International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 11 Nov. 2022, pp: 31-38 www.ijaem.net ISSN: 2395-5252

Block chain Technology Application in Current Agricultural Sectors in India

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Submitted: 25-09-2022 Accepted: 04-11-2022

ABSTRACT:
At present situation block chain capability is use significant attentions in various agricultural applications. The basic theme these applications are satisfy the needs of the ecosystem of agricultural products, as per example increasing transparency of food safety and IoT based food quality control, provenance traceability, improvement of contract exchanges, and transactions efficiency. As multiple untrusted parties, including small-scale farmers, food processors, logistic companies, distributors and retailers, are involved into the complex farm-to-fork pipeline, it becomes vital to achieve optimal trade-off between efficiency and integrity of the agricultural management systems as required in contexts demonstrate the use of the block chain techniques. In addition, the popular platforms and smart contract are provided to show how practitioners use them to develop these agricultural applications. Thirdly, we identify the key challenges in many prospective agricultural systems, and discuss the efforts and potential solutions to tackle these problems. Further, we conduct an improved food supply chain in the post COVID-19 pandemic economy as an illustration to demonstrate an effective use of block chain technology. This paper present blocks chain technology will used in agriculture sectors.

Keyword: IoT,MarkleTree,MySQL,Bitcon, Ethereum,Quorum

I. INTRODUCTION

Increasingly, block chain technology is attracting significant attentions in various agricultural applications. These applications could satisfy the diverse needs in the ecosystem of agricultural products, e.g., increasing transparency of food safety and IoT based food quality control, provenance traceability, improvement of contract exchanges, and transactions efficiency. Feature of block chain support as trust of distributed ledger technology. For traceability purpose it is base on Markle Tree base are text processing. Digital signature and public key cryptographic are use for digital identity. The data are secure by using public cryptography. For the purpose of decision making we follow consensus processing mechanism. The component of block chain is ledger, smart contract, consensus network, memberships, Even, system management, wallet and system integration. Block chain consensus mechanism we prove the miners solve mathematical problem, prove of stake, proof of capacity, proof of identity, proof of authority, proof of activity. Actual data management efficient we follow following models of techniques for efficient management of data.As a formal definition, block chain is a distributed ledger to share transactions or sensitive data across untrusted multiplestockholders in a decentralized network [1]. A basic block chain structure is illustrated in Fig.1. The data are recorded in a sequential chain of hash-linked blocks that facilitate the data distribution in a more manageable manner comparing to other traditional data storage formats. The blocks are verified and uploaded into the chain-like system by selected nodes via an agreed consensus protocol. This consensus mechanism allows all the parties to

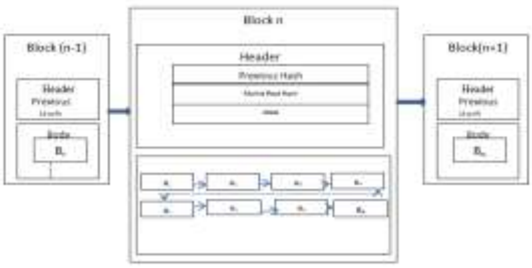

Figure.1 Data structure of block chain

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engage in the monitoring process when adding data/information flow on chain. In addition, the duplicates of these data are stored in all involving nodes to ensure their temper- lessness. In this section, a high level reviewof block chain ecosystem and technical details of the implementation are provided before the investigation of current block chain applications in the agricultural sector. Work flow of Block chain shown in Fig.2

