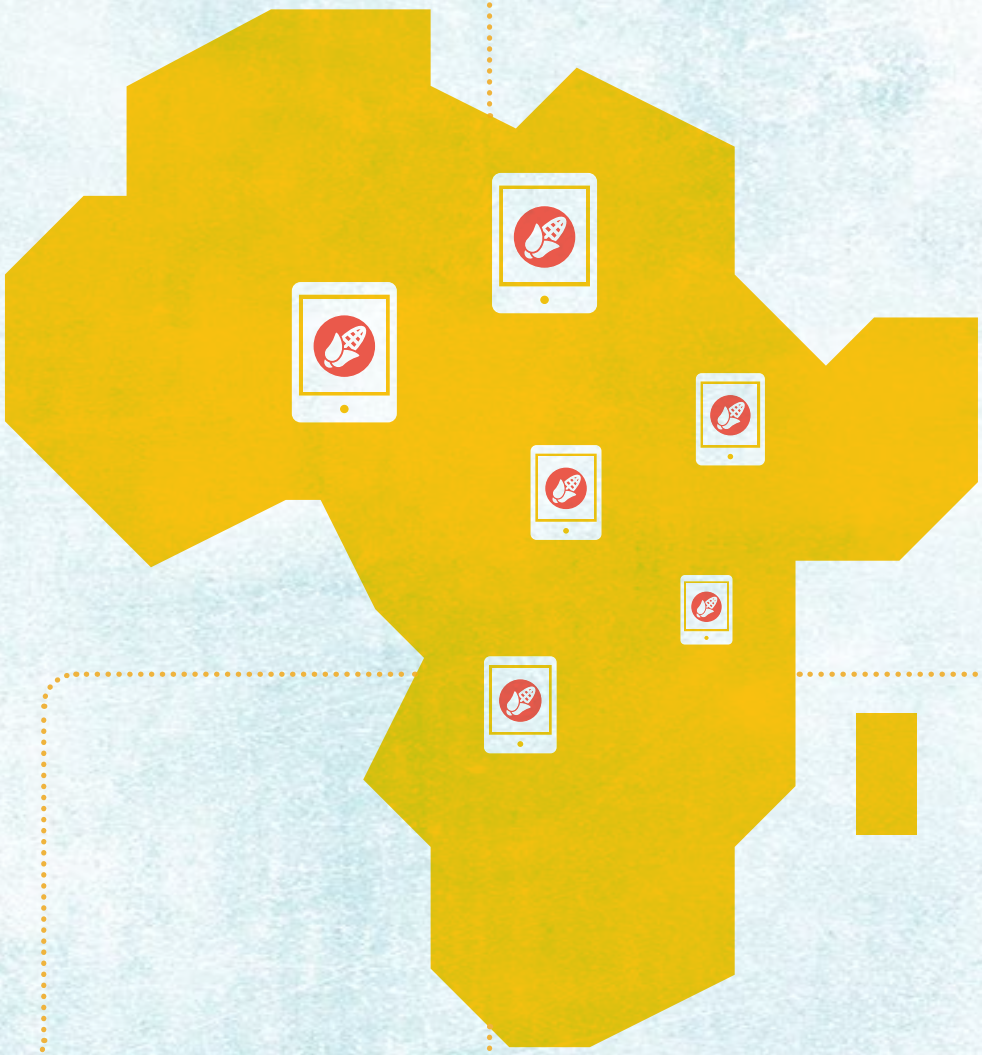
After checking the fields, Rose takes the boda-boda to go into town. She has an appointment at the bank. By recording every financial transaction on a blockchain, Rose has built up a financial track record which can be accessed by financial institutions, who can use this information to lend her money and offer personalised insurances that are paid out automatically the moment bad weather or other complications occur. Rose sends a video message back to her daughter: 'I'll be in town. Let's meet for lunch.'

See also https://www.youtube.com/watch?v=g8tHedBgrRA

WHAT'S GOING ON?

At this very moment, at least 390 distinct digital solutions for smart farming are actively being used across the African continent, according to CTA's Digitalisation of African Agriculture Report 2018-2019. Nearly 60% of these were launched within the last three years.

