



# Agriculture Blockchain/technologies

Computer Science

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# Outline

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- Introduction
- Technology Analysis
- Industry Analysis
- Applications
- S.W.O.T
- Conclusion
- References



# Outline

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- **Introduction**

- What is blockchain
- Why to use blockchain in Agricultural sector?

- **Technology Analysis**

- **Industry Analysis**

- **Applications**

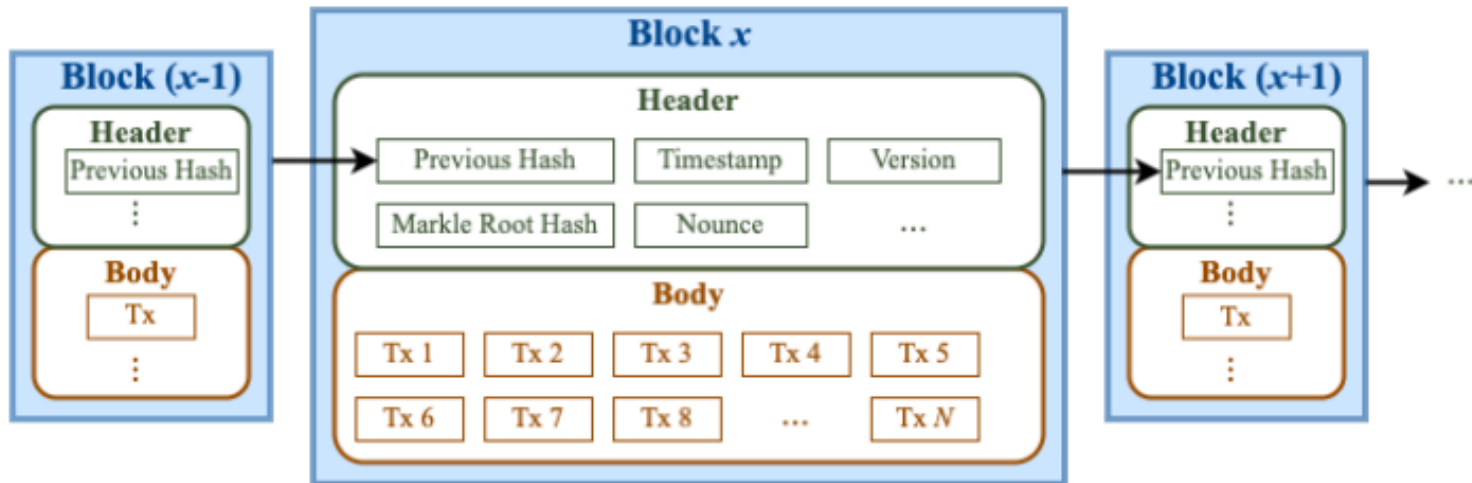
- **S.W.O.T**

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- **References**

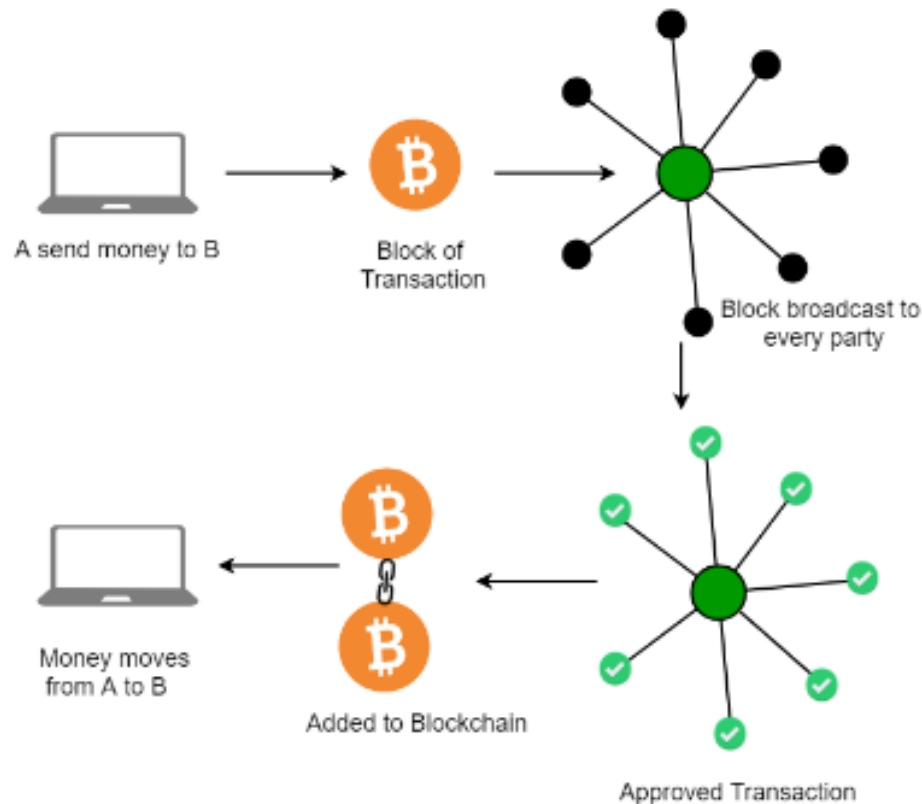
# What is blockchain

- A blockchain is a type of distributed ledger technology (DLT) that consists of growing list of records, called blocks, that are securely linked together using cryptography.



