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Blockchain In Agricuiture

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Abstract: Food holds a major role in human beings' lives and in human societies in general across the planet. The food and agriculture sector is considered to be a major employer at a worldwide level. The large number and heterogeneity of the stakeholders involved from dierent sectors, such as farmers, distributers, retailers, consumers, etc., renders the agricultural supply chain management as one of the most complex and challenging tasks. It is the same vast complexity of the agriproducts supply chain that limits the development of globa l and ecient transparency and traceability solutions. The present paper provides an overview of the application of blockchain technologies for enabling traceability in the agri-food domain. Initially, the paper presents definitions, levels of adoption, tools and advantages of traceability, accompanied with a brief overview of the functionality and advantages of blockchain technology. It then conducts an extensive literature review on the integration of blockchain into traceability systems. It proceeds with discussing relevant existing commercial applications, highlighting the relevant challenges and future prospects of the application of blockchain technologies in the agri-food supply chain. Keywords: blockchain; distributed ledger; traceability; agriculture supply chain; agri-food industry

Introduction:

Food supply chains have a vast complexity which is often the cause of lack of transparency and traceability. On top of that, a major issue directly a ecting public health is food safety. During the past twenty years, various
food epidemic incidents have been reported, like the foot-and-mouth Disease in Europe in 2001, the Escherichia coli outbreak in spinach in 2006 in USA, the Sanlu milk scandal in China in 2008, the E. coli O104:H4 outbreak in Germany in 2011, the South African listeriosis outbreak in 2017–2018, etc. Governments and health organizations, in an attempt to prevent such dangerous outbreaks, have established relevant directives, laws as well as standards and regulations. For example, in Europe, the traceability of food products is compulsory according to the European Directive 178/2002 since 1 January 2005, together in compliance with the HACCP (Hazard Analysis and Critical Control Points) principles. Likewise, regulations all over the world have been established aiming to diminish food epidemic incidents. Nowadays, consumers' concerns regarding food provenance and quality are extremely high, resulting in the tendency to spend more money on food products whose origin is certified. Despite the developed technologies that are already in use, in many cases, the vast majority of the traceability systems are centralized, asymmetric and outdated in terms of data sharing and interoperability. Existing systems lack in transparency and consumers' trust due to the unavailability of a fast and trustworthy way to retrieve information on the product's provenance. Considering all the trustworthy way to retrieve information on the product's provenance. Considering all the above, together with the rapid technological development adopted in value chain areas, we observe a significant increase in emerging innovations that lead the way for new digital traceability systems by taking advantage of information and communication technology (ICT), Radio-Frequency Identification (RFID) sensors, Internet of Things (IoT), blockchains and more. In this context, distributed ledger technologies (DLT) such as blockchain offer a solution to many existing problems, but simultaneously pose new challenges as well. above, together with the rapid technological development adopted in value chain areas, we observe a significant increase in emerging innovations that lead the way for new digital traceability systems by taking advantage of information and communication technology (ICT), Radio-Frequency Identification (RFID) sensors, Internet of Things (IoT), blockchains and more. In this context, distributed ledger technologies (DLT) such as blockchain o er a solution to many existing

