

IOT and AI for Smart and Sustainable Agriculture

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ABSTRACT

The most challenging problem before the world is providing enough food for the gigantic leap in population. There are numerous reasons for the shortage of food and technological innovations in agriculture are required to overcome the shortages in food supply. Sustainable Development goals (SDGs) provides the futuristic vision and ICT along with other latest technologies will help achieve these development goals at a brisk speed. Recent developments such as use of mobile-broadband access devices, Internet of Things (IoT), Specialized Robots, Drones, big data analytics and Artificial Intelligence have provided farmers tools and technologies to improve production and marketing of their products.

In this paper, we will discuss how Smart Agriculture is changing the face of agriculture in Budaun, a small city in Uttar Pradesh. Smart agriculture coupled with block chain technology is being used to achieve sustainability in agriculture growth. The production/yield has risen by over 20% and the profits have increased by over 30% with the new technology.

Keywords: Block chain, Smart agriculture, Sustainable development, distributed ledger

1. INTRODUCTION

Agriculture is the biggest source of income of farmers. Data projects 75% of rural population dependent on agriculture. India has been doing exceptionally well in agriculture domain after achieving Harit Kranti/Green revolution. India is in the list of top 15 exporters of agricultural products. In India, agriculture is the main sector for food security, nutritional security and sustainable development & for poverty alleviation.

Just as we were looking for ways of increasing profits, Technology and Innovation (AI, IoT, Big data and analytics) has completely changed the scenario. Block chain technology is helping us with accurate data about Inventory, farming, credit scores and food tracking.

With its launch in 2009, crypto currencies have gained attention from all kinds of industries as well as academia. Bit coin, the first crypto currency, currently has a market capitalization of 117.81 billion USD [1]. Bit coin functions and operates using block chain technology. Block chain is a list of records that keeps increasing or growing as new information, called blocks, are added to it. These blocks are linked using cryptography [2]. Every block consists of cryptographic hash value of the block previous to it, a unique time stamp, transactional data, and a calculated hash of its own complete block. Block chain has the potential to impact the way agricultural business is done and will result in increased productivity and better decisions.

In this research paper we will discuss latest IOT and AI technology and how it could transform the agriculture sector in India. Sustainable smart agriculture is the reality of the future.

II PROBLEM STATEMENT

Rural areas face a number of issues in day to day agriculture operations. A lot has been done to improve the much needed cultivation but Indian agriculture depends upon traditional farming techniques and natural waters irrigation. Poor farmers rely on ground waters, rivers and rains. Over-pumping of water has led to the falling in groundwater levels in certain parts, where water-logging is leading to salty soil. In rain-fed areas, soil disintegration and floods are significant dangers to Indian farmers all over the state and the country.

The agriculture community in Uttar Pradesh is occupied with other difficulties as well. The biggest obstacle is that the farmers don't get the price they deserve for their produce. This is basically a result of brokers. Lower returns compel them to take credits that they can't support, driving them further into poverty. They don't have access to powerful and better quality pesticides to protect their crops from bugs, diseases, weed and rats. Also, Indian farmers do not have a way to improve crop yield or information to comprehend soil health. New agriculture policy of the government is aimed at removing all the brokers from the scene.

The questions asked are

- What are the agricultural needs of the farmers' community in India and especially my small hometown Budaun that will lead to upliftment of living standards?
- What technology is being used and what more can be added to make the total profit higher and agriculture sustainable.

III THE STATE OF AGRICULTURE IN DISTRICT BUDAUN (U.P.)

We are talking of a small district in middle Uttar Pradesh. District Budaun is in Western Plain Zone of U.P. The temperature ranges from 4.5 degree C to 45.4 degree C. The soil of city is alluvial. Rainfall is during June and October with annual rainfall is 882 mm.

Agriculture crops are wheat, mustard, potato, paddy, sugarcane, maize, bajra, toria while Horticulture crops are guava, mango, papaya, capsicum, brinjal, chilli, tomato, muskmellon and watermellon.

The main crops in the selected city Budaun are Wheat, Rice and Sugarcane. **Wheat's** yield in **1 Bighe** land is approximately **4 Quintals** at a rough cost of **1800/-** per quintal.

Rice's yield is Basmati where **1 Bigha** produces **3 Quintals** of Rice at the cost of **3000/-** per quintal.

Sugarcane is a rich crop where **1 Bigha** produces **50/60 quintals** of Sugarcane at the cost of **325/-** per Quintal.

Small cities have their own problems. Farmers have low yield and don't usually get the profits they deserve. Transport, roads, irrigation facilities, supply chain and many other factors are hindrances in the overall functioning.