# What is blockchain

- Blockchains are typically managed by a peer-to-peer (P2P) computer network





# What is blockchain

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- Property of Blockchains:
  - **Data Immutability and Integrity** : without the consent from the majority of nodes, no one can add/delete/edit any transaction blocks to the ledger.
  - **Decentralized**: not like Client-Server model, managed by P2P network
  - **Transparent**: Because every node or participant in Blockchain can access to all transaction data.
  - **Consensus-based**: Every blockchain thrives because of the consensus algorithms.
  - **Flexible**: Smart Contract



# Why to use blockchain in Agricultural sector?

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## ■ Food safety issues

- Data Immutability and Integrity
- Transparent
- Food supply chain may be traceable

## ■ Smart farming

- track the provenance of food
- trustworthy food supply chains
- build trust between producers and consumers
- facilitates the use of data-driven technologies to make farming smarter

## ■ More application

- Trustworthy platform

# Why to use blockchain in Agricultural sector?

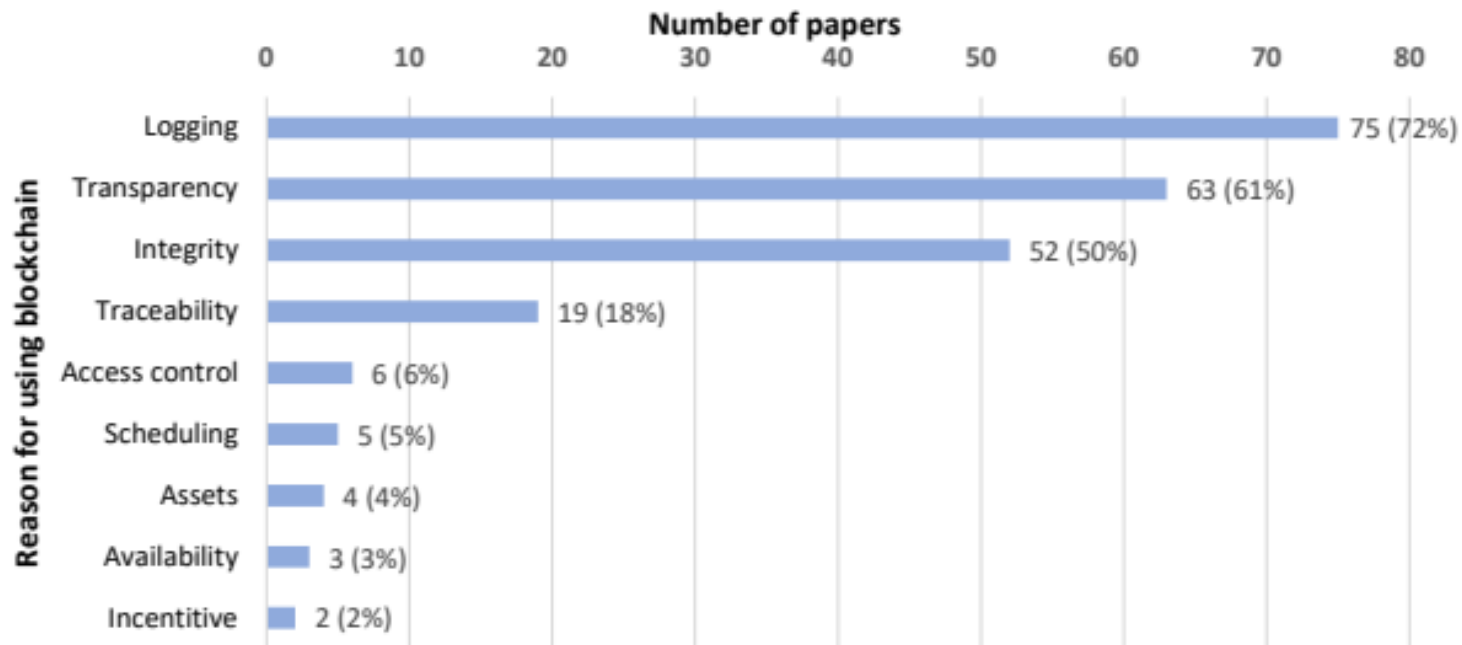


Figure 13. Reasons for using blockchain exploited in the papers included in our scoping review.

Source: Andreas Sendros et al: Blockchain Applications in Agriculture: A Scoping Review





# Outline

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- Introduction
- **Technology Analysis**
  - How blockchain works
  - Types of blockchain
  - IOT and IPFS
- Industry Analysis
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# How blockchain works

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- **Cryptography**
- **Consensus:** a mechanism for adding new blocks into the blockchain
- **Smart contracts**
- **P2P network**



# Cryptography

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- A method of securing data from unauthorized access.
- Symmetric-Key cryptography
- Asymmetric-Key Cryptography
- **Hash Functions**
- example of an SHA-256 hash function
  - **Input:** hello my friend
  - **Output:** 5d575bc10fbfbf62435849d4f8d0382a5acc939e9f92492d87e70852655d8be9
  - **Input with a slight difference:** hello my friend!
  - **Output:** 7f254266b011eec22f0af99bf627143bab758ae5eb840fffb87e5d24850f1320



# Consensus

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- A method of authenticating and validating a value or transaction on a Blockchain or a distributed ledger without the need to trust or rely on a central authority.
- Consensus mechanisms are central to the functioning of any blockchain or distributed ledger.
- PoW, PoS, DPoS
- PBFT, PoET



# Consensus

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- **POW**
- **Miners bundle up a group of transactions into a block and try to mine it (try to solve hard puzzle)**
  - **Hard puzzle defines:**
    - *Given data  $A$ , find a number  $x$  such as that the hash of  $x$  appended to  $A$  results is a number less than  $B$ .*
- **The first problem-solving miner add this block into the blockchain and broadcast this new block to every nodes**

# Consensus

## ■ Mining ASIC

### Bitmain Antminer KA3 (166Th)



Manufacturer	Bitmain
Model	Antminer KA3 (166Th)
Release	September 2022
Hashrate	166Th/s
Size	195 x 290 x 430mm
Weight	16100g
Noise level	80db
Fan(s)	4
Power	3154W
Voltage	200-240V
Interface	Ethernet
Temperature	5 - 40 °C
Humidity	10 - 90 %

# Consensus

## ■ Mining GPU

Nvidia  
Geforce RTX 3080 Ti



15.24Gh/s hashrate	Hash rate
12 GB GDDR6X	VRAM
8nm	Process size



# Consensus

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## ■ POS

- **The system randomly pick up a validators who confirm transactions and validate block information.**

