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Block chain enable for Smallholder's farmer's Crop Transaction Using Peer-to-Peer

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Abstract: Agriculture plays a major role for smallholder farmers in primary and secondary processing, supply chains, and infrastructure that enhance resource efficiency and marketing by decreasing market intermediaries. This paper explores the possibilities of using Blockchain technology in agriculture. The agricultural sector has a great need for information that supports traceability. Production growth could lead us to a radical change in the agriculture business. Technology can be an important pillar in this transformation. Therefore, we proposed using Blockchain with agriculture using peer-to-peer and a hash, which is a cryptographic mechanism for ensuring crop data security. Every time one is created, a new block is added to the end of the shared ledger. Blockchain technology can be used to improve outcomes in agriculture. We are able to collect crop supply chain data from farmers and store it on a distributed ledger technology network. Classification and regression, two of the most common methods used in data mining and machine learning to make predictions about crop productivity, were employed in this research. The experimental results are conducted on crop classification using decision trees and random forests, and future crop likelihood using linear regression. Finally, the estimated 99.23% cropped data accuracy is compared with others, on yield prediction for farming, and respond time is estimated for each block node in the blockchain.

Keywords: Agriculture, Blockchain, Decision Tree, Peer-to-Peer, Random Forest, Linear Regression.

Introduction:

In 2020, the population of India is predicted to exceed 1.38 billion people, 58 percent of whom will be dependent on agriculture. Crops, water, and soil are all impacted by climate change in some way, whether it's in the form of reduced water availability, altered drought intensity and frequency, altered microbial populations, decreased soil organic matter, decreased yields, or depleted soil fertility. For small-scale farmers, primary and secondary processing, supply networks as well as infrastructure that reduces market intermediaries, agriculture is essential. 80 percent of the world's population lives in rural areas and works in agriculture, which has the potential to alleviate poverty and enhance food security for these people. In order to meet the global development goals, we need food systems that are healthy, sustainable, and inclusive. Agricultural development is one of the most effective ways to eradicate severe poverty, increase prosperity for all, and feed the 9.7 billion people that will exist on the planet by 2050. The lowest people's incomes are rising two to four times faster in agriculture than in any other sector. 65% of the working poor relied on agriculture to make ends meet in 2016, according to a recent study.

In India, smallholder farmers out-yield medium and large farmers in terms of yield per acre. As a result, India's agricultural future lies with small farms. As a result, the size of the farm has no influence on the viability of the produce. Everything hinges on the way, when, what, and for whom they produce, as well as the amount. Poverty reduction and food security are also under threat: Even in the most food-insecure countries, climate warming may have a negative impact on crop harvests. Agriculture, forestry, and other land-based activities are responsible for around one-quarter of all global emissions of greenhouse gases. In agriculture, climate change mitigation is a part of the answer.

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As the human population grows, so does the demand for digital services that cater to their demands. An increasing number of people's want for food means that farmers and agricultural enterprises should consider using blockchain technology into farming and farming management solutions. Crop management, IoT sensors, IoT mapping, vertical farming systems, location intelligence, precision farming, and other technologies are helping agricultural companies to increase food production and supply chain management. Concerns such as counterfeit goods, which threaten food supply chains at numerous levels, have arisen as a result of increased food consumption. Inefficiency and a lack of accountability harm farmers and consumers alike. As a final point, the agricultural supply chain can benefit from blockchain farming and distributed ledger technology by enhancing efficiency, transparency, and trust. In the agriculture supply chain, blockchain technology has the ability to transform the industry. It is possible to empower all market participants by forming trusting alliances, as Mohammad and Hossein Ronaghi, 2020 [5] show.