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problems, but simultaneously pose new challenges as well. Over the last few years, a rapid increase regarding the practical and e ective application of DLT in the agri-supply chain has been under the spotlight in the academic and food industry communities [1]. In addition, the establishment of the Industry 4.0 paradigm renders DLT a promising area for further Over the last few years, a rapid increase regarding the practical and effective application of DLT in the agri-supply chain has been under the spotlight in the academic and food industry communities [1]. In addition, the establishment of the Industry 4.0 paradigm renders DLT a promising area for further research in the future. In this paper, the authors identify, gather and present a thorough literature review of ongoing scientific papers, technical publications, research projects and pilot integrated and commercial platforms using blockchain for traceability in the agriculture supply chain. The main target of this paper is to conduct an analysis of the research activities performed over the last years and demonstrate a taxonomy of different ideas and a chronological presentation of useful studies. This will serve as the basis for conducting further research in order to better address the challenges that still exist in the domain. research in the future. In this paper, the authors identify, gather and present a thorough literature review of ongoing scientific papers, technical publications, research projects and pilot integrated and commercial platforms using blockchain for traceability in the agriculture supply chain. The main target of this paper is to conduct an analysis of the research activities performed over the last years and demonstrate a taxonomy of di erent ideas and a chronological presentation of useful studies. This will serve as the basis for conducting further research in order to better address the challenges that still exist in the domain. The remainder of the paper is organized as follows: Section 2 presents an overview of the definitions, levels, tools and advantages of traceability; Section 3 provides a brief review about the blockchain technology; Section 4 includes a literature review of related activities to date regarding the integration of blockchain into traceability systems; Section 5 presents relevant existing commercial applications; Section 6 highlights challenges and future prospects; Section 7 concludes the paper. The remainder of the paper is organized as follows: Section 2 presents an overview of the definitions, levels, tools and advantages of traceability; Section 3 provides a brief review about the blockchain technology; Section 4 includes a literature review of related activities to date regarding the integration of blockchain into traceability systems; Section 5 presents relevant existing commercial applications; Section 6 highlights challenges and future prospects; Section 7 concludes the paper.

LITERATURE SURVEY

1. Almeida, O.X.B.; Rodriguez, M.C.; Samaniego, T.; Gomez, E.C.F.; Cabezas-Cabezas, R.; Bazan, W. Blockchain in agriculture: A systematic literature review. In Proceedings of the Technologies and Innovation, Guayaquil, Ecuador, 6–9 November 2018; Valencia-García, R., Alcaraz-Mármol, G., Del Cioppo-Morstadt, J., Vera-Lucio, N., Eds.; Springer International Publishing: Cham, Switzerland, 2018; pp. 44–56.

Blockchain has been used to solve problems from different sectors. In agriculture, Blockchain is being applied for improving food safety, and transaction times. The increasing interest of Blockchain technology in agriculture calls for a clear, systematic overview. In this sense, we present a systematic literature review (SLR) whose objective is to collect all relevant research on Blockchain technology in agriculture to detect current research topics, main contributions, and benefits of applying Blockchain in agriculture. We have extracted 10 primary studies from scientific databases and web sources published between 2016 and 2018, which means that Blockchain is a recent research area in the agricultural sector. The results show that 60% of papers are focused on food supply chain. Also, 50% of the studies on Blockchain in Agriculture are dominated by Asian community researchers, especially from China. Similarly, the half of the studies addressed challenges related to privacy and security of the Internet of Things with Blockchain technology.

2.ISO Technical Committee. Traceability in the Feed and Food Chain—General Principles and Basic Requirements for System Design and Implementation; ISO 22005:2007; ISO Technical Committee: Geneva, Switzerland, 2016.

ISO 22005:2007 gives the principles and specifies the basic requirements for the design and implementation of a feed and food traceability system. It can be applied by an organization operating at any step in the feed and food chain. It is intended to be flexible enough to allow feed organizations and food organizations to achieve identified objectives. The traceability system is a technical tool to assist an organization to conform with its defined objectives, and is applicable when necessary to determine the history or location of a product or its relevant components.

3.Aung, M.M.; Chang, Y.S. Traceability in a food supply chain: Safety and quality perspectives. Food Control 2014, 39, 172–184.

The food industry is becoming more customer-oriented and needs faster response times to deal with food scandals and incidents. Good traceability systems help to minimize the production and distribution of unsafe or poorquality products, thereby minimizing the potential for bad publicity, liability, and recalls. The current food labelling system cannot guarantee that the food is authentic, good quality and safe. Therefore, traceability is applied as a tool to assist in the assurance of food safety and quality as well as to achieve consumer confidence. This paper presents comprehensive information about traceability with regards to safety and quality in the food supply chain.