- **Probability(Coin age) of being selected**

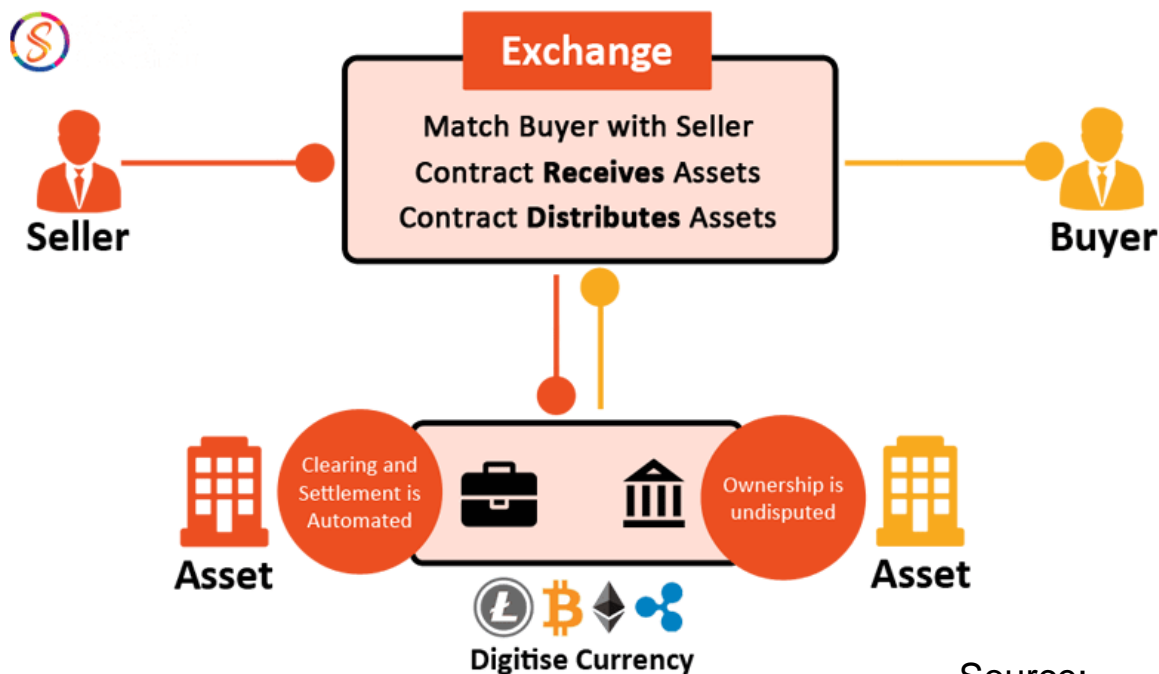
- *Coin age = days of coin stack \* number of stack coins*

*In Ethereum*, Blocks are validated by more than one validator, and when a specific number of the validators verify that the block is accurate, it is finalized and closed.



# Smart contracts

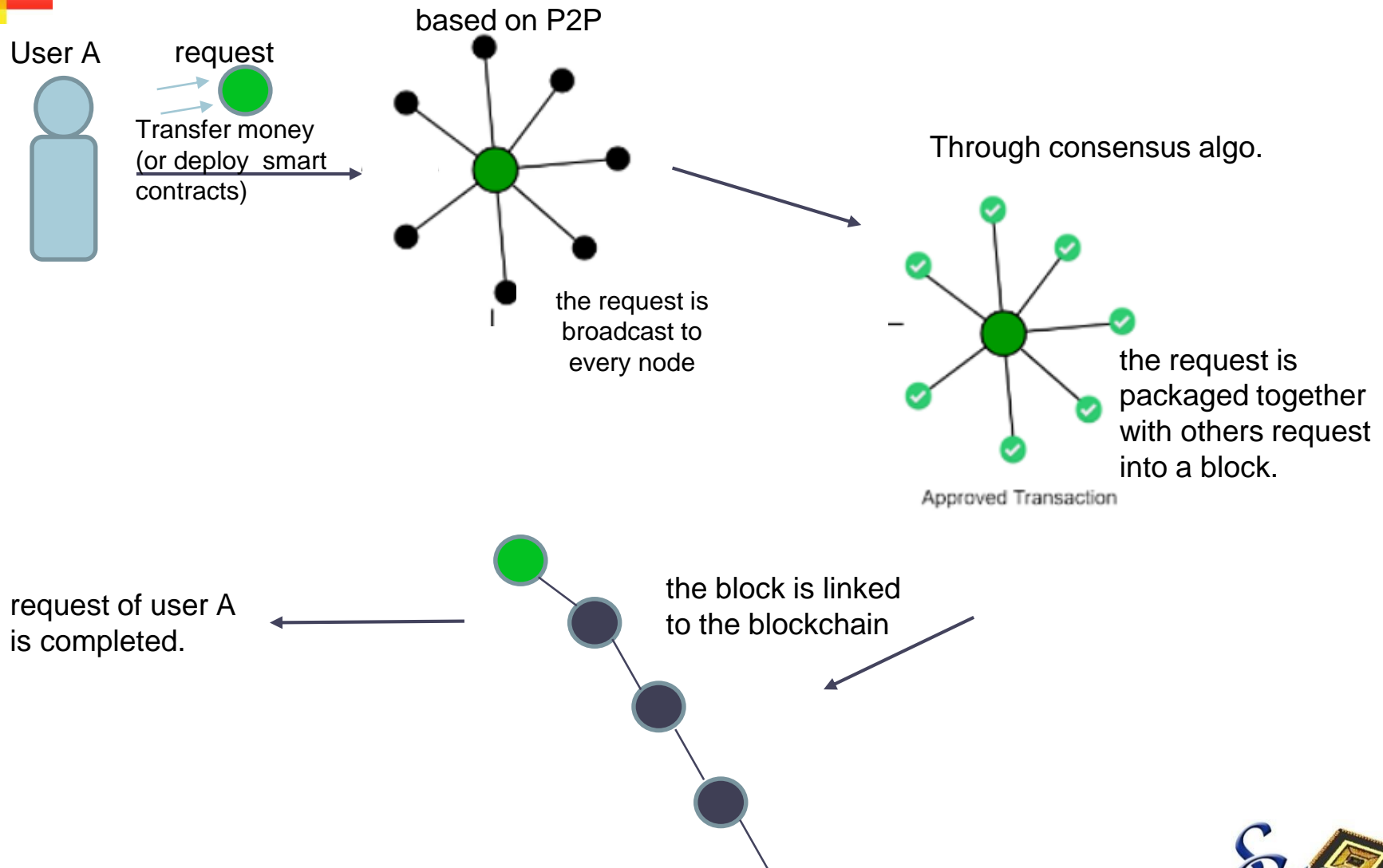
- Smart contracts are simply programs stored on a blockchain that run automatically when predetermined conditions are met.