With AI and IoT, things are changing and the yield is increasing and Block chain when combined with Smart Agriculture, things are dramatically changing.

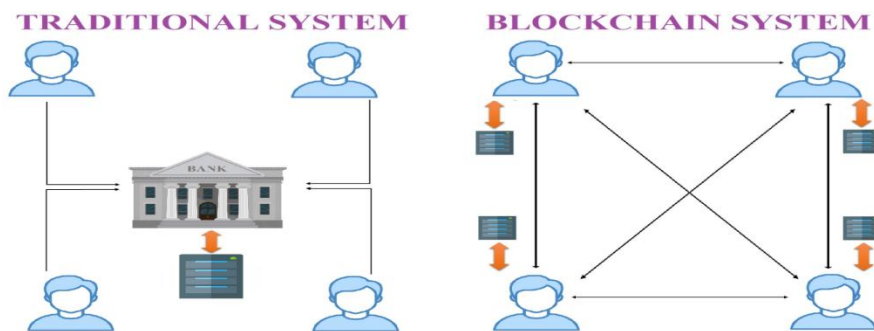
IV POTENTIAL OF IOT, AI AND BLOCK CHAIN IN AGRICULTURE

Most of the failures in agriculture business are related to the unavailability of correct data. Internet of Things (IOT) offers a great promise in various agricultural business functional areas in terms of efficiency enhancement, correctness of information, profit gains and even the development of new business processes and models. AI in addition to IOT is giving businesses a new horizon to chase.

A block chain is a distributed data set of records, also known as a public ledger, consisting of all the transactions that have taken place and are shared over the network [3]. Each transaction taking place is verified by all the participant computer systems present on the network. Once the data has been entered and verified, it can never be erased or even edited. To better understand it using a basic analogue, it is easier to steal a chocolate from a chocolate stand kept in isolated place, than stealing a chocolate from a chocolate stand kept in a market place, being observed by a lot of people. Block chain is a chain of interconnected blocks of data. Block consists of the data and the chain resembles the link/topology of the data [4].

Although Bitcoin is the most known use of block chain technology, block chain can be applied to various other applications. It does not require any central entity for verification; therefore, it can be used for various financial services such as digital assets, remittance and various online payments [5]. Block chain is also coming out to be a promising technology for the next generation of internet interaction systems. Like, smart contracts [6], public services [7], Internet of things (IoT) [8], reputation system [9], security services [10] etc.

A block chain is a chain of blocks, which stores all the details of the transaction like a legacy public ledger [11]. To better understand the working of block chain we will first compare it with the traditional system. The main difference between the two entity is centralization. In traditional system all the records are stored on a centralized database [14], while in block chain system, each member has a copy of all the records and the changes made and each member can view the origin of the data [15]. If a malicious user tries to change some information in the traditional system it will be very hard and time consuming to detect and rectify. But in case of block chain, if some inconsistency occurs, the technology immediately identifies and corrects the unreliable information since every user has the correct information with them.



V BENEFITS OF IOT, AI AND BLOCKCHAIN IN ARGICULTURE

This collaboration of block chain into agriculture aims to provide mobile-based services which would assist farmers in analysing and monitoring the information provided by the block chain network such as financial transactions, farm inputs, demand of crops in market, market rate, supply chain, land holding etc. Thus, this would ensure the transparency and would help farmers to take effective decision.

- Trace-ability

Small-scale farmers often do not get the right price for their produce. Block chain enables farmers and customers to trace agricultural produce and skip dealing with intermediaries. In addition, block chain technology would give a clear picture of trending prices and would eventually help in increasing the income of farmers. ICRISAT considers this collaboration as the first step and further aims to employ Block chain technology in creating an E-agricultural system.

- Registration of Land

Andhra Pradesh government has collaborated with ChromaWay (a Swedish company) for development of a block chain-based platform through which record keeping of land registration can be conducted. This will enable farmers to directly contact with the government thereby, saving them from frauds. Other Indian states will follow on Andhra Pradesh footsteps if this pilot project is successful.

- Food Security

Block chain would help in tracing food, this would let the farmers and customers keep track of the transactions occurring at every level. Block chain to detect any fraud from farm till it reaches the final consumer.

- Verified Agri-inputs and Monitored Subsidy Disbursal

Block chain technology will help farmers buy verified inputs by monitoring the transactions of the product from the very beginning till it reaches them. The funds or subsidiary provided by the government almost reduced by significant percentage before reaching the farmers. Block chain provides a decentralized and transparent platform which would help the government and farmers to trace the transactions at each level.

Thus, Block chain seems to be a promising technology which could provide solutions to the problems faced by the Indian agricultural sector.