4.Pappa, I.C.; Iliopoulos, C.; Massouras, T. What determines the acceptance and use of electronic traceability systems in agri-food supply chains? J. Rural Stud. 2018, 58, 123–135.

The paper is investigating the electronic-based traceability systems (ETsystems) that are considered as a valuable tool for the assurance of food safety and quality, for guaranteeing value added to products and ultimately, for serving the transparency and sustainability of agri-food chains. The objective of this research is to investigate the factors influencing the acceptance and use of ETsystems in agri-food chains.

A model that identifies the most significant factors influencing farmers' and processors' behavior regarding the installation and operation of an ETsystem is proposed. The theoretical approach is based on a combination of the Technology Acceptance Model 2 (TAM2) and the Theory of Planned Behavior (TPB). The theoretical concept and related hypotheses are tested by means of PLS-SEM analysis of data from the dairy supply chain in Greece.

'Perceived Control' and most importantly, the 'perceived costs' over the installation and operation of the ETsystem, is the most important factor with the strongest direct effect influencing the intention to install and operate such a system. This effect is stronger in the case of dairy farmers than in the case of dairy processors. Stronger for dairy farmers is also the identification mechanism thus, their need to comply with their social/business group expectations.

Useful findings offered for policy makers and regulators interested in the way traceability systems could be successfully integrated within an agri-food sector to guarantee its added value. The limitation of voluntariness and the enforcement of certain mandatory requirements is one tool to exploit and, based on our study, would be more effective at the processors' level.

1. Costa, C.; Antonucci, F.; Pallottino, F.; Aguzzi, J.; Sarriá, D.; Menesatti, P. A review on agri-food supply chain traceability by means of RFID technology. Food Bioprocess Technol. 2012, 6, 353–366.

Radio Frequency Identification (RFID) is a technology which provides appealing opportunities to improve the management of information flow within the supply chain and security in the agri-food sector. Nowadays, food safety is considered a major requirement in several countries, in particular, the traceability of food products which is mandatory by law. Thus, technological implementation leading to traceability strengthening in the agri-food sector is crucial. The first aim of this review is to analyze the current developments in RFID technology in the agri-food sector, through an operative framework which organizes the literature and facilitate a quick content analysis identifying future research direction. RFID technology seems to be able to bring great opportunities to this sector; nevertheless, several constraints are slowing its adoption. This survey may provide readers with an exhaustive overview of opportunities and constraints for the wide adoption of RFID. The second aim of this review is to provide an updated analysis on the current developments of RFID technology for different product typologies within the agri-food industry, discussing at the same time its potential in technological and logistical

development regarding different sectors of the production/distribution chain. As referenced here, RFID implementations in the agri-food sector are increasing at a fast rate, and technological advancement follows the applicability opportunities. However, real applications of RFID technologies are still limited because of various technical and economical obstacles which are also discussed.

PROPOSE METHOD

Implementing Smart Contracts for Automated & Transparent Supply Chain Management in Agriculture

In this project we are designing online applications for agriculture stakeholders like farmers/sellers or buyers who can sell and buy agriculture products online. Seller can add crop details and then buyer can view list of products and put buy request to seller. Seller can confirm or reject sale.

In propose work we are employing Blockchain technology to manage Farmer agriculture supply transparent. Blockchain has inbuilt support for decentralize storage, data encryption based security and privacy and provide tamper proof storage.