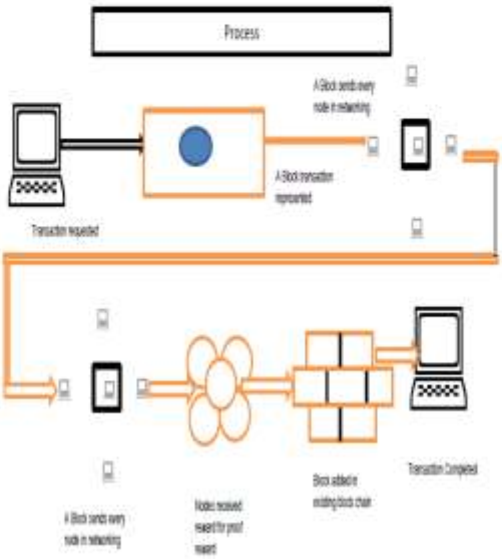

Figure.2 Work flow of block chain

II. LITERATURE REVIEW

Hung.et.al is focus in his research work on Integration with legacy system used in fish firming. Her writing filter functions in smart contract to integrate with legacy database [2]. Leng.et.al on Redundancy in storage and privacy agricultural transaction research work elaborate privacy of information [3]. Salah.et.al is focused on storage video data on soybean transaction [4]. Hao.et.al is focusing high amount of storage data on real time application [5]. On our survey technology are applied on storage database management in agriculture sectors. Here identified that block chain technology on ecosystem of agriculture product increasing transparency of food safety and IoT base food quality control provenance traceability, improvement of contact exchange.

III. DATA STORAGE ECO SYSTEM

In agriculture systems data storage and retrieval solution is playing a centric role. The ecosystem of data storage is illustrated in Fig. 3. Conventional databases, such as MySQL, Oracle SQL software used data in a centralized way. So data are synchronized well and shared among trusted parties. However, it is hard to hold the assumption in most real world systems. Information asymmetric problem emphasized. Efficient allocation resource in agriculture supply chain management is major factor. As a variety of untrusted parties with different geographic locations are involved to generate data in a supply chain, it requires a more tamper-free system to protect the sharing of data across parties. The robust and decentralized features of block chain offer one of the most suitable solutions by improving data transparency as well as data integrity without paying a third party to verify the process. Apart from the centralized solutions, block chain systems dominate the distributed database solutions. Three types of block chain systems are defined based on the accessibility and security level of applications: (1) public block chain; (2) consortium block chain; and (3) private block chain. Public block chain system can be joined by any nodes across the world with internet connection. The public block chain is fully transparent so that data are difficult to be tampered by any internal or external attackers. However, the high decentralization trait of these systems generates large redundancy as well as less efficiency when considering the burden of sharing large amount of data. Therefore, the public block chain is more suitable to applications with relatively small number of transactions (or data) to store into the block chain system. Typical public block chains include Bitcoin and Ethereum. The private block chain is deployed by a single party. It shares many similar characteristics to those centralized solutions but with block chain architecture. Although it is argued that private block chain systems can be replaced by conventional solutions. Itoffers advantages over the centralized data storage when they are attacked by insiders. The consortium block chain refers to a solution to keep data privacy and fast on-chain speed but involving more than one party for data storage. It is the most popular type in agricultural supply chain applications since having a balance performance; it fits most user requirements in this sector. Many block chain platforms, such as Hyper ledger Fabric, Multi Chain, Quorum and Corda, can be used to deploy either consortium or private block chain systems. An artificial intelligent system applied in block chain technology as advance computation information sharing which called smart contract shown in Fig.3.

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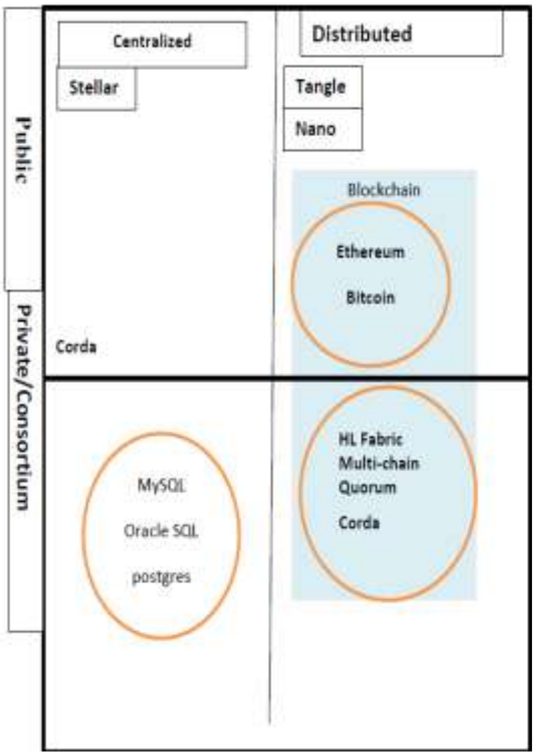