DApp (decentralized application) is an combination of a series of smart contracts.

Source:  
<https://www.scalablockchain.com/smartcontract.html>

# How blockchain works





# Types of blockchain

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- Public blockchain
- Private blockchain
- Consortium blockchain



# Public blockchain

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- It is a **permissionless** distributed ledger on which anybody can join and conduct transactions.
- Public Blockchain nodes do not need to know or trust each other, so **consensus mechanism is often complexity**, such as PoW, PoS, and so on.
- **Open and transparent**: data on a public blockchain is transparent to all member nodes.



ethereum



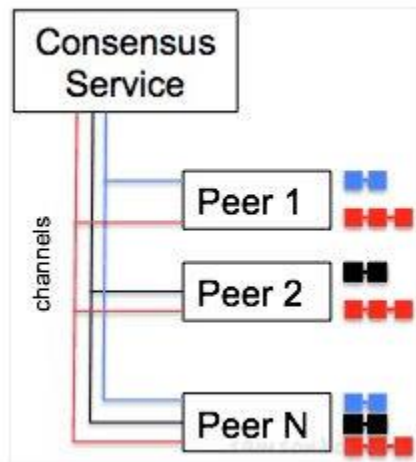
# Private blockchain

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- A blockchain network operates in a private context, **such as a restricted network**, or is controlled by a single identity.
- it has a similar **peer-to-peer connection** and **decentralization** to a public blockchain network.
- They are often run on a small network within a firm or organization rather than open to anybody who wants to contribute processing power.

# Consortium blockchain

- A consortium blockchain is a combination of multiple private blockchains **belonging to different organizations**.
- each organization manages their own node or blockchain, the data within can be accessed, shared and distributed by organizations within the consortium.
- **Hyperledger Fabric** was designed for enterprise use.



Source:  
<https://www.samsonhoi.com/661/blockchain-hyperledger-fabric>



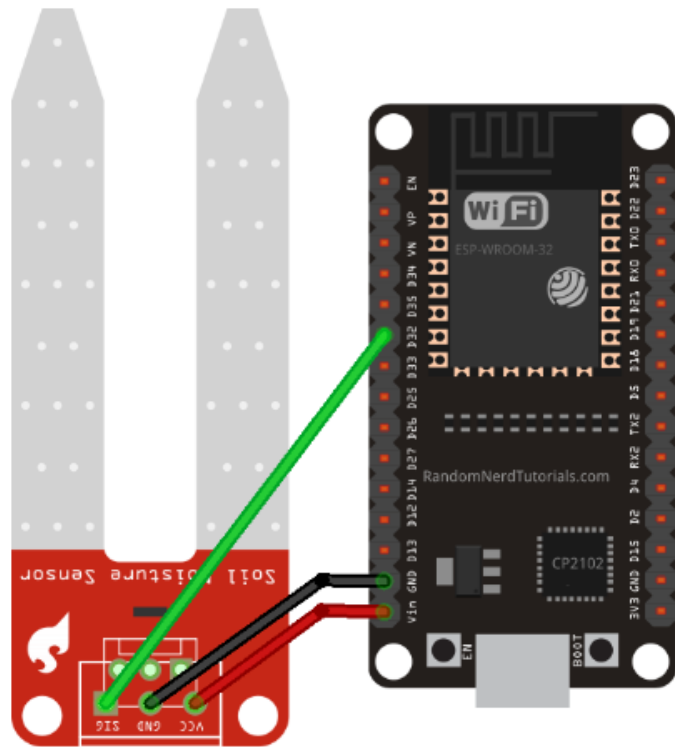
# IOT and IPFS

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- IOT in agriculture
- IPFS
- IOT data with blockchain and IPFS

# IOT in agriculture

## ■ Soil Moisture Data Retrieval using using Tuya Link SDK



fritzing

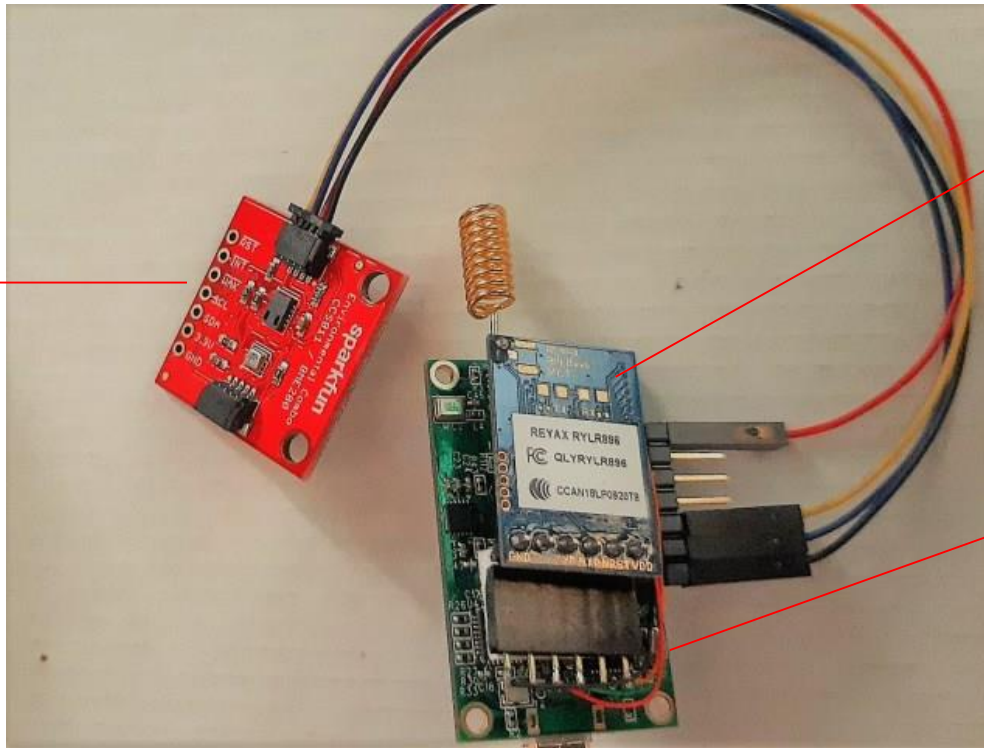


# IOT in agriculture

## ■ Himax WE-I Plus EVB Endpoint AI Development Board with SparkFun's Qwiic sensors on farms

### Sensors:

TVOC  
eCO2  
Temperature  
Humidity  
pressure



### LoRa:

is a physical  
proprietary radio  
communication te-  
chnique

Himax WE-I Plus:  
The ML model used  
in this application is  
for basic crop  
detection.