The report looks at the emerging trend of so-called 'super platforms' that bundle multiple agricultural and financial services. 'Big tech' players such as Microsoft, Google, IBM, Bosch and Alibaba, as well as 'big agri' companies like Bayer, Syngenta, Yara, John Deere and UPL, are set to change the agri-food sector's scale and scope. They have already entered the agri-food market through exploratory acquisitions, partnerships, and new product developments. One example is the recent partnership between IBM and Yara International, one of the largest fertiliser companies and a provider of global environmental solutions. Building on Yara's agronomic knowledge and IBM's experience with artificial intelligence (AI) and data analytics, they plan to build the 'world's leading digital farming platform' that provides digital services and instant agronomic advice to farmers. An increase in platforms such as these is likely to advance financial, human and technological resources in the agri-food sector and could be accompanied by major investments in important underlying infrastructure.



WHAT IS BIG DATA?

Sources: Laney (2001), UN Global Pulse (2018), Oracle, UN Women

THE MOST COMMON TYPES OF FARMER DATA

Localised data: Data generated on farm, such as soil quality, seed use, fertiliser use.

Exported data: Localised data, shared with others.

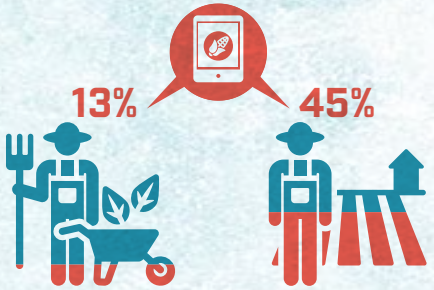
Imported data: Information about climate, weather forecasts, market prices et cetera. Generated off farm, used on farm[1].

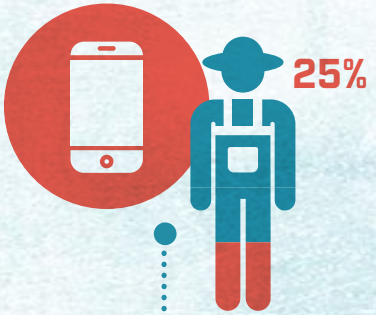
And that's where Big Data (see previous page) comes in as a resource for economic value creation. According to UNCTAD, the United Nations body that deals with trade, investment and development issues, 'control over data is strategically important to be able to transform them into digital intelligence.' Moreover: 'In virtually every value chain, the ability to collect, store, analyse and transform data brings added power and competitive advantages', states the UNCTAD Digital Economy Report 2019. 'Digital data are central to all fast-emerging digital technologies, such as data analytics, AI, blockchain, IoT, cloud computing and all Internet-based services.' Since most users are unaware that the data goldmine on which they are sitting is most possibly being exploited, a first crucial step towards ethical data exchange would be to require informed consent for data use by third parties. New encryption technologies such as blockchain and decentralised file storage could allow users to make use of digital innovations without unknowingly giving away their data for free, and would even enable users to put a price tag on their data in the near future.

THE MOBILE PHONE: GATEWAY TO KNOWLEDGE

AGRI APPS

13% of all Sub-Saharan African smallholders and pastoralists, and up to 45% of smallholder households currently have access to digital agricultural solutions.





PHONE USE

More than 25% of smallholder farmers in countries such as Kenya and Senegal have access to smartphones.

BY 2030

Expected ~50% - 80+% unique mobile subscribers in rural Sub-Saharan Africa.

Source: CTA

EXPERT VIEW: JAN TOP

FOOD INFORMATICS RESEARCHER AT WAGENINGEN UNIVERSITY & RESEARCH, THE NETHERLANDS

The metaphor of data as the new gold runs short, claims Professor Jan Top, as the same data can be shared and used multiple times, by different actors and for different purposes.

'You cannot run out of your own data. Instead of data ownership, it would be better to speak of the right to use data and relate it to decision making potential. Data and knowledge are essential to make informed decisions. When selecting a 'fair product', a consumer wants to be sure that the farmer earns enough. A trader wants to know the exact origin of a batch of coffee, to determine the correct price. Data collected over time also can feed a (machine) learning process. So, data ownership itself is not the issue, the issue is that farmers should be in control of whom they share their data with for which purpose.'

'WE NEED DATA LOCKERS THAT ENABLE ANYONE TO SAFELY STORE AND MANAGE THEIR OWN DATA'

Jan Top foresees an important future role for farmer cooperatives in this: 'They should stand up as a collective and protect their members from free data exchange. They could bargain a reasonable price for their data or set conditions and force companies to cooperate with them.'