Fig.3 Block chain play important role in ecosystem where data store

IV. SMART CONTACT

Smart contract refers to a computerized program which is consisted of states, values, addresses and logical functions that are required at the business model layer in a system automatically execute contracts to improve efficiency of business models involved. As illustrated in Fig. 5, smart contract plays a key role in a block chain system implementation. In specific, once it takes the transaction requests as input to trigger the business logic, it uses defined policy to get the endorsement from peers in the block chain network. After receiving all the endorsements, it calls the ordering services to verify the endorsement and add the verified transactions into blocks of the block chain. The records stored in the block chain are immutable so that no one could tamper the on-chain data. In addition, Data Apps can query the states of accounts or transactions via the smart contract. To support the fast block chain application development, most block chain

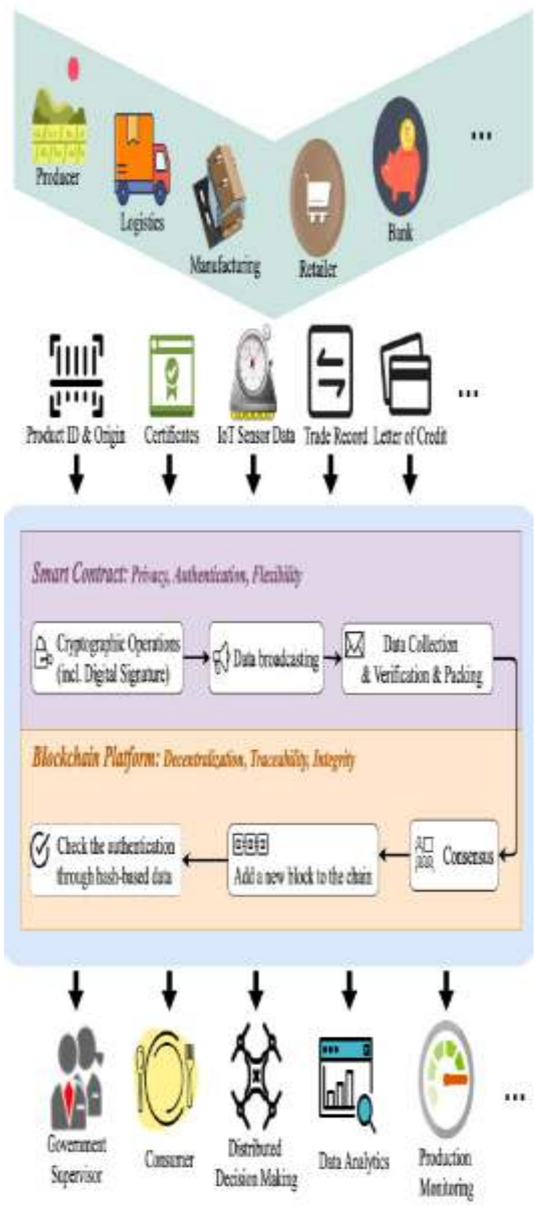

Fig. 4 AI and machine learning base system agriculture can include block chain technology.

Platforms support the programming of smart contracts to fulfill the different business logics behind these applications. Ethereum platform and its extension platform Quorum provides Turing complete smart contracts: theycompile both Solidity and Serpent code into Ethereum virtual machine (EVM) byte codes and the EVM takes responsibility to track state changes to ensure Turing completion. As the most active platforms in Hyperledger family, Hyperledger Fabric and Sawtooth uses Golong, Java, Python

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and Javascript as themain programming languages for smart contract development.