# IOT in agriculture

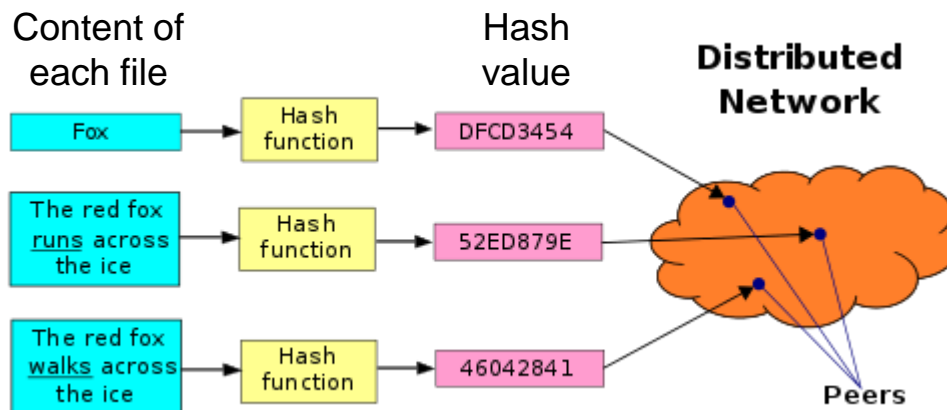
## ■ Himax WE-I Plus EVB Endpoint AI Development Board



- WE-I Plus ASIC (HX6537-A)
  - ARC 32-bit EM9D DSP with FPU
  - 400MHz clock frequency
  - 2MB SRAM
  - 2MB Flash
- Himax HM0360 AoS TM ultra-low power VGA CCM
  - 1/6" CMOS Sensor
  - 640 x 480 Pixel
  - 60 FPS
- FTDI USB to SPI/I2C/UART bridge
- LDO power supply (3.3/2.8/1.8/1.2V)
- 3-axis accelerometer (STM LSM9DS1)
- 1x reset button
- 2x microphones (L/R)
- 2x user LEDs
- MicroUSB connector
- Expansion header
  - 1x I2C port
  - 3x GPIOs
  - Power/Ground

# IPFS

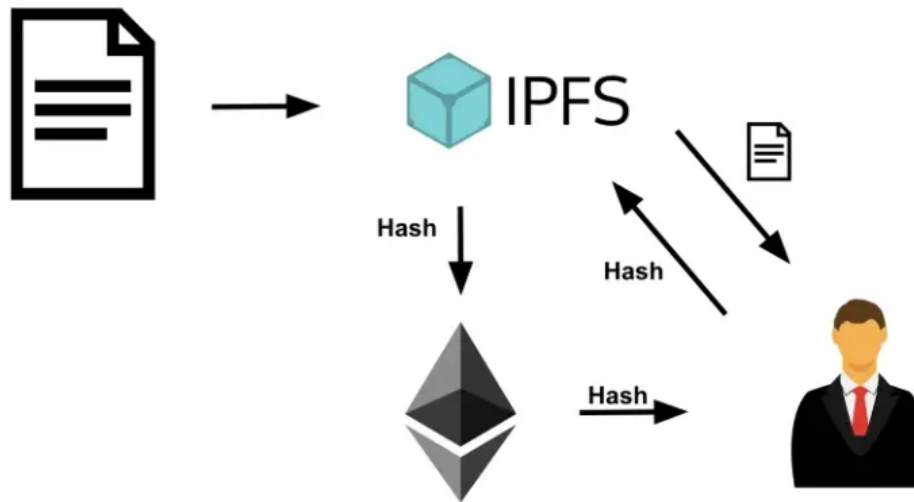
- The **InterPlanetary File System (IPFS)** is a protocol, hypermedia and file sharing peer-to-peer network for storing and sharing data in a distributed file system.
- IPFS uses content-addressing to uniquely identify each file in a global namespace connecting IPFS hosts.



Source: [https://en.wikipedia.org/wiki/Distributed\\_hash\\_table](https://en.wikipedia.org/wiki/Distributed_hash_table)

# IOT data with blockchain and IPFS

- IOT data is too large that is hard to put them all into blockchain.
- Thus, IOT data usually store into IPFS File System.
- Get the hash value of IOT data file, then store it into blockchain.  
And, other user can get the hash value from the blockchain and get the IOT data.