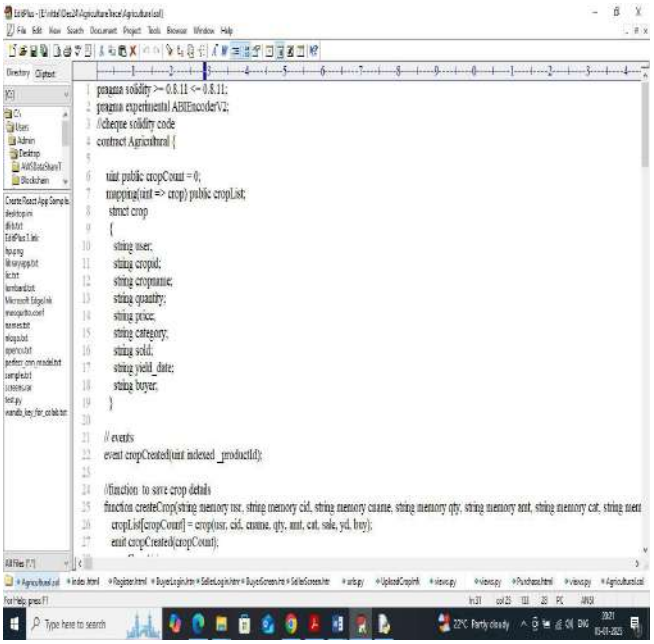
Existing applications were utilizing single centralized server to manage all supply chain data and can be easily hack and database administrator can tamper any record easily without getting detected. If single centralized server crash then all services to users get disturbed.

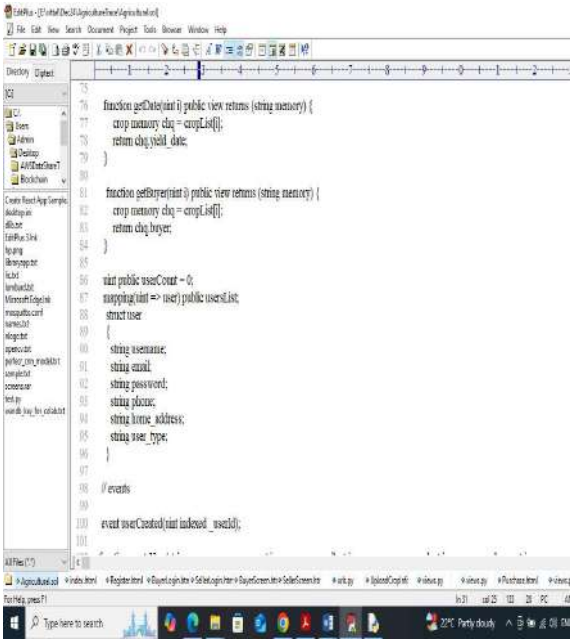
Blockchain Decentralized Storage: Above disadvantage can be overcome via Blockchain technology, Blockchain store data in decentralized fashion which means data store in Blockchain will be replicated to multiple nodes, if any node down then user can get services from other working nodes.

Tamper proof storage: Blockchain store each record as block/transaction and associate each block with unique hashcode, this hashcode get verified for subsequent block storage, if any block data modify then result into hashcode mismatch and data tamper get detected. This verification process make Blockchain tamper proof

Secured and privacy data storage: Blockchain has inbuilt support for data encryption before storage and this will provide security to user data.

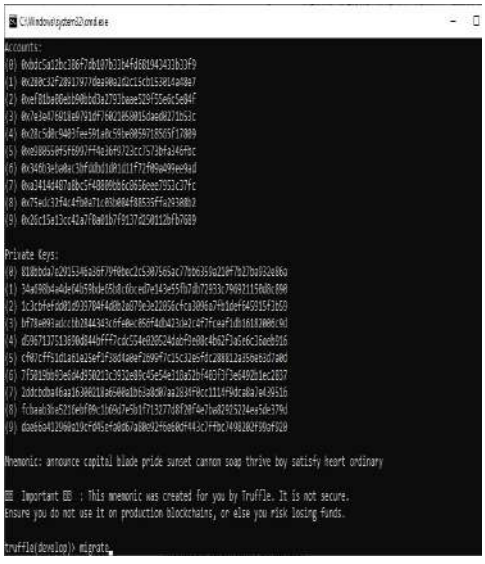
Blockchain Ethereum can store and retrieve date using SMART CONTRACTS which can be designed using solidity programming. This contracts contains functions which can be called using any programming language to store and retrieve data. To manage agriculture crop sales and purchase we have designed following smart contract.