In other words: we need data lockers that enable anyone to safely store and manage their own data. 'Think of a – possibly – simple application that enables people to tick a box to distinguish what they want to share with whom and for which purpose.' Blockchain technology could be useful in creating a digital ecosystem with multiple actors.

Top finds the most inspiration in Solid, a recent initiative by Tim Berners-Lee, inventor of the worldwide web. This decentralised identity platform provides a mechanism for users to store all kinds of information, such as photos, comments, contacts, calendars and health data, and offer various people and apps permission to interact. Top foresees a future in which universities, tech start-ups and farmer cooperatives jointly design applications that serve local farmers' needs. 'The most important thing is to work closely together with the farmers, so they will actually use and benefit from it.'

[1] https://cgspace.cgiar.org/bitstream/handle/10568/92477/GFAR-GODAN-CTA-white-paper-final.pdf fig 2

[2] Digital economy report 2019, UNCTAD

THE ROAD TO SOLUTION

STEP 1

THE FIRST STEP: DIGITAL IDENTITIES

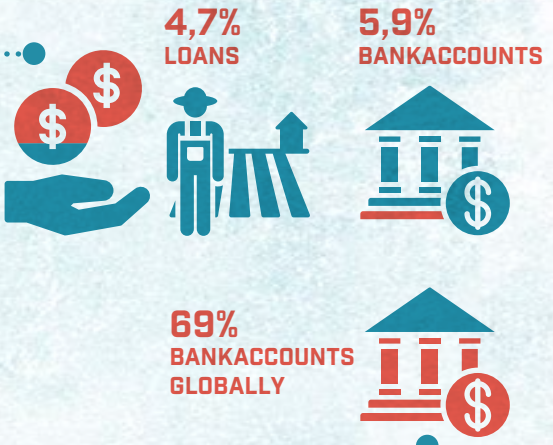
For smallholder farmers to manage their own data, they first must be able to authenticate themselves and prove that they are who they claim to be. Basically, they need a way to digitally identify themselves. With over 1.1 billion people currently having no access to a legally recognised form of identity, many users will have to resort to alternative ways of identification. Blockchain can play a key role in this process as it can permanently store and prove interactions between people and institutions or companies.

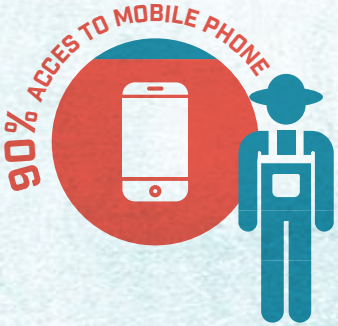
By storing digital interactions between smallholder farmers and companies around them, such as their input suppliers, purchasers, local NGO's, other agribusinesses and neighbours, farmers can build up a digital identity, reducing their dependency on governments to identify themselves. In contrast to centralised systems where institutions provide ID credentials, these 'user centric' or 'self-sovereign' digital IDs empower individuals to personally control the formalisation of their identity. This allows users to manage their distinct digital personas and to actively monetise their personal data in the future .

In order to be useful, as with any ID system, a self-sovereign digital ID should be unique to only one person, stay with the same person from life to death, be accessible from anywhere, and should only be given out with permission from that person. User centric ID's could be relevant and interesting to anybody who wants to be able to identify him or herself without relying on their government. User centric ID's could be particularly useful to the 1.1 billion people who currently do not have access to formal identification, of which many are likely to be smallholder farmers living in rural areas.

LOANS & BANK ACCOUNTS

4.7% of adults in rural areas in developing countries globally have a loan from a formal financial institution. Only 5.9% own a bank account, compared to 69% globally.



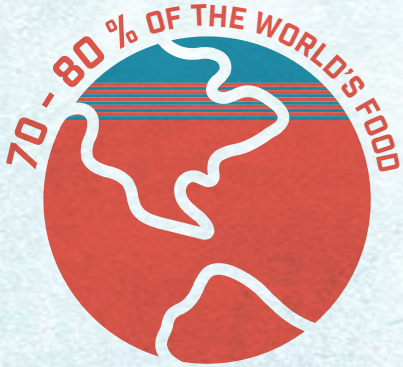


ACCESS TO PHONE

90% of smallholder farmers have access to a basic mobile phone.