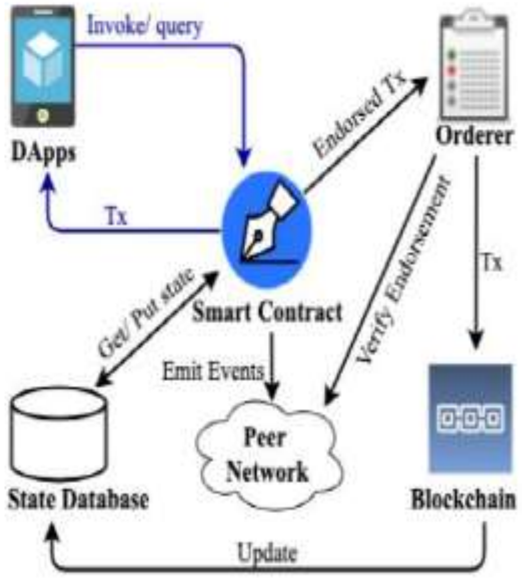

Fig.5 Smart Contract play role of transaction endorsement and verification

V. PURPOSE PLATFORM OF BLOCK CHAIN USE IN AGRICULTURE

Increasingly, block chain technology is attracting significant attentions in various agricultural applications. These applications could satisfy the diverse needs in the ecosystem of agricultural products, e.g., increasing transparency of food safety and IoT based food quality control, provenance traceability, improvement of contract exchanges, and transactions efficiency. Feature of block chain support as trust of distributed ledger technology. For traceability purpose it is base on Markle Tree base are text processing. Digital signature and public key cryptographic are use for digital identity. The data are secure by using public cryptography. For the purpose of decision making we follow consensus processing mechanism. The component of block chain is ledger, smart contract, consensus network, memberships, Even, system management, wallet and system integration. Block chain consensus mechanism we prove the miners solve mathematical problem, prove of stake, proof of capacity, proof of identity, proof of authority, proof of activity. Actual data management efficient we follow following models of techniques for efficient management of data

Hash Function

Hash function is a key technique in block chain, which is used for multiple purposes, including address generation, digital signature and consensus. Through hash function, arbitrary size data can be easily mapped to fixed-size values. While inversely, it is difficult to restore the original data from its hash value. For example, with a given large data x, its corresponding hash value can be obtained by irreversible hash function, Hash(x). If x is modified to x0 in an unintended manner, the hash result Hash(x0) is completely different from Hash(x). Two most common hash functions used in block chain include message digest 5 (MD5) and SHA256 based on the complexity of data. During network transmission, data integrity can be verified by crypto graphical hash technique. For example, assume Farmer sends data x to FCI. Along with data x, the encrypted hash value Encrypt (Hash(x)), is also enclosed. After Bob receives the data, he can verify data integrity by calculating the hash value from received data x0, Hash(x0), and comparing it with the expected hash results decrypted from the received Encrypt (Hash(x)). If Hash(x0) = Hash(x), it means data is transmitted properly, x0 = x. Otherwise, if Hash(x0) 6= Hash(x), it means data integrity has been broken, so FCI may ask Farmer to transmit the data again.

i) Asymmetric Cryptography

To implement verifiable transaction in distributed system, asymmetric cryptography technique is used along with hash function to enforce digital signature technique. In asymmetric cryptography, each user has a pair of keys, i.e. private key k and public key K. The private key is kept confidentially and known only by the owner, while the public key could be known by the others. The public key can be calculated from the private key, but with given public key, private key cannot be obtained in reverse. The public key K and the private key k can encrypt and decrypt data in pairs. For example, as shown in Eqn. 1, data x encrypted by public key K can be decrypted by corresponding private key k. On the other hand, data x encrypted by private key k can also be decrypted by corresponding public key K.

$$\mathrm{Decryptk}(\mathrm{EncryptK}(x)) = \mathrm{DecryptK}(\mathrm{Encryptk}(x)) = x(1)\ldots\ldots\ldots\ldots\mathrm{Eq}\ldots1$$