VI DATA AND RESULTS

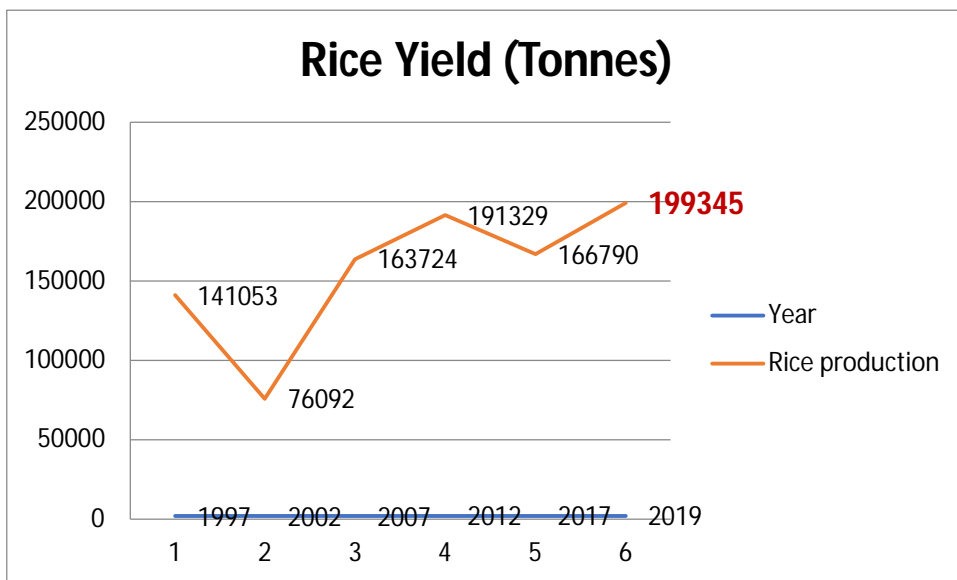
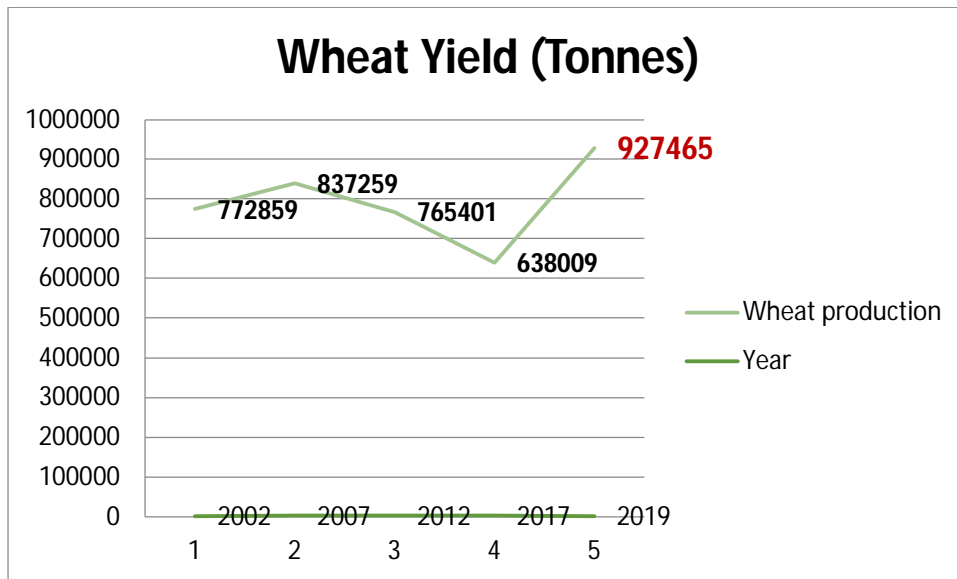
Following is the data of Wheat and Rice production for years 1997-2019 in five years duration for the district that we have chosen for Smart Agriculture and undergoing technological innovations. The data refers to district wise, crop wise, season wise and year wise data on crop covered area (Hectare) and production (Tonnes).<https://data.gov.in/catalog/district-wise-season-wise-crop-production-statistics>

Year	Wheat production(Tonnes)	% Growth
1997	721587	
2002	772859	6.634069
2007	837259	7.691766
2012	765401	-9.38828
2017	638009	-19.9671
2019	927465	31.20937

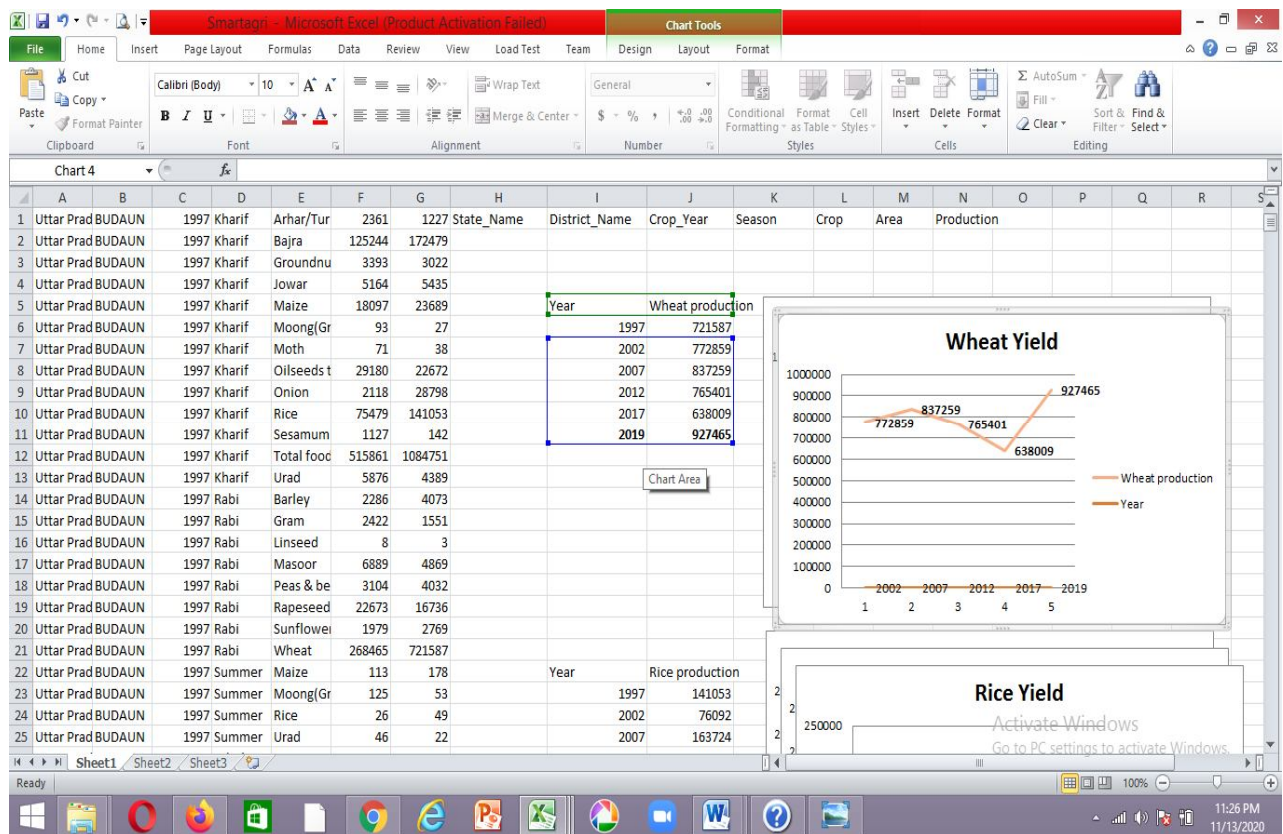
The highest % growth in 2018-19 was **31%** which points to the technological advances and the benefits of new technology.

Year	Rice production(Tonnes)	% Growth
1997	141053	
2002	76092	-85.3717
2007	163724	53.52422
2012	191329	14.42803
2017	166790	-14.7125
2019	199345	16.33098

The % growth in 2018-19 was 16% which points to the technological advances and the benefits of new technology after seeing a decline of -14% in 2017.



Google Colab, Python and official Budaun website (<https://data.gov.in/catalog/district-wise-season-wise-crop-production-statistics>) were used to simulate the results.



VII CONCLUSION

Technology can cater most challenges our farmers face. It can assist them with predicting climate accurately, decrease the use of water and increase the yield and raising their net profit margins. Block chain is a growing technology. Even though it has begun to revolutionize many industries, there is still a long way to go. However, it's becoming increasingly clear that there are limitless opportunities for block chain technology in the agriculture industry.

The use of Mobile broadband access devices, IoT, Robots, Drones, Data Analytics and Artificial Intelligence have helped Indian farmers tools and technologies to improve production and marketing of their products. The coming up of Block chain added to the recent innovations have increased the crop output/yield since 2019 onwards. Farmers are able to yield more wheat, rice, sugarcane and other crops by the use of AI, IoT and Block chain. Our throughput has clearly increased by over 31% and 16% for wheat and rice respectively and we are targeting more.

We are getting a better price of wheat, rice and sugarcane by using the supply chain of block chain technology. Our profits for these three crops have gone up by 30% and intend to use the block chain for other crops too. Other farmers are taking up the technology and now we can look for a better future by getting a better price for a better yield.

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