Source: <https://medium.com/pinata/ethereum-and-ipfs-e816e12a3c59>



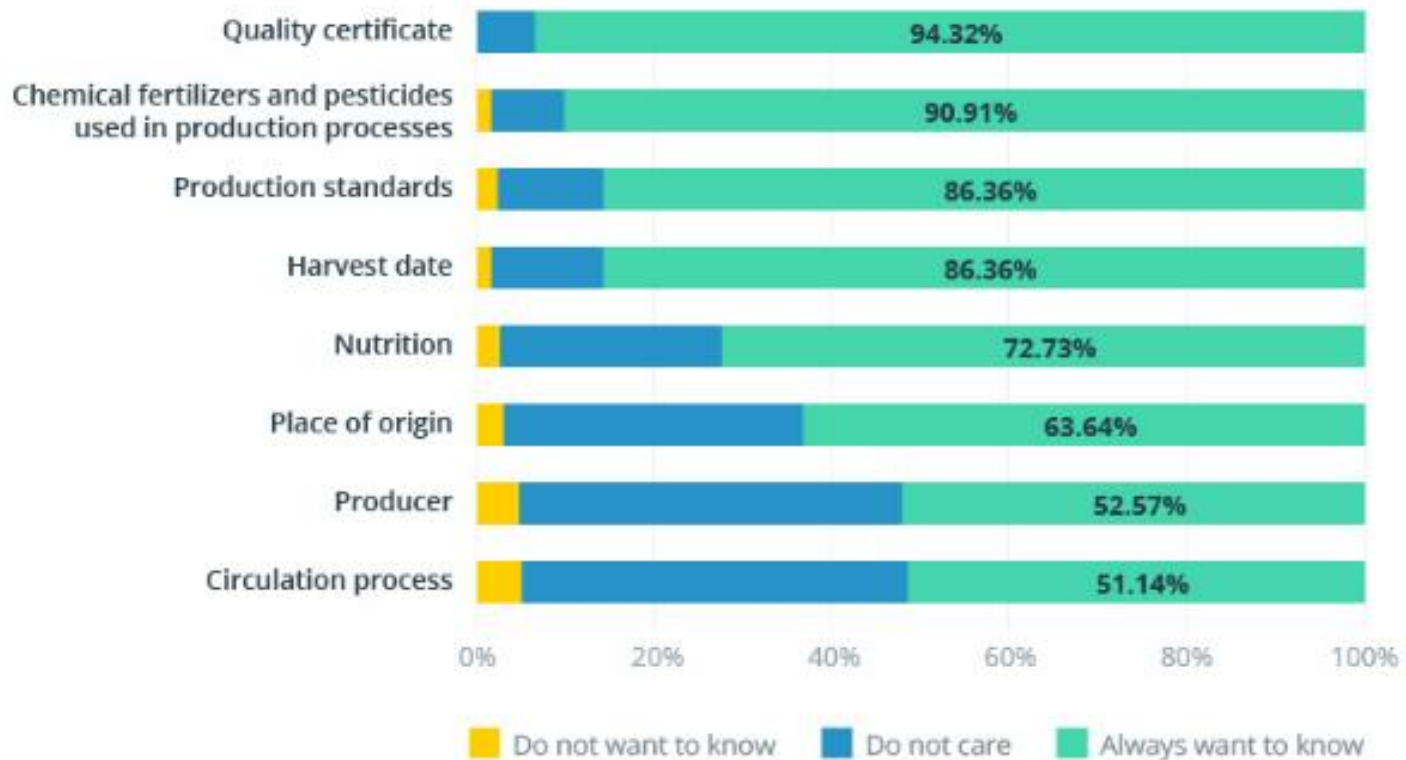
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# Industry Analysis