Targeting different security requirements, asymmetric cryptography can be flexibly applied. Again, assume Farmer is sending data x to FCI, and both of them have a pair of asymmetric key. Note, Farmer and FCI know each other's public key whereas their private keys are only known by themselves, individually. To ensure confidentiality, Farmer can encrypt data x through FCI public key, EncryptKB(x).Hence, only Bob can decrypt the data by using his private key. On the other hand, to ensure authentication and nonrepudiation, Farmer should send data x encrypted by her own private key, EncryptkA(x). In this case, after receiving the transmitted data, Bob can attempt to decrypt it by Alice'spublic key. If successful, these data are indeed sent by Alice and she cannot deny it.

ii) Digital Signature

For each block chain transaction, digital signature is required to avoid issued transaction being modified or denied. Technically, digital signature is an integrated technique utilizing both hash function and asymmetric cryptography. Like the signature for paper documents, a valid digital signature ensures that an unaltered data is sent by a known sender, which cannot be repudiated. For this purpose, the file is firstly hashed to a fixed length and then encrypted by sender's private key, and the result refers to the digital signature of this sender. Since only nominated sender has his own private key, the asymmetric cryptography technique ensures authentication and non-repudiation of this signature. Meanwhile, because anyone can obtain the sender's public key, the integrity of signature can be verified by anyone through calculating the hash value from the data and comparing it with the hash value decrypted from the signature. Moreover, if confidentiality is also required, the data can also be encrypted by the public key of nominated receiver.

iii) Merkle Tree

Once the number of transactions becomes larger, doing verification by downloading all the antiquated transactions in block chain consumes a large amount of storage resource. To address this issue, Merkle Tree technique is used to reduce the storage data without breaking the block's hash. Merkle Tree is a binary tree consisting of leaf hash nodes, intermediate hash nodes and a root hash node. In each block, leaf hash nodes are the hash values of individual transactions. For example, assume there is a block with transaction data TA, TB, TC and TD. Here comes a Markle Tree with 4 leaves, i.e. Hash (TA), Hash(TB), Hash(TC) and Hash(TD). As the parents of these leaves, two intermediate hash nodes, HashAB and HashCD, are calculated as follows.

$$\mathrm{HashAB} = \mathrm{Hash}(\mathrm{Hash}(\mathrm{TA}) + \mathrm{Hash}(\mathrm{TB})) \ldots\ldots\ldots\text{Eq..2}$$

$$\mathrm{HashCD} = \mathrm{Hash}(\mathrm{Hash}(\mathrm{TC}) + \mathrm{Hash}(\mathrm{TD})) \ldots\ldots\ldots\text{Eq.3}$$

Finally, the value of root hash, which is included in the block header, is calculated by hashing the value of intermediate nodes, as shown in Equ. 4.

$$\mathrm{HashABCD} = \mathrm{Hash}(\mathrm{HashAB} + \mathrm{HashCD}) \ldots\ldots\ldots\ldots\text{Eq.4}$$

To this end, by stubbing off branches of the tree, old blocks can then be compacted to reduce the size of the block chain.