FOOD PRODUCTION

513 million smallholder farmers produce 70-80% of the world's food.



Sources: Worldbank , Oxfam, IFC, FAO

[3] Read more about digital identities in this blog post
https://fairfood.nl/en/fairtech/blockchain-smallholder-farmers-self-sovereign-digital-identity/

USE CASE: BANQU

BanQu provides smallholder farmers and refugees with a platform to build up an economic identity from scratch.

HOW DOES IT WORK?

After signing up, users can begin tracking their relationships and interactions with their banked network to build up a recognisable, vetted, economic identity over time. Every interaction is logged onto a private and permissioned blockchain. The platform allows users to retain ownership of their personal data, meaning they can decide which information they want to share with whom.

In 2018, BanQu launched a pilot together with Anheuser-Busch InBev to revolutionise supply chain transparency in Zambia. The main goal of the pilot was creating transparency and traceability in the cassava crop value chain by digitally connecting 2,000 of the region's smallholder farmers and digitising 2,000 tonnes of cassava. Furthermore, BanQu is currently piloting small-plot farmer land mapping. In this pilot, they map land and confirm land ownership for women in Latin America, where access to financing is difficult due to lack of land rights and outdated property registries.

THE ROAD TO SOLUTION

STEP 2

THE SECOND STEP: DATA AS AN ASSET

Generally, it is safe to assume that as more and more data is being combined and cross-referenced from different domains, its value increases. For example, in a supply chain with traceable products from farm to fork, farmer production data such as the type of seeds used and use of chemicals is not merely interesting to the end consumer. When combined with consumers' data on taste and texture preferences, the production method data can be very valuable for food brands and agricultural research centres, as they can correlate taste with production methods. When cross-referenced with other information, such as the environmental footprint of different production methods, the production method data also increases in value and interest to a wider audience. The more data points are connected, the higher the accuracy of the data becomes, and the more data can tell us about a product, person or event. Thus, as more connections are made, data becomes a better source for decision making within the supply chain itself, for the farmers who upload the data, and for potential third parties as well.

So, whilst there may be benefits for the farmers when sharing their data such as having better access to market, inputs and credits, thus increasing their yield and productivity, data could also be an additional product they produce. Puvan Selvanathan, who is working on digital IDs with the Bluenumber initiative, has estimated that Indian farmers could receive at least 100 rupees (1 euro 26 cents) per month for a basic basket of inputs and related productivity data. In Indonesia, a basket of data revealing sustainability practices even at $10 per month would be significantly cheaper and more accurate than having field-based audits which typically cost hundreds of dollars per farm. However, the big challenge is making sure that data stays in the hand of the farmers and that this potential payment actually reaches the farmer.

EXPERT VIEW: ANTON EITZINGER

DATA SCIENTIST AT CGIAR COLOMBIA AND FOUNDER OF THEMETRIX, COLUMBIA

‘The problem in today’s agricultural landscape is that there are many different organisations gathering valuable data about farmers and production methods which doesn’t gets shared’, says Anton Eitzinger, data scientist at CGIAR Colombia and founder of TheMetrix.

‘The reasons why data maintain siloed are a lack of trust among agri-food organisations, the lack of data interoperability and the effort it takes to share data with other organisations.’ Most companies don’t see the benefit of sharing data as it can only bring them a potential competitive disadvantage and doesn’t give them anything in return. There is no way for companies to stay in control of the data they share and easily enjoy the benefits of the added value their data create when combined with other data.

Eitzinger is currently working on TheMetrix, a solution that will enable interoperability of data collected by research, academy, non-profits, governmental institutions and private sectors and enables them to easily share this data while staying in control. ‘By making use of blockchain technology, every participant can monitor and control exactly which data they want to share with the network and under which conditions’, says Eitzinger.

The project aims to reduce production risks for farmers and various stakeholders through better monitoring of produce supply, whilst simultaneously facilitating the development of new business opportunities for value chain stakeholders from

better data for decision making. In this pilot, the project will conceptualise, build and implement a blockchain platform with at least three data providers from the private and research sectors, working with the coffee value-chain in Uganda. ‘My goal is that one day we can create an ecosystem in which every actor is incentivised and facilitated with the right tools to share their information so they can start working together and create a better food system for all.’