It is more difficult to manage the supply chain of an agriculturist because of the unpredictable nature of weather, pests and diseases. Financial transactions are more time consuming, and human labour is frequently required, as a result of the agricultural supply chain's lack of traceability. It's also possible for counterfeits to surface at any point in the supply chain, which poses a threat to all stakeholders in the supply chain, as well as governments and consumers [4]. Supply chain blockchain services and initiatives can lower the risk of counterfeits and improve the efficiency of blockchain-based agriculture by providing transparency and removing intermediate links in the value chain. Using distributed ledgers and smart contracts, smallholders, micro, small, and medium-sized businesses, and other market participants can be more confident in the market and hence participate more actively. The fundamental challenge in agricultural supply networks is the transportation of products. While the cryptography associated with each transaction may be used to track transaction data, F. Benanti, E. Riva Sanseverino, G. Sciumè, and G. Zizzo, 2020 [8] show that transferring a genuine product from farm to customer demands a significantly more immutable product–process association.

1. Peer-to-Peer with Blockchain

The word "blockchain" refers to a collection of crop data known as "blocks" in agriculture. Each user in the blockchain network will have access to the entire list, known as the shared ledger. Crop data, as well as a hash for it, is stored in each block of the ledger. A hash is a cryptographic approach for protecting crop data and preventing unauthorised access to it. In a two-way linked list, each block has a logical relationship to the next and previous block, implying that each block will preserve the hash of its own block as well as the hash of the block before it. The first block in the shared ledger is the genesis block, also known as the root block.

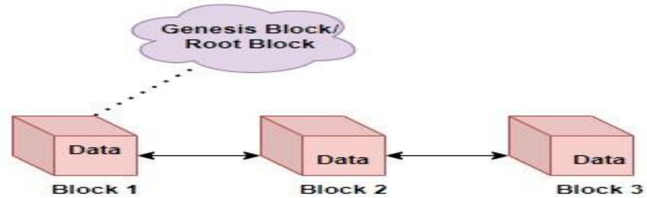

Figure-1: No.of Blocks in the Blockchain

As previously stated, each user will have their own shared ledger. As depicted, Blockchain employs network topology within the group, which means that each user maintains a point-to-point connection with all other users in the group, allowing for peer-to-peer (P2P) communication as represented by Aakash Madaana, 2020 [1].

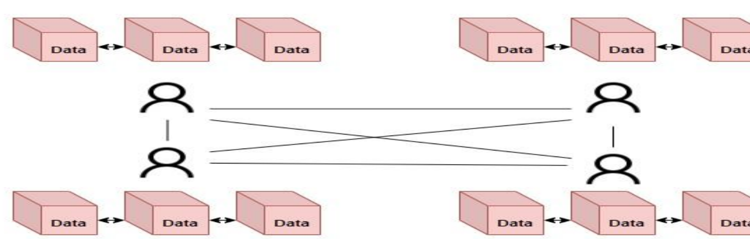

Figure-2: What a Blockchain network lookslike

The end of the shared ledger is updated whenever a new block is produced. To prevent agricultural data falsification, blockchain technology stores a timestamp. Secure Hashing is the most widely used cryptographic method. The key feature of Secure Hashing is that the encrypted output is always 256 bits long, regardless of the message's data size (input block). Even minor changes in the input have an effect on the hash computed. Figure-2 shows that, in addition to data, each block in the blockchain network contains the following: an index, which is simply a block number; a time stamp indicating when a block was created; and the hash of the previous block and its hash, as represented by Saurabh Dhumwad, 2019 [9].

2. Related Work

Each member contributes to the blockchain, which is a shared record of accounts and transactions. For an industry where the cost of obtaining such information is prohibitive, this service offers to be a dependable source of information. Blockchain technology makes it possible to track the provenance of food, which promotes the creation of reliable food supply chains and a relationship of mutual trust between producers and consumers. It promotes the usage of data-driven farming technologies by offering a safe way to store data. As a result, it enables for timely payments between stakeholders that are triggered by data changes in the blockchain when combined with smart contracts.

2.1. Building a Blockchain

Choose a use case for which the blockchain network will be built, such as smart agriculture.

1. Select a platform for blockchain development.
2. Make a genesis block.
3. Hashing techniques are used to generate the data hash.
4. When a new transaction occurs, do the following:
   - Give each item an index number.
   - Create a hash of the data.
   - To join the block at the network's end, point to the hash of the previous block.