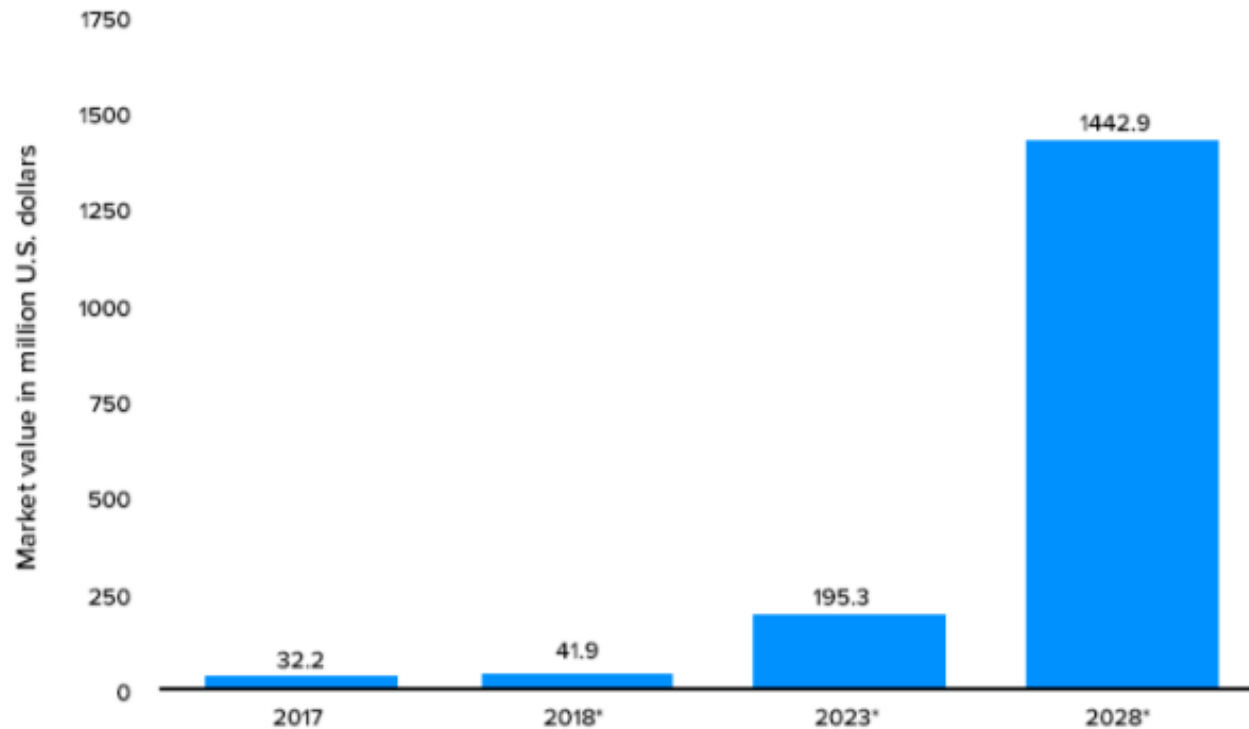
## Demand for information about food



Source: Consumer Preferences for Traceable Food

# Industry Analysis

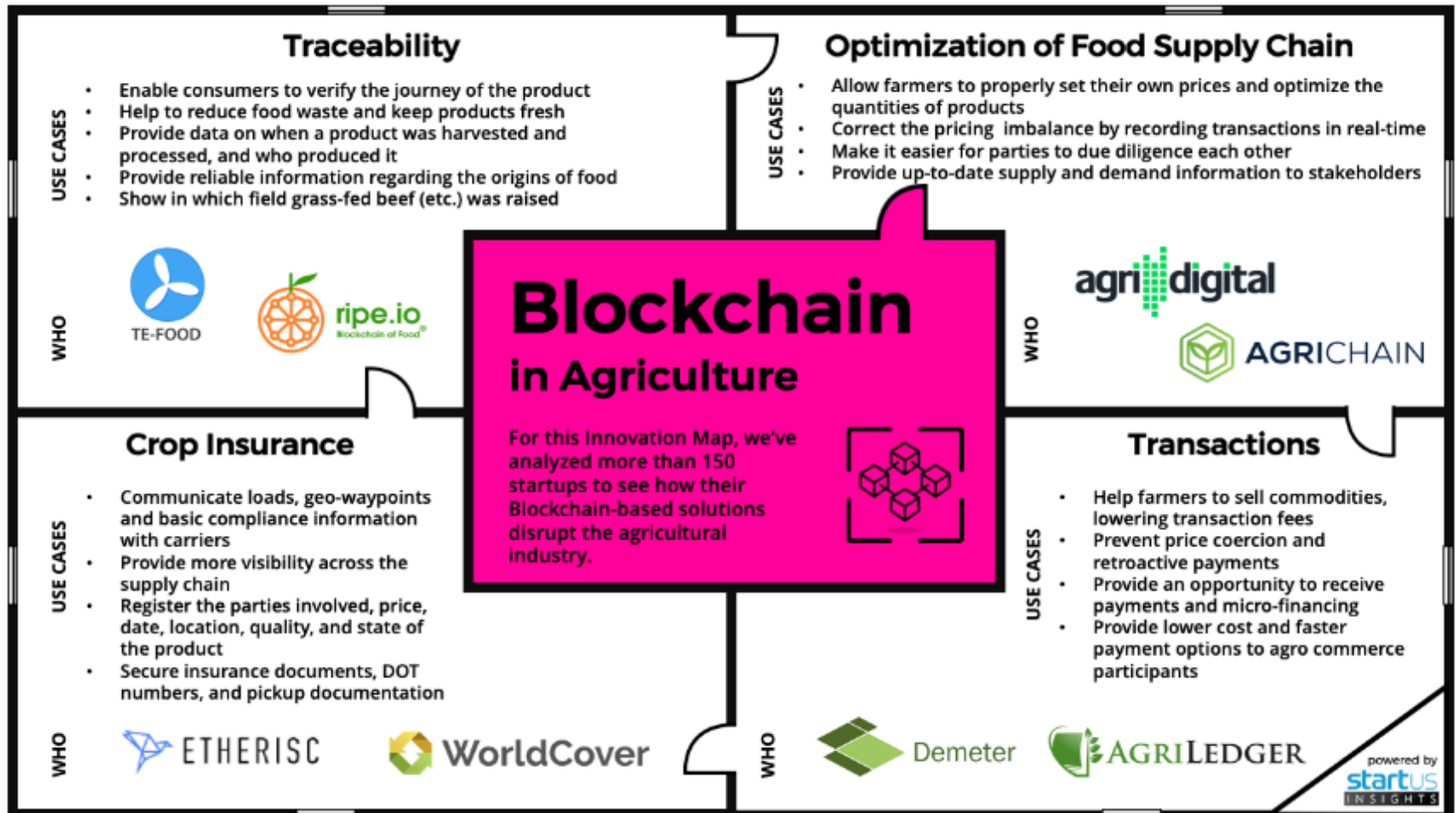
**Forecasted Blockchain Value in Agriculture and Food Market Worldwide  
(2017 to 2028)**