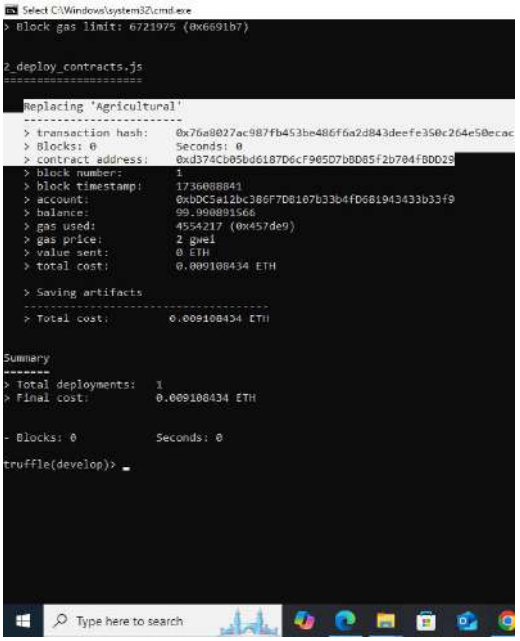
In above screens can see contract code where we have define functions to save and get crop details. Now we need to deploy above contract to Ethereum Blockchain by following below steps.

1) First go inside 'hello-eth/node-modules/bin' folder and then look and double click on 'runBlockchain.bat' file to get below page



2)

3) In above screen Ethereum started with default accounts and private keys and now type command as 'migrate' and then press enter key to deploy contract and get below page



4)

5) In above screen in white colour text can see 'Agricultural' contract deployed and got contract address also and this address need to specify in below python code to call contract

6)

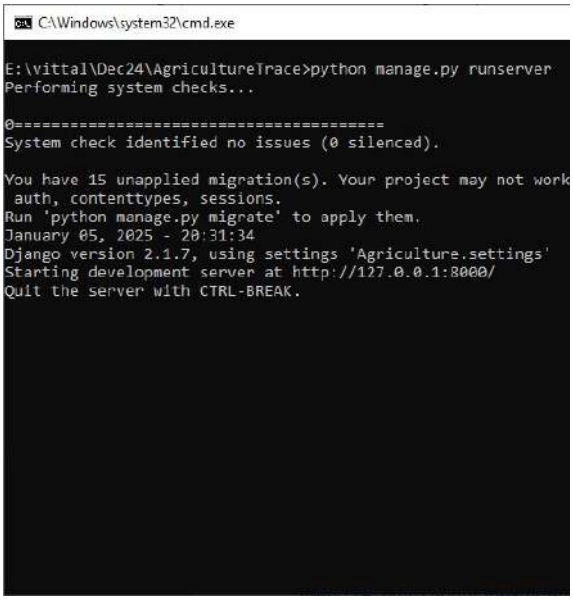
7) In above screen in red colour comments you can see by using contract address we are calling Blockchain functions to store and get data. In above screens we have deployed contract and running successfully and let it run till you execute code.

To implement this project we have designed following modules

1) New user sign up: using this module farmers or buyers or sellers can sign up with the application
2) Seller/Farmer Login: seller can login to system
3) Provide Crop Information: seller can add and upload available crop details along with price, quantity and images
4) View Crop Details: using this module seller can view list of added crop details
5) View Buyer Request: seller can view list of buy request from buyers and then can approve or reject sale
6) View Payments: seller can view list of confirmed payments
7) Buyer Login: buyer can login to system
8) View Seller Crop: buyer can view list of seller crops and can make desired crop purchase. This purchase request will be sent to seller for approved or rejection
9) View Reply: buyer can view purchase accepted or rejected status from seller.