2.2. Possessions of Blockchain

A blockchain employs a decentralised network configuration. As a result, anyone in the blockchain network can engage (or make transactions) with anyone else at any time, without the need for a third party. Another critical component of the blockchain is transparency. It specifies that only the network's transactions can be viewed, and that the being's identity is kept private. This is achieved by displaying encrypted data rather than the individual's identity. The data on the blockchain network is immutable. Data in the network cannot be tampered with because the blockchain maintains a shared ledger as represented by **S.Thejaswini and Ranjitha K R, 2020[16].**

The following strides how Blockchain Works:

1. At first, a transaction is required.
2. The transaction is represented by a Block.
3. A copy of the Block is sent to every node in the network.
4. The node verifies the transaction.
5. Your Proof of Work will be rewarded by Node.
6. Afterwards, the Block is added to the Chain.
7. The deal has been completed and the funds have been transferred.

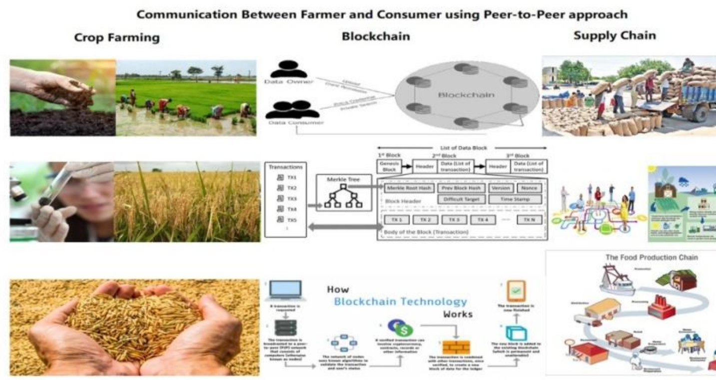

Figure-3: Peer-to-Peer Approach for Farmers and Consumers

2.3. Contributions

The main contribution of this paper is to construct a Peer-to-Peer with Blockchain Technology for crop data prediction with the following

• Appropriate Block node process into the agriculture system by defining the jargon including smallholder's farmers.

• Proposed a supply chain procedure for crop type's data using regression models integrating with machine learning model.

• Crop types data evolution and efficiency using the proposed model with respect to accuracy.

3. Background Knowledge

There are two main reasons to employ regression analysis, both of which are conceptually distinct. Before we go into machine learning, it's important to understand regression analysis as an important tool for forecasting and predicting. regression analysis can also be used to find out how independent and dependent variables are related in certain situations. An important part of the analysis of a dataset is the discovery of correlations between variables in the dataset. Researchers must carefully justify why existing correlations have predictive power in a new context or why a link between two variables has a causal interpretation before utilising regressions for prediction or inferring causal relationships. Both David A., 2009[] and R. Dennis Cook, 1982 stress the significance of the latter when attempting to infer causal relationships from observational data alone.

3.1. Decision Tree Regression

In this crop data, we have one independent variable, croptype, and one dependent variable, count, to forecast. In this job, we must develop a Decision Tree Regression Model that will look at the relationship between crop type and average price at maximum cost and predict maximum cost depending on crop profit in a given year.

3.2. Random Forest Regression

An algorithm known as Random Forest involves supervised learning. Classification and regression problems can be solved with it. Ensemble learning, a method of merging many classifiers to solve a complex problem and increase the model's performance, is used. An algorithm called Random Forest can be used to improve agricultural yield forecasts by taking the average of many decision trees. In place of using a single decision tree, the random forest uses the predictions from all of the trees to anticipate the final result based on the most accurate predictions available.

3.3. Linear Regression

Straight lines, known as regression lines, are used in Linear Regression or Least Squares Regression to indicate the relationship between the variables, which is linear. The basic linear relationship can be used to explain relationships between two variables, say X and Y.

$$\mathbf{Y=a_0 + a_1X.}$$

is referred to as the Y-X regression line. In the same way, if X is dependent on Y,

$$\mathbf{X= b_0 + b_1Y}$$

is referred to as the Regression line between X and Y.

4. Proposed Work

For both theoretical and practical views, this article investigates the use of blockchain technology by smallholder farmers in food supply networks, smart farming, and the exchange of agricultural products. We also talk about the difficulties in capturing smallholder farmer transactions and developing a database a system for implementing blockchain technology in the food and agriculture.