Source: Worldwide; BIS Research; 2021



# Industry Analysis



Source: StartUs insights



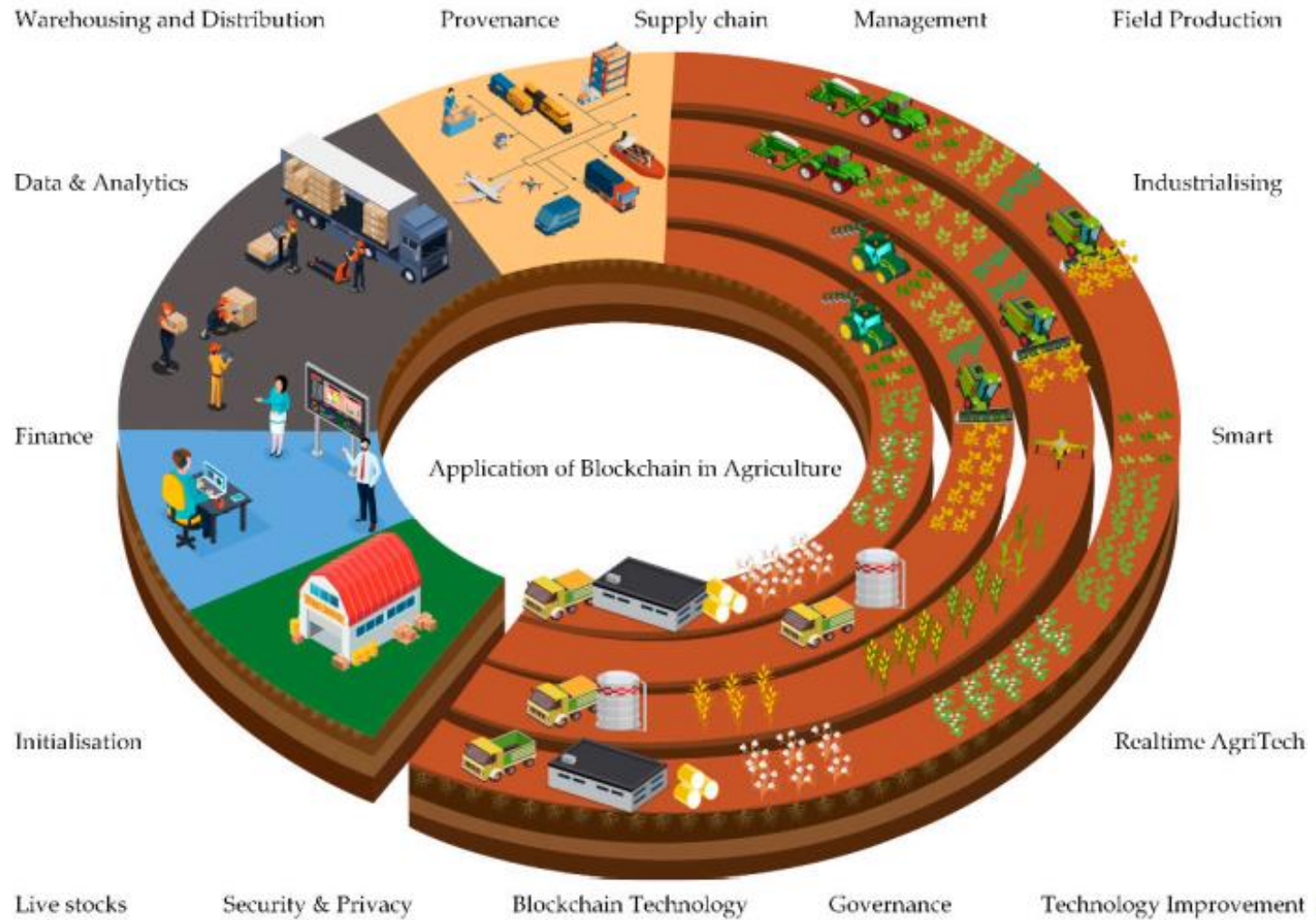


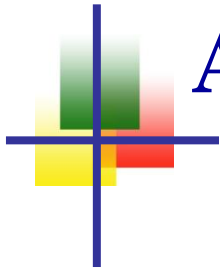
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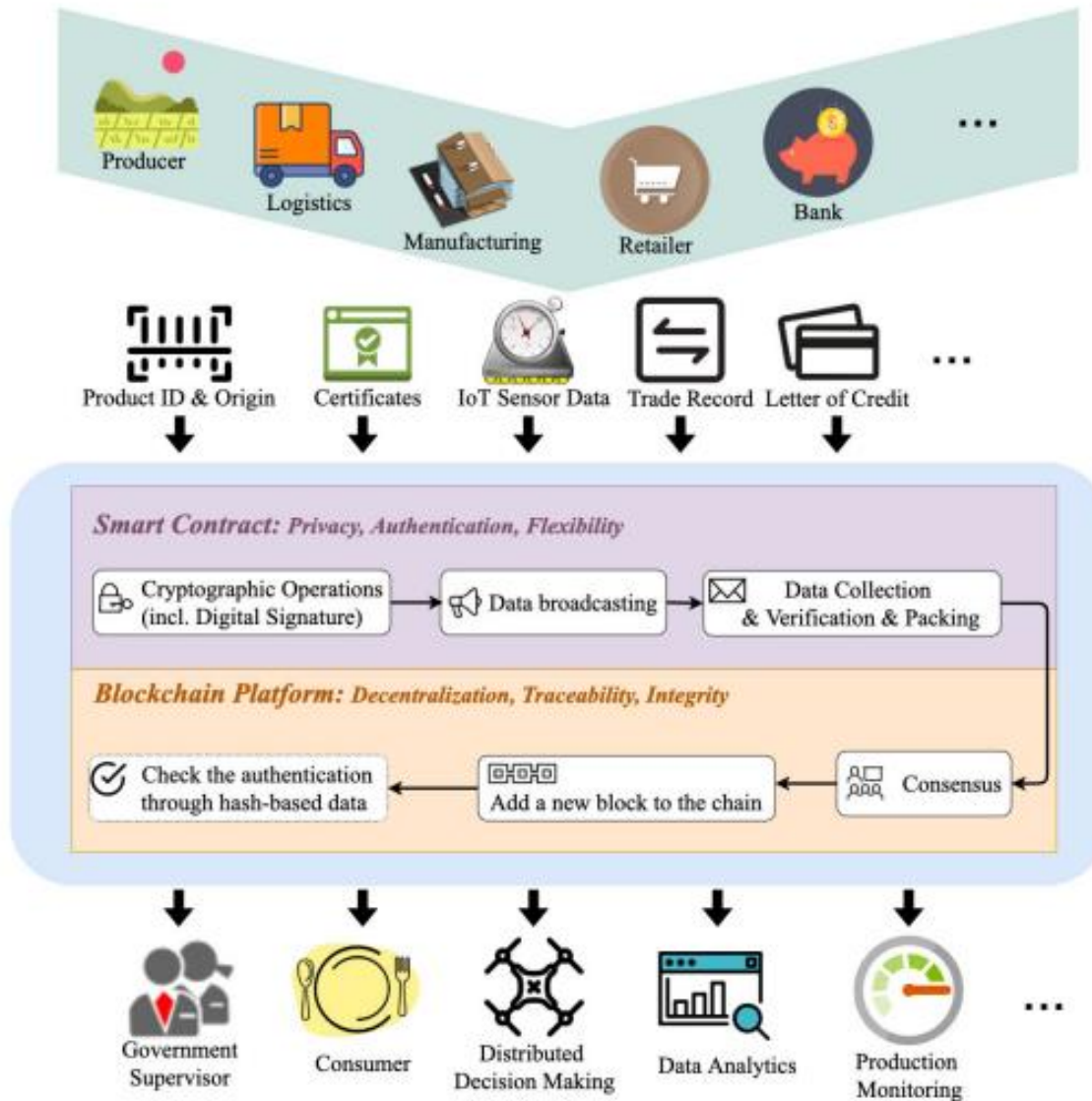
# Applications





# Applications

Source: W. Lin et al.: Blockchain Technology in Current Agricultural Systems





# Applications

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- **Product quality control**
- **Improving supply chains**
- **AgTech IoT-optimization**
- **Fair pricing**
- **Crowdfunding of agricultural production**
- **Small Farm Insurance**
- **Corporate Responsibility**



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# S.W.O.T

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## Strengths:

Transparency, immutable and integrity  
Can be more trustable and traceable  
help solve various security issues

## Weakness:

Still develop  
It is not always clear why blockchain  
is used and the security issues  
it solves.

## Opportunity:

still develop  
Everything is possible.

## Threat:

The scandal of some blockchain  
relative organizations/companies  
Traditional agriculture



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# Conclusion

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**It is a clear trend that integrating new technologies in the traditional agricultural sector.**

**However, the field is still in its infancy and most of the solutions are conceptual.**

**Traceability, optimization of food supply chain, crop insurance and transactions may be the four directions of future development.**





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# Reference

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- **Blockchain Technology in Current Agricultural Systems: From Techniques to Applications**  
(<https://ieeexplore.ieee.org/document/9159588>)
- **Survey on the Applications of Blockchain in Agriculture**  
([https://www.researchgate.net/publication/363068991\\_Survey\\_on\\_the\\_Applications\\_of\\_Blockchain\\_in\\_Agriculture](https://www.researchgate.net/publication/363068991_Survey_on_the_Applications_of_Blockchain_in_Agriculture))
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