RESULT:

To run project install python 3.7.2 and then install all packages given in rqquirements.txt file and then double click on run.bat file to start python server and get below page



In above screen python server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and then press enter key to get below page

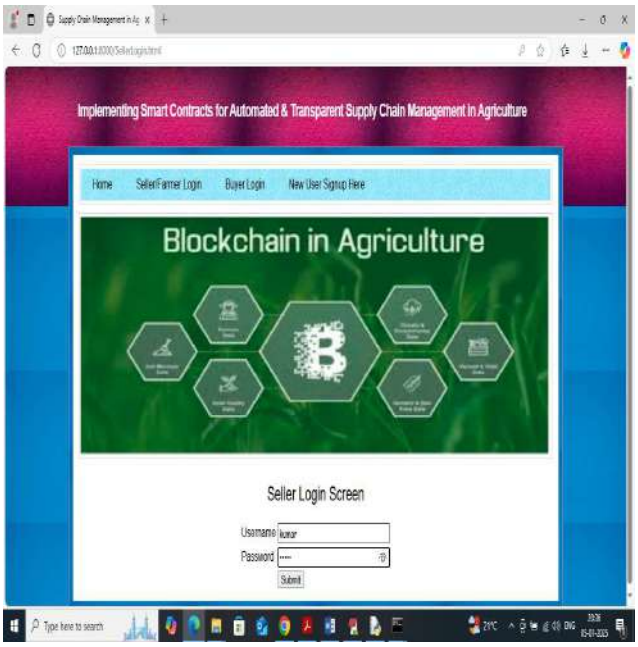
In above screen click on 'New User Sign up Here' link to get below page

In above screen adding seller details and then press button to get below page

In above screen in blue text can see seller sign up task completed and then in red lines I am displaying entire log obtained from Blockchain after storage. This log contains details like Transaction no, block no, block hashcode and many other details and this log displaying for you and your guide understanding purpose. Similarly can add buyer details also.

In above screen buyer details also added and now click on 'Seller/Framer Login' link to get below page

In above screen adding buyer details and then click on button to get below page

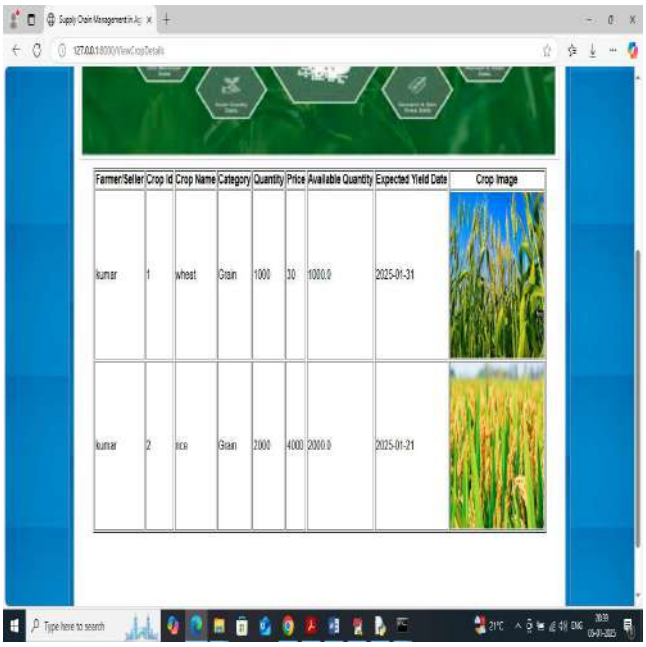


In above screen login as seller and then click button to get below page

In above screen seller can click on 'Provide Crop Information' link to get below page