4.1. Blockchain Process Supply Chain in Agriculture

Information about smallholder farmers, crops, food distribution, and product transactions are all included in this part, which focuses on the various layers of the smallholder farmer's agricultural system.

The Smallholder farmers' crop-growing system relies heavily on data and knowledge about the natural resources that sustain all agricultural methods. For example, in Figure 1, we can see the flow of data and expertise among smallholder farmers, along with products moving through various value-adding stages and cash moving from outputs to inputs. As a result, a wide range of individuals and organisations are involved in creating and managing data and information.

There are a wide range of parties involved in the entire value-added process of developing an agricultural product, from seed to sale, which is where the blockchain technology comes in. Data and information are accessible to all parties and stakeholders involved in ensuring that all recorded data is unalterable. On the Ethereum or Hyperledger platform, a particular blockchain is used, while a Proof of Work-based system is used to collect data and information at various stages of the crop farming process. Traditional technology relies on secrecy to offer security; blockchain technology, on the other hand, relies on decentralisation to give security. To prevent data loss and distortion, it is better to disseminate data rather than store it in a centrally managed server. It is a timestamped database that stores batches of product transactions and activity in the form of transactions. Centralised servers are more sensitive to data loss and corruption than Internet-based servers because of their location in a centralised location.

Weeds and pests ravaging crops including paddy, chilly, and cotton are a problem for small-scale farmers in the region. At night, when most farmers are at home, these problems tend to develop more frequently than during the day. An infestation begins near the base of a plant where it is difficult to see. As a result, we plan to use a drone equipped with an AI night vision camera to count weeds and pests in fields. The drone will be able to identify any issues and report them to the system with pinpoint accuracy. The system will analyse the data and identify the problems survey by survey. The software will send an SMS to the farmer's registered cellphone number when the details are compared to land records. Sending photos over WhatsApp is also possible. It is possible for a farmer to avoid significant losses by becoming aware of the issue in a timely manner. Statisticians are those who study how to learn from data. As a result of statistical understanding, we are better able to collect and analyse data, as well as effectively present our findings. We produce scientific discoveries, make data-driven decisions, and anticipate the future using statistical analysis. A deeper understanding of a topic can be gained through the use of statistical methods.

Individual product information can be publicly released on the blockchain to help manufacturers create trust with their customers and enhance the reputation of their products. Increasing the value of a company's products can help it compete more effectively in the marketplace. If this is implemented, it will be impossible for fraud and low-quality product providers to remain in business, forcing all suppliers to improve product quality across the entire agricultural crop growing sector. The blockchain is beneficial to consumers because it gives accurate and trustworthy information about how food is grown and traded.

Due to the usage of blockchain, customers can have a better understanding of the food production process and establish direct connections with farmers. As a result of eliminating commodity exchange barriers, consumers benefit from increased trust and confidence in the safety of their food. They may now make well-informed decisions because of the blockchain's accurate and dependable data. A product's whole lifecycle can be recorded on the blockchain, from the moment of manufacture all the way to the retail store. Pesticide residues in grain, for example, can be stored safely and permanently at the beginning of the supply chain using this technology. Checking and verifying such data is possible for any company in the supply chain. Samples can be used to collect this data, which is prohibitively expensive for all items.

There have been a slew of blockchain-based approaches to increasing the traceability of agricultural products. Tracking products along the supply chain is possible with the use of trustworthy data. As a result of using blockchain technology, it is possible to assure that all of the system's records are correct and real. In this proposed blockchain-based traceability system, drones are linked to supply and demand data. The Ethereum and Hyperledger blockchain technologies are used to track transactions.