iv) Distributed Consensus schemes

Byzantine general problems [1] has been raised as a trust issue in distributed systems. It refers to the data tamper caused by some dishonest nodes under the block chain context. The consensus mechanism is proposed to solve the problem and protect the data from minority attacks by allocating the responsibility of updating data blocks to random candidates selected from all the nodes. The popular consensus mechanisms include Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPOS), Practical Byzantine Fault Tolerance (PBFT), and Proof of Elapse Time (PoET). PoW is the first proposed scheme in the bitcoin to achieve consensus in peer to peer management. The nodes across the network compete with each other to solve a cryptographic puzzle to add the next block into the block chain with a small amount of incentives. This is called "mining" in block chain based crypto currency. Although the scheme is remarkable to protect the block chain system from malicious attacks, it is a time-consuming and energy consumption process. Therefore, the on-chain speed (transactions per second) is low in the systems by using this scheme. PoSis a mechanism to use validators instead of miners to update the blocks. The nodes must prove their stakes by depositing certain amount of coins in the system. The key advantage of the PoS over PoW is the significant reduction of the computational power. However, the main issue is that the nodes who have large proportion of stakes are more likely to become the validators of the blocks. Delegate Proof of Stake (DPoS) is an improved version of PoS by restricting the number of validators to further improve the scalability of the block chain. Block producers are voted by all the users who have number of votes calculated based on their stakes on Practical Byzantine Fault Tolerance (PBFT) algorithm was initially proposed to target on the Byzantine general problem. It highlights that the PBFT requires 3f+1 node to make a correct decision if f nodes are faulty/dishonest nodes in the network. The algorithm has been adopted into a block chain system as one alternative consensus scheme. In the scheme, a block proposer is first selected based on a robinround manner. The proposer will broadcast and collect 3f+1 node in the network. If two third of the validators agree on a block proposal, the block is valid to commit into the block chain. Proof of Elapsed Time (PoET) is a more efficient mechanism compared to other consensus schemes [2]. It was developed by Intel on top of the SGX technology. After signing attestation, each node participates in a randomized lottery selection by receiving an object timer from the trusted code. The node who wakes first will lead the next block creation. However, the SGX is made by Intel which is a third-party company. This has a potential to compromise the principle of block chain to remove the intermediaries. Overall, consensus scheme design is still an open challenge in block chain research. The selection of the scheme relies on the application context to balance the block on-chain speed as well as the robustness to against various types of attacks.

v) Ethereum

It is the most active block chain platform in the for block chain practitioners. It is permission less block chain that is friendly to public block chain based APP development. The access control can only be added via the smart contract that is limited. Many proof-of-concept agricultural traceability systems, such as, finance trading systems, such as and some information management systems, including,are deployed on top of the platform. However, there are some disadvantages of using the Ethereum platform for development: as shown in the platform uses PoW as its consensus scheme, thus the on-chain speed is relatively low, i.e.20 tps. Another constraint for DApp development on the platform is the cost when committing data and transactions on the block chain measure the computational use. When building a system with intensive on-chain data, it is not economic to use this platform.

vi) Hyperledger

This platform is endorsed by Linux foundation to provide several distributed ledger frameworks, e.g., Fabric, Sawtooth, Indy, and Burrow], for the enterprise level block chain development. In these frameworks, Hyperledger Fabric and HyperledgerSawtooth are the two most popular platforms for the development of the agricultural related projects. The examples include by using Fabric and by using Sawtooth. The default consensus scheme in the Fabric is PBFT while in the Sawtooth,PoET is set as the default consensus scheme. In addition, these are flexible to adopt any other schemes to further improve the on chain speed efficiently. Regarding the performance, both platforms have higher on-chain transaction throughput comparing to the Ethereum. it uses Fabric to achieve 20,000 tps with delegate design of the architecture. The difference between these two platforms is that Fabric supports permissioned block chain but Sawtooth support both the permissioned and permission less block chain development. Thus, the use of Hyperledger frameworks is increasing significantly in agricultural applications.

vii) Quorum

Quorum blocks chain is systems. It provides an Ethereum based platform to support applications of finance, supply chain, and retails with extra protection on the privacy of transactions and contracts. The transaction data are encrypted to preserve data privacy. In addition, it offers centralized enforcement on the access control so that it is more suitable for private/consortium block chain systems. Although the platform is built on top of Ethereum, it uses either Raft or Istanbul BFT, as its consensus scheme. Therefore, the average transaction speed can reach 500 to 700 tps in average. Examples of agricultural systems developed by using the platform include AgriDigital and insurance claim. Although there are many other platforms for block chain based system development, such as Multichain and BigChainDB , these four platforms have been widely chosen for the deployment of agricultural systems. Table.1 shown main feature of attribute of block chain implementation on agriculture.