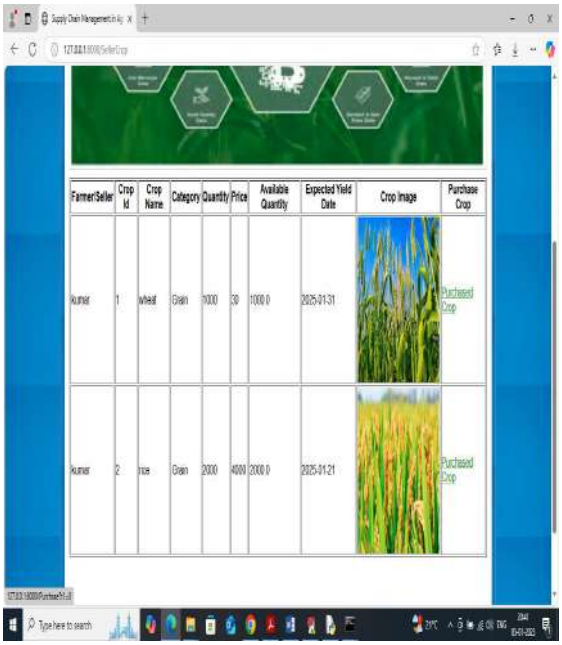
In above screen crop details added and similarly you can add as many crops as you want and now click on 'View Crop Details' link to get below page

In above screen adding wheat crop details and then uploading image and then click on button to get below page



In above screen seller can view list of added crop details and now logout and login as buyer to make purchase

In above screen buyer is login and then will get below page

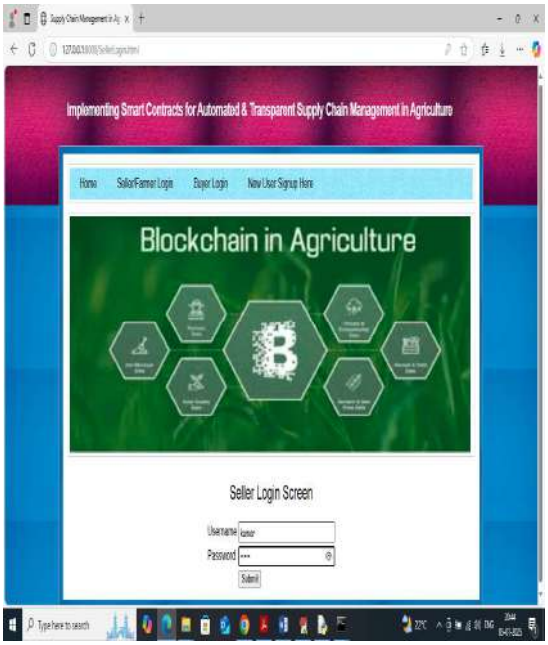


In above screen buyer can view list of crop details and then click on 'Purchase Crop' link to get below page

In above screen buyer can click on 'View Seller Crop' link to view list of all crops to purchase

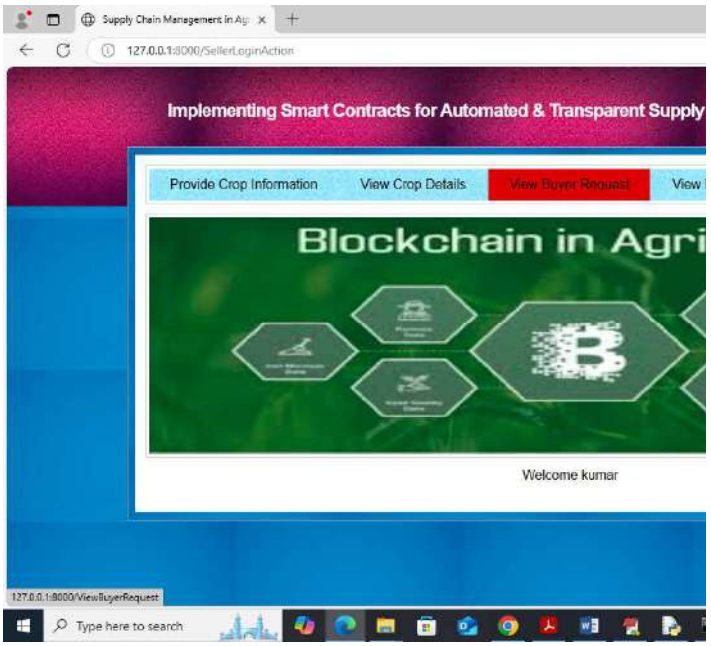
In above screen buyer will enter interested quantity and then enter payment method and then press button to get below page