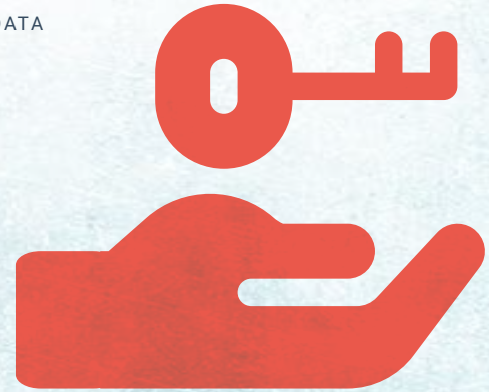
THE ROAD TO SOLUTION

STEP 3

STEP 3: DATA OWNERSHIP AND MONETISATION

In order for users to receive a financial reward for their data, several functionalities are needed in their digital toolbox. First, the user needs to be able to securely and reliably store their information. At the same time, they must be able to prove certain pieces of information without granting complete access. Both of these conditions can be met through a combination of blockchain, decentralised file-storage, and zero-knowledge proofs.

Once this is done, users must be able to verify payments for allowing access to their data. Ideally, this process would be fully automated, using micro-transactions, in a safe and controlled setting, so that farmers can granularly and securely allow access to certain data sets under certain conditions. Cryptocurrencies and smart contracts can offer the exact functionalities needed for this. Data monetisation can and has so far been taking place without the use of blockchain. However, blockchain technology and smart contracts could considerably improve the security of data transactions and lower the overall costs of the process, allowing individual users to monetise their data safely and easily in real time.



DIGITAL TOOLBOX ESSENTIAL #2: DATA VERIFICATION

For data to be trustworthy, it needs to be verified by multiple parties. For example, data regarding agricultural transactions between farmers and input suppliers or purchasers should always be confirmed by both parties involved in the transaction. Data about farmers' land ownership and production methods can, for example, be verified by the farmers' neighbours. Data on pesticide use and rainfall can most accurately be confirmed by sensors rather than by other people. These verifications can be stored on a (public) blockchain so that they are accessible to anyone and cannot be altered afterwards, making sure that the information is fully transparent and accurate.

DIGITAL TOOLBOX ESSENTIAL #1: DECENTRALISED FILE STORAGE

When data is stored encrypted on a server, only the user with the encryption key (or private key in blockchain terms) can decrypt that information. However, the problem with simply encrypting users' data on a centralised server is that the data is still stored on the server of a platform that is able to delete and censor the data. Also, in order to provide proof of certain things or to interact with applications, the platform owner often needs access to the data, meaning he or she needs to be able to decrypt your encrypted data using a "back door" – a private key that can decrypt all data on the platform. With the invention of technologies like blockchain and decentralised file storage, the user can retain full control over who gets to see what information and under which conditions.

When data is stored on a distributed file storage network, the data is cut into many different parts that all get encrypted and stored on different computers spread around the world. Every piece of data is stored on at least two computers. When a computer disconnects, the data can immediately be replicated on another computer, so that no files or data are lost. The encrypted and fragmented data can only be decrypted and put together using the private key of the owner. Therefore, nobody can get access to the data or even delete or censor it without the private key holder's consent. Distributed file storage is an essential part of most dApps that are currently being developed and provides essential functionalities for online systems to run without central authority.

DIGITAL TOOLBOX ESSENTIAL #3: SMART CONTRACTS

By using a smart contract, users can establish rules regarding who gets access to which data and under which conditions. One condition could be a minimum payment in cryptocurrencies, determined by a set price per piece or MB of data. This would allow users of a digital platform to automatically sell the data they create on that platform to the highest bidder, or at a set minimum price and only to companies that are identified by and connected to the same supply chain. Virtually any rule can be integrated in smart contracts.

The "data storage nodes" – nodes in the network that store other people's data – are also automatically rewarded for storing the data through smart contracts. Because all the interactions are automated, there is no counterparty risk and thus no need to identify users or create a legal framework to safely facilitate the data exchange. Every rule is already embedded in the system. Therefore, the costs of data transaction will drastically lower with the use of smart contracts.