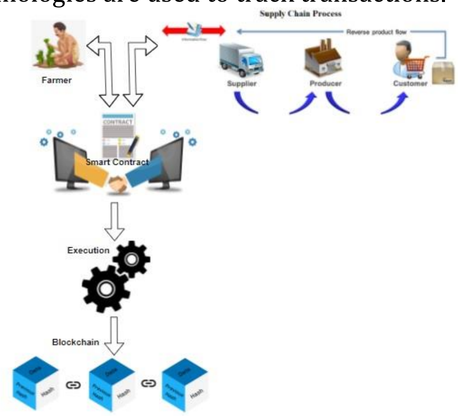

Figure-4: Blockchain Process Supply Chain in Agriculture

The following steps How Blockchain Work on Agriculture

1. The farmer will seek advice from the mediator.
2. The mediator will consult the miller.
3. Miller will notify the mediator of the final price.
4. The mediator will notify the farmer once the cost has been approved.
5. If the farmer accepts that price, he will sell his goods to the mediator.
6. The goods will be taken into possession by the mediator and transferred to the miller.
7. Finally, the miller will submit the cost and quantity information to the government portal.
8. The government will deposit such funds into the farmers' accounts.

5. Experimental Result

The yield prediction for farming and respond time is estimated for each block node in the Blockchain. The Response time is used to assess a performance in its supply chain transactions. Response time is the amount of time that elapses between when user/farmers sends a request and when the block node P-to-P programme indicate the request to transaction query process in Figure-1 and data shown in Table-1.

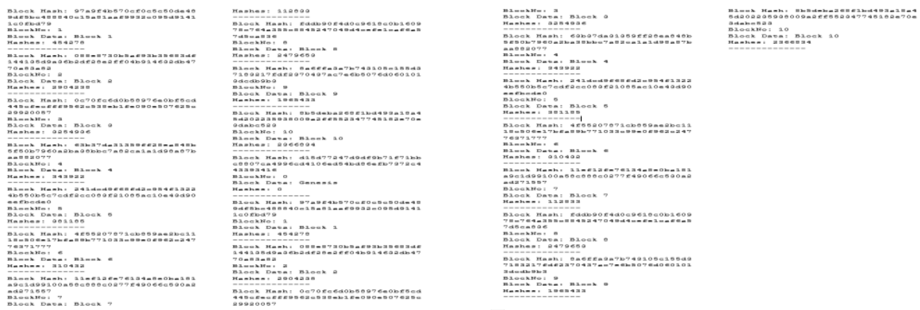

Figure-5: Blockchain Operation Created No.of Blocks

Block Node Response Time(Sec) with Peer-to-Peer										
Process	**A Block Node-1**	**A Block Node-2**	**A Block Node-3**	**A Block Node-4**	**A Block Node-5**	**A Block Node-6**	**A Block Node-7**	**A Block Node-8**	**A Block Node-9**	**A Block Node-10**
1	0.71	0.68	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36
2	0.77	0.71	0.59	0.57	0.55	0.53	0.51	0.49	0.47	0.45
3	0.86	0.74	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.41
4	0.88	0.76	0.62	0.59	0.56	0.53	0.5	0.47	0.44	0.41
5	0.91	0.77	0.63	0.61	0.59	0.57	0.55	0.53	0.51	0.49
6	0.96	0.79	0.65	0.62	0.59	0.56	0.53	0.51	0.47	0.44
7	0.97	0.82	0.69	0.64	0.59	0.54	0.49	0.44	0.39	0.34
8	0.99	0.83	0.73	0.69	0.65	0.61	0.57	0.53	0.49	0.45
9	1.02	0.85	0.75	0.71	0.67	0.63	0.59	0.55	0.51	0.47
10	1.06	1.08	0.75	0.72	0.69	0.66	0.63	0.61	0.57	0.54