In above screen purchase request sent to Farmer or seller 'KUMAR' and now click on 'View Reply' link to view status of purchase



In above screen seller is login and after login will get below page

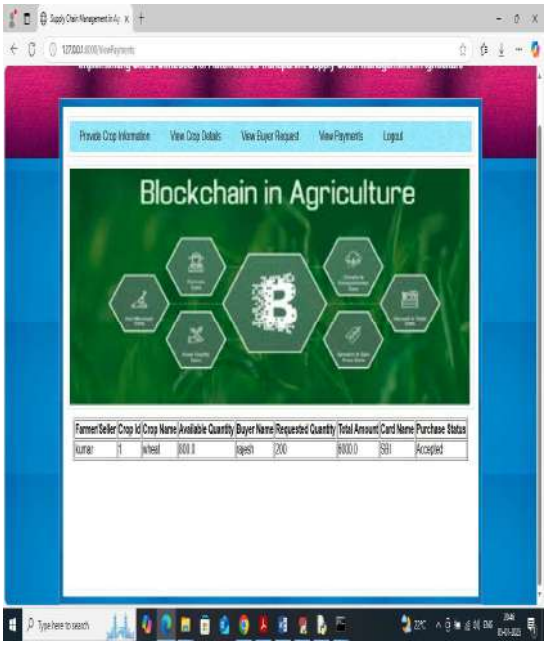
In above screen buyer can view all purchase list and in above screen purchase status is EMPTY as seller not yet approved this purchase. Now logout and login as seller to approve or reject purchase



In above screen click on 'View Buyer Request' to view list of request and get below page

In above screen seller can view list of request and then can click on either 'Accept or Reject' link to approve or cancel request and now I am clicking on 'Accept' link to get below page

In above screen buyer request successfully accepted and now click on 'View Payments' link to get below page



In above screen purchase status changed to 'Accepted' and sale is completed and can see available and purchased quantity.

Similarly by following above screens you can make any number of sales and purchase

CONCLUSION

The goal of this study was to conduct a thorough research in the literature concerning traceability techniques and blockchain technologies and their combination in the agriculture sector. Traceability is a field that has been well studied throughout the years. Several regulations, directives and laws around the world regarding the traceability of agri-food products have been established. On the other hand, although blockchain technology has been a subject of extensive research over the last decade, it is only in the last few years that some research studies on the implementation of blockchain in agriculture traceability systems have made their appearance. At the same time, an increasing trend on startups and pilot applications is observed. Researchconductedinthecontextofthispapershowedt hatusingblockchainscanadvantageously help to achieve traceability by irreversibly and immutably storing data. Blockchain technology creates a unique level of credibility that contributes to a more sustainable food industry. Although assuring

food traceability with blockchain technology look spromising. Certain limits remain to be considered and addressed, including regulations, relationships between stakeholders, data ownership, scalability, etc. In order to better understand the technology and, possibly, generate new implementations, researchers and developers would benefit from the development of a universal evaluation model. To conclude, for the implementation of a new system to be characterized as successful, this system should empower the following: (i) reduce costs, (ii) reduce risk, (iii) save time, and (iv) increase trust and transparency. Stakeholders are willing to adopt a new way of working only when they are convinced that the proposed method is user-friendly, increases productivity and brings added value. Taking the above into account, it is clear that the consolidation of new technologies in the traditional sector of agriculture is an enormous challenge which should be carried out step by step, and only by e ciently engaging the directly a ected stakeholders across the supply chain

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