	Ethereum	Hyperledger Fabric	HyperledgerSawtooth	Quorum
Transaction throughput	Low	High	High	Medium
Consensus	PoW	PBFT &Plugable	PBFT, PoET&Plugable	Raft or Istanbul BFT
Smart contract languages	Solidity	Java, Javascript, GOLANG, Python		Solidity
State databases	LevelDB	LevelDB or CouchDB	LMDB	LevelDB
Access control	limited control via Smart Contract	Access control lists (ACL)		Centralized enforcement

Table.1 Main features and attributes of the popular block chain platforms to deploy agricultural

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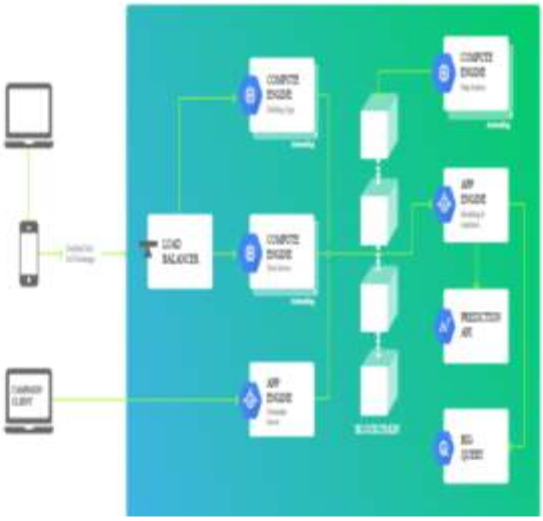

Fig. 6 Propose model process architecture Block chain application in agriculture

The block chain on agriculture data facilitate better planning and operation of up chain stakeholders, such as suppliers, manufacturers and logistic companies. As illustrated in Fig.6 up-chain parties could request these retailer data to feed into their AI modules to optimize their planning and operations. For examples, logistic companies could request data of retailer units and their demands of products to make routing optimization based on the geographic distribution of demand; manufacturers could use the data to adjust their raw material processing to meet urgent market demands; and farmers could make better planning for future productivity. The block chain retailer data improve work priority of government and regulation bodies. As illustrated in Fig. 7, once government and regulation bodies have the permission to access regional data on demand, policy makers could set priorities and coordinate with all involving parties more.

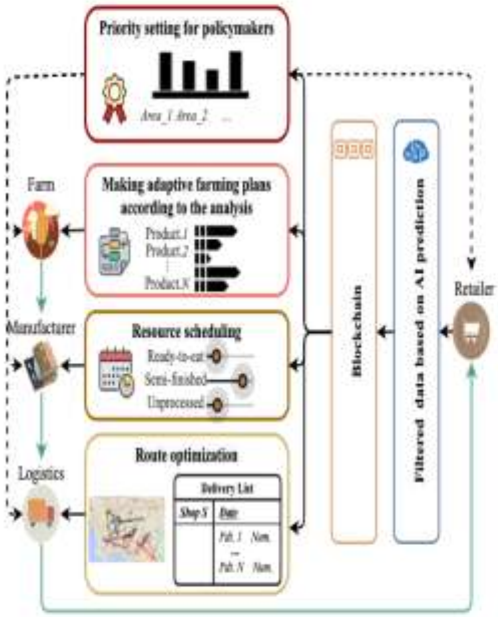

Fig.7 Purpose model i.e. data are important to improve efficiency of the food product supply chain.

VI. CONCLUSION

On above discussion we acquire little knowledge about block chain technology and its work flow, data storage techniques. This technology applied agriculture, produced, logistic, financial by Artificial Intelligence and Machine Learning system. Block chain applied in agriculture sector how it can efficient management and supplied chain on food. It is that issues, such as transaction costs, information governance, new business models, information asymmetry, and the use of block chain as a management tool in the agribusiness sectors, be explored. Another area for investigation is the implementation cost of that technology.

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