ES Food & Agroforestry

Opportunities in Crop Deciding Platform

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Abstract

Agriculture has been the backbone of human existence and also the primary source of livelihood for about more than half percent of India's population. It has also seen much advancement in agriculture sector over the years. Modern agricultural technology is all about to reduce human efforts and widely using in the foreign and Indian countries as well and able to increase crop productivity. The present study suggests the basic platform for assisting strategic and proper decision making of farmers. Specifically, the study will be utilized for farm-level decisions used by the farmers for reducing climate risks; examined information communication and knowledge sharing strategies for enhancing decision making.

1. Introduction

New technologies in agriculture have the potential to develop agriculture and to reduce environmental impact through a green revolution. The government is encouraging innovations and advanced scientific agricultural techniques for providing the way to ensure inclusive development in agricultural sector and rural development.[1-3] Agriculture is major sector in the enhancement of economy of any country. In India, agriculture sector provides employment to 59 % of country's workforce and is the single largest private sector occupation. It is acceptable that agricultural practices and advancements in crop productivity play a role in their progress as well. The importance of the exchange of knowledge from different agriculturally-involved individuals from all over the world, improvement of techniques can be experienced as well. It has made an impact on how information is shared, and being able to use this information for the progression of the agricultural sector.[4-7]

The main phases of the agriculture production include crop production, water management, fertilizer application, pest management, harvesting, transport of food products, packaging, food preservation, food safety, food storage, and food marketing. All stakeholders of agriculture industry need information and knowledge about these phases to manage them efficiently. Any system applied for getting information and knowledge for making decisions in any industry should deliver accurate, complete, concise information in time or on time. With these decision systems, farmers can take risk for specific crop production. Smarter and faster decisions are needed for agriculture. The progress in these decision making system using technology is really remarkable by foreign as well as Indian government.[8-10] It is hereby mentioned that fortunately our farmer is taking efforts to learn and implementation of technology in crop productivity.[11-12] Internet of Things (IoT) is enabling farmers globally influence technology to take informed decisions for higher yield, better resource management and timely results with minimum wastage. Technology is helping our farmers with IoT based devices at every stage of farming process and even after.[13-14] Our technologies and applications are used at the first stage where using GPS and weather condition trackers help farmers to decide which crop can get highest yield for available conditions.

2. Technology based farming

2.1. Research work carried out

The success behind agriculture sector mainly includes weather parameters, monsoon, irrigation patterns, soil quality, product commercialization and government support. The lacking in any one of these parameters impacts on farm economics and its owner (farmer). The successful steps like the predictability, as well as modeling of risks on above parameters is a challenging task and its implementation by

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Fig. 1 Mobile based technology assisting farmers in India.

many Indian and global agritech startups.[12] In this context, there is growing demand to work with these agri ecosystem players to solve multiple problems including remote farm monitoring, weather risk management, crop/pest detection, and crop yield estimation etc. The demand for these solutions is increasing sharply and accurate with the combination of hardware (such as satellite, drones, sensors, IoTs, cameras, robots) and software (SaaS, AI, ML, deep learning). Drones and satellites are likewise helping farmers work more efficiently by generating millions of relevant data points.[11-15] Nowadays, satellite imaging allows us to analyze a single patch of land at a resolution of just 30 centimeters. The ability to analyze highly accurate data from the current growing season and compare it with previous years brings a whole new dimension to modern agriculture.[14]

Technology has changed the way of Farming. With the introduction of the Watson Decision Platform for Agriculture, IBM is bringing together data and artificial intelligence to help growers make better decisions.[16] This new platform is an innovation that draws on IBM's most advanced capabilities in artificial intelligence (AI), analytics, IoT, Cloud, and weather to create a suite of solutions that span the farm-to-fork ecosystem.

The Indian Government has decided to invest heavily in agricultural infrastructure to strengthen it with technology. Technology would help in boosting the income of Indian farmers and promote sustainable farming. These solutions will be helpful to provide supporting platform to our nation.

 Gujarat-based venture started in 2001, Ekgaon Technologies is an IT based network integrator that provides a technology platform and offers a range of facilities to farmers in rural areas including financial, agricultural inputs and twist instruction.[18]

The Electronic National Agriculture Market (e-NAM) was launched in April 2016 to create a unified national market for agricultural commodities by networking existing APMCs. It had 16.6 million farmers and 131,000 traders registered on its platform until May 2020. Over 1,000 mandis in India are already linked to e-NAM and 22,000 additional mandis are expected to be linked by 2021-22. Niti Aayog, policy-making commission of India, is planning to conduct programs and researches on technologies like machine learning, artificial intelligence and Internet of Things (IOT) to escalate the Agri Economy of the country.

India successfully developed Internet Based Solution and helping our farmers. E-Choupal: ITC Ltd initiative, Direct Procurement from Rural farmers of agricultural and aquaculture products like soybeans, wheat, coffee, and prawns. Kisan Suvidha: Learning based solution for farmers to increase yields and returns.[19]

Technology is providing apps for farmers like Uzhavan: Hiring and Renting Farm Equipment. AG Mobile: This app keeps you informed about day-to-day activity in agriculture market. CC Mobile: Helps farmers monitor their crops. IIFCO Kissan: Mandi Prices, Weather Forecast, Govt Policies and all Agri Related Schemes and News Solution.

Integration of IOT and RFID technology is an agricultural information cloud used to provide correct information to farmers. Farmers can further utilize the data provided by the technologies and equipment involved.[20]

2.2. What India can learn from rest of the world?

Researchers in China employed the technology of cloud computing and IOT in agriculture sector, it resulted in advancing soilless culture, solution control technology, environment control technology (monitoring the environmental factors, such as humidity, wind pressure and speed) and smart irrigation technology (it helps in optimizing the use of water). The research was conducted in 2013 in China. It achieved success in projects like 'Golden agricultural project', 'The three Dian project', etc.[21]

The use of GPS and wireless nodes provide a powerful monitoring tool. It helps in analyzing crop cultivation and has also helped in monitoring the use of pesticide by using