Table-1: Respond Time for Processed Blocks in Blockchain Network

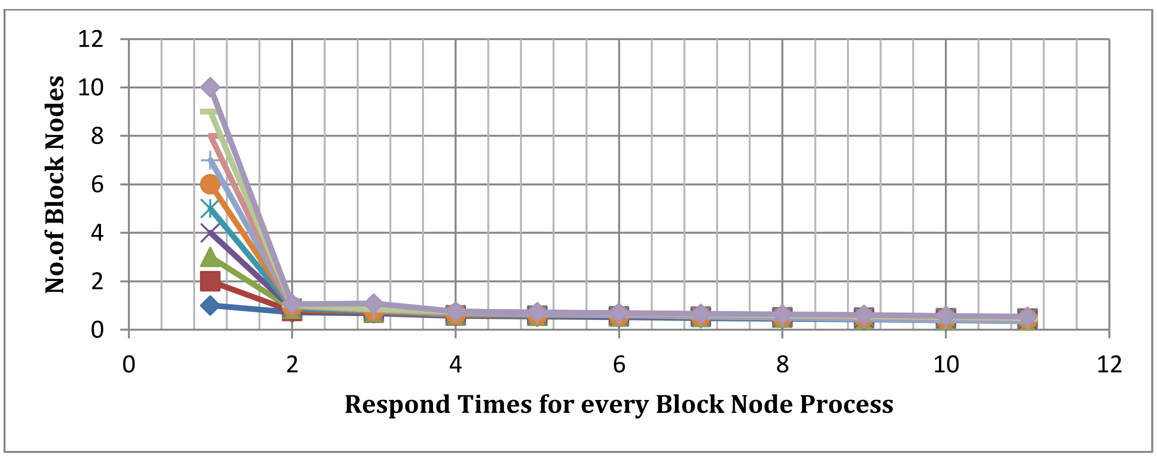

Figure-6: Block Nodes Response Time (Sec) with Peer-to-Peer

The Decision Tree, Random Forest Classification of predicting a discrete class labels like different crop yields data in the Agriculture. Linear Regressionis used for predicting a continuous quantity. These are machine learning procedures are play a very crucial role in the agriculture.In this regard, we observein which crop is suitable for small farmer.Decision Tree classifier and fit it to our crop data. We can now evaluate the trained model on the test set and print out the accuracy. We achieve anaccuracy of 98.53%, which is very impressive.It means that 98.53% of samples in our test set were correctly classified as shown in Figure-3. Random Forests are a decision tree extension in which several decision trees are grown to form a forest. For regrssion it may be a simple average outputs or a label vote in the classification. We achieve an Random Forest Regression accuracy of99.20% on the test set which is Paddy (Dhan) is the best crop and other one is coconutas shownin Figure-a, which is a massive jump from 98.53 when we used a decision tree classifier.Furthermore, we used linear regression for future yield prediction and linear regression is a continuous variable and the relation between independent and dependent variable. Here based crop types wise we are taken Min_Price, Max_Price and Avg_Price, after calculating linear regression yield crop prediction it results show 99.23% Paddy (Dhan) is very helpful to smallholder farmer getting more and more profits and when we use these technologies stop the smallholder farmer'ssuicide cases in Andhra Pradesh results as show in Figure-b.

RegressionAlgorithms	Accuracy
Decision Tree	98.53
Random Forest	99.20
Linear	99.23

Table-2: Accuracy on Train data

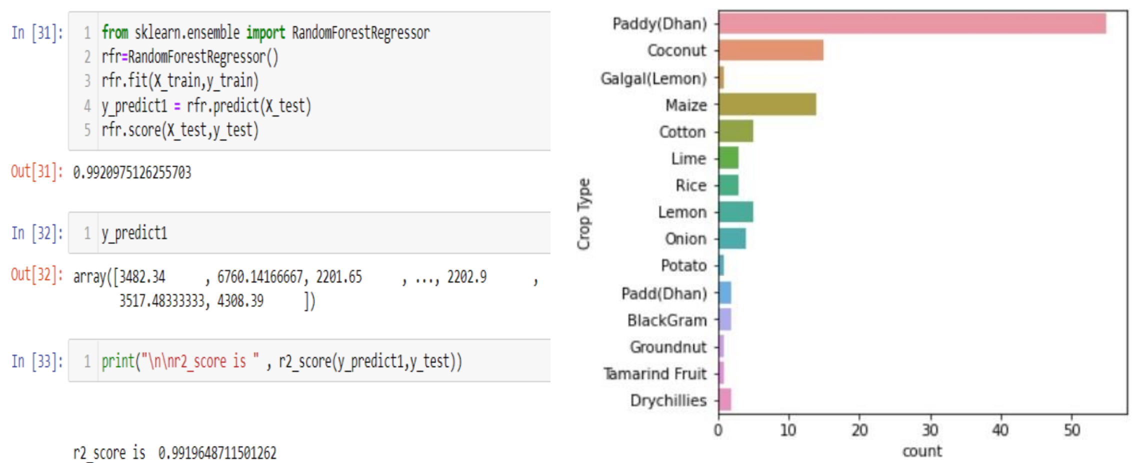

Figure-7: Decision Tree

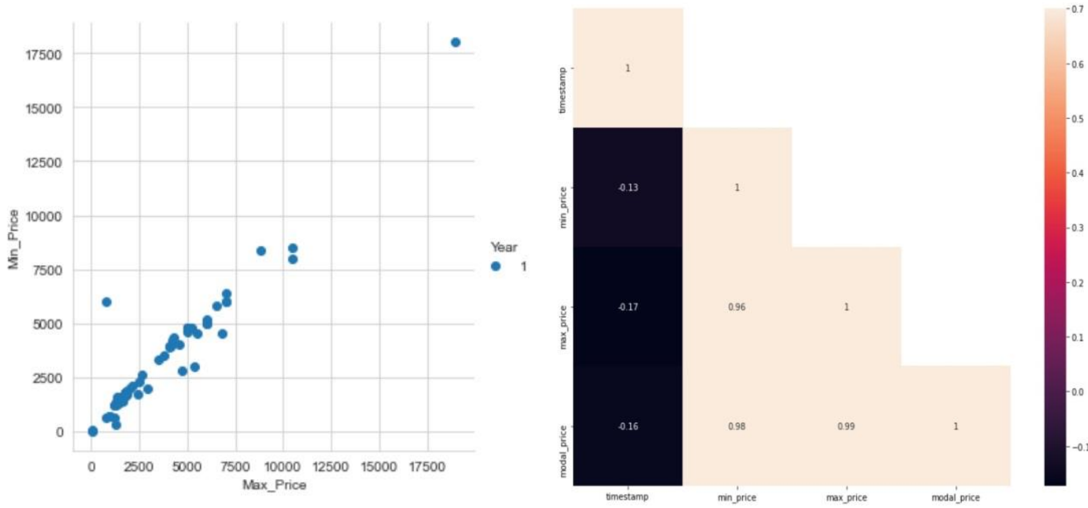

Figure-8: Random Forest

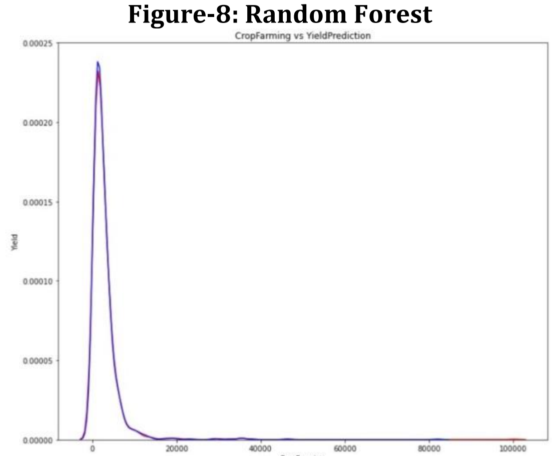

Figure-9: Crop Yeild Prediction Using Linear Regresion

6. Conclusion

As can be seen, the randomization method used by the decision tree, random forest, and linear regression algorithms allows the algorithms to create better results, resulting in increased accuracy on the test set. A cryptographic approach for maintaining crop data security is blockchain with agriculture using peer-to-peer and a hash. The end of the shared ledger is updated whenever a new block is produced. Blockchain technology has the potential to improve agricultural outcomes. In the future, we shall establish strategies for small farmers' crops and land. We conduct soil analysis for farms. Crop yields will gradually rise as a result. The main of the concept was to figure out what kind of soil was in question. Then we make a number of recommendations for how to improve it. Even while a soil has limitations, there are things we can do to maximise its potential.

7. Declarations

7.1. Funding

Not currently in receipt of any research funding for this paper.

7.2. Competing interests

It is stated by the writers that they have no conflicts of interest.

7.3. Data availability statement for the data used in this manuscript

Data will be provided based on a request to the corresponding author.

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