DIGITAL TOOLBOX ESSENTIAL #4: ZERO KNOWLEDGE PROOFS

With zero knowledge proofs, certain elements of a data set can be validated without revealing the entire data set. This means that users can provide proof to or interact with digital platforms without automatically revealing all their information. For example, they could prove that a certain data set falls between two values, without revealing the specific value or the entire data set to the system. Combining these toolbox essentials, users can interact with digital platforms, while maintaining ownership of their data to a large extend.

The upcoming new market for data exchange needs some time to mature. In an article on Wired.com, Hagar Vardimon explains how he tried to sell all his personal data for cryptocurrencies on all the latest developed data crypto exchange platforms. The result, after selling various types of data, was a total of 0.3 cents. However, this is not to say that data isn't valuable. The value of data varies significantly between different valuations reaching from less than a dollar to over 100 dollars per person. The value often depends on the number of cross referenced data points included. It is therefore safe to say that this is not the end of data exchange and monetisation, but rather the beginning.

USE CASE: YOTI DIGITAL IDENTITY, LONDON

Yoti is a digital identity solution that incorporates data verification and advanced data encryption. It stores users' personally identifiable information (PII) encrypted on their servers without a backdoor, meaning the data is only accessible for users.

After a users' registration, a selfie is matched to their passport picture using artificial intelligence. A real person double checks the confirmation before the data is added to the database and encrypted with the user's unique password.

Yoti can also be used to quickly identify oneself online without having to provide a passport, simply by logging in with the use of a key phrase or biometric authentication. Some vending machines that sell 18+ products in the UK allow users to identify themselves with their Yoti "digital ID". Using zero knowledge proofs, the Yoti ID allows the vending machine to confirm that the user is older than 18, without revealing the actual age or any other information about the user.

YOTI KEYS

Yoti is also working on a digital identity solution specifically aimed at providing financial inclusion for the 1.1 billion people that are currently without access to identity proof. The solution, called Yoti Keys, allows anyone with a tablet or smartphone to create a digital identity for someone else in three simple steps:

1. Add a photo and details
2. Choose a 5 digit PIN to protect their data
3. Give them their Yoti Key

The Yoti key is the small RFID chip seen in the picture above. It can be used in combination with a pin to authenticate interactions and transactions, and over time, build up a track record to prove trustworthiness.

USE CASE: HARA, INDONESIA

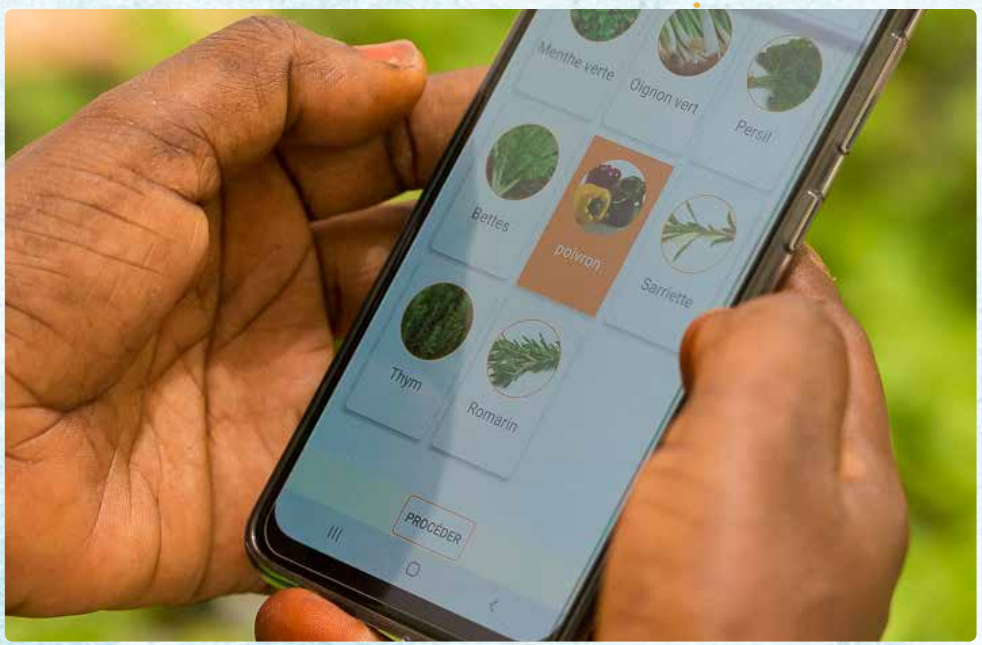
Indonesian data company HARA connects data creators, data verifiers, data buyers and value adding services on a decentralised data exchange platform, starting in the agri-food sector.

HOW DOES IT WORK?

HARA created a mobile app that assists smallholder farmers by offering advice in the most effective way to grow their crops. In the app, farmers can provide specific information about their farming practices including irrigation systems, pesticide and land use, and crop output. Third party data verifiers can confirm this data to ensure its value and integrity. The platform automatically rewards farmers and data verifiers for their work in cryptocurrencies, which they can exchange for cash at their local kiosk. According to CEO Regi Wagyu, HARA has already collected data from 27,000 rice and corn farmers in East Java. They plan to expand to the central and western part of the island.

WHAT IS THE BENEFIT?

HARA makes use of a decentralised file storage platform and smart contracts to streamline their data exchange. Data buyers get access to data after sending in their crypto, of which a percentage will go straight to the farmer's wallet. Value adding services can use the platform to offer their services to the platform's users, such as loans or cultivation advice for farmers, based on the data provided by them. HARA currently works with some of the largest banks in Indonesia to provide loans for farmers, and plans to collaborate with more banks, leasing and financial technology companies, and marketplaces in the future.



EXPERT VIEW

FOTEINI ZAMPATI, DATA RIGHTS RESEARCH SPECIALIST KTBL, GERMANY

WHO SUPPORTS THE FARMERS TO PROTECT THEIR DATA?

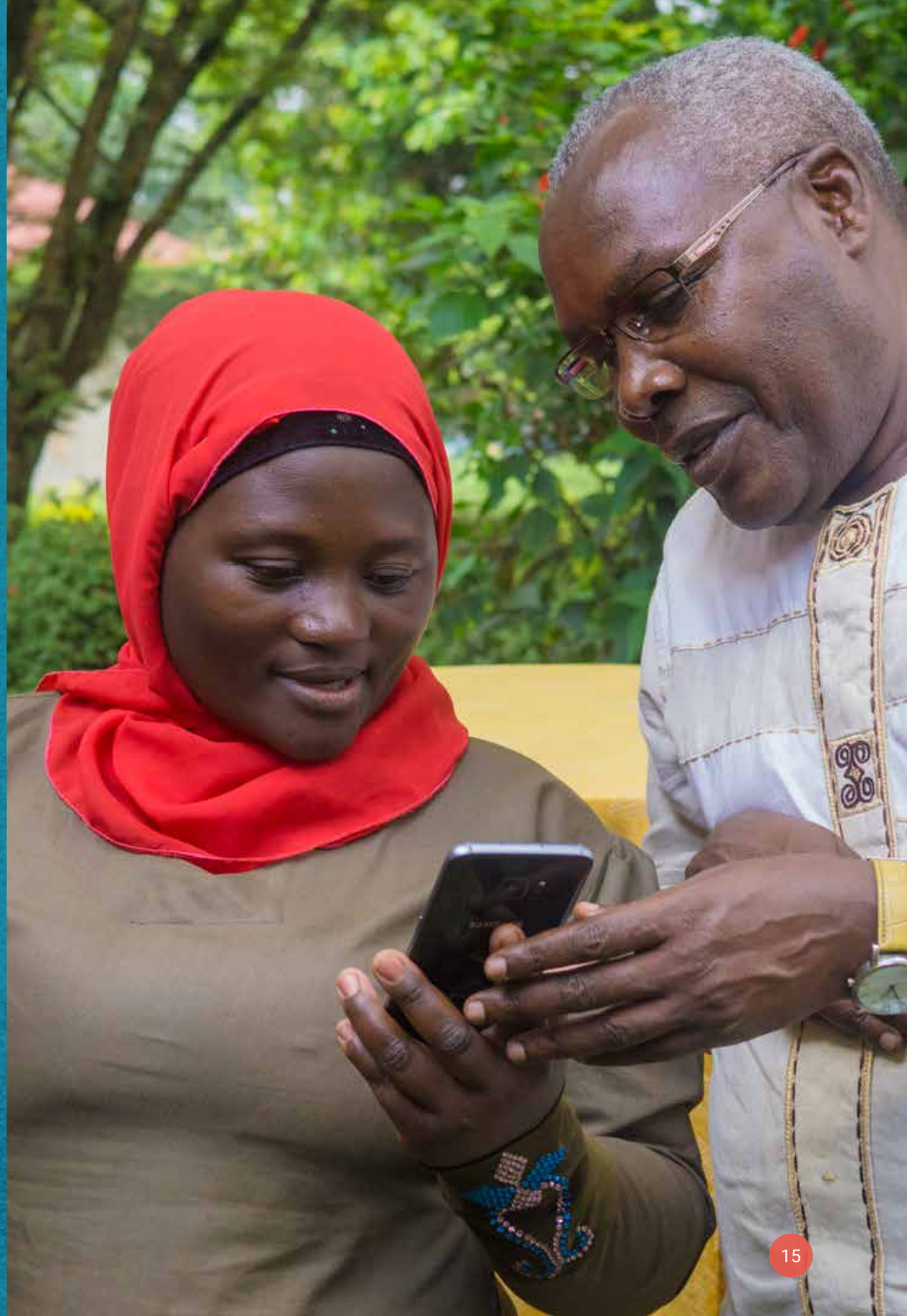
So far, worldwide, there are three main codes of conduct that have been developed regarding the use of agricultural data:

- The US American Farm Bureau Federations' Privacy and Security Principles for Farm Data
- The New Zealand Farm Data Code
- The EU Code of conduct on agricultural data sharing by contractual agreement.

These codes cover central issues such as terminology, data ownership, data rights (including right to access, data portability, and the right to erasure/to be forgotten), privacy issues, security, consent, disclosure and transparency. Even though they are not legally binding, these codes help build awareness about the importance of transparency in agricultural data flows. They change the way agribusinesses view data and make data producers – primarily farmers – more aware of their data rights.

However, these codes primarily target agribusinesses and agri-tech companies that work with farmers and use their data, as opposed to the farmers themselves. Moving forward, a customisable code of conduct will be critical, that provides basic and general guidelines for farmers based on their needs and interests.

Source: Spore, CTA, September 2019



A GLANCE INTO THE CRYSTAL BALL

With the rapid development of digital solutions for smallholder farmers, farmers will become more empowered by gaining access to the right tools and infrastructure to provide all the data necessary for an effective smart food system.

Supply chain partners will know when to expect the next harvest and consumers will know exactly what the social and environmental footprint of a product is. Financial service providers will gain insight into farmers' financial track records, so farmers have better access to loans and insurances. Food and research centres will gain insight into local farming practices which they can use to improve the nutritional value and taste of our food. Farmers will gain access to information they can use to increase their yield, productivity and profitability.

This also means that the amount and quality of data being produced by farmers will rapidly increase in the coming years. Upcoming user centric digital identities, decentralised storage and data exchange solutions such as Solid, HARA, Yoti and Banqu, offer farmers personal control over all of their data and even allow them to monetise it, creating a new source of income. Together with Dutch NGO Fairfood, Dutch family-owned company Verstegen Spices & Sauces is now starting a pilot project to generate new sources of income for nutmeg farmers in Indonesia, based on data provided through the use of a blockchain-enabled traceability platform.

The Pan African Farmers Organisation and members have been working with CTA to build capacity in data management around associations and cooperatives. The objective is to give smallholders control over their data and demonstrate the benefits of data sharing on their terms. As an example, working with CIAT in Uganda, CTA is looking at blockchain to facilitate data exchange for coffee data.

In the future, more and more smart data sharing coalitions will be set up within supply chains so that data can flow freely but securely. This allows supply chain actors to work together to better serve their customers and create more value for all. The effective creation, recording and sharing of data will be the main driver behind the upcoming "demand driven" economy. In this economy, optimised supply chains will feed the world in a responsible manner by minimising food waste while maximising consumer value. All of these data exchanges will be governed by smart contracts and other smart encryption systems so that autonomy always remains in the right hands; the hands of the producers of that data. This will not only open up new income resources for farmers, it will incentivise them to actively contribute to global solutions and ultimately play a bigger role in the global economy.

SOURCES & FURTHER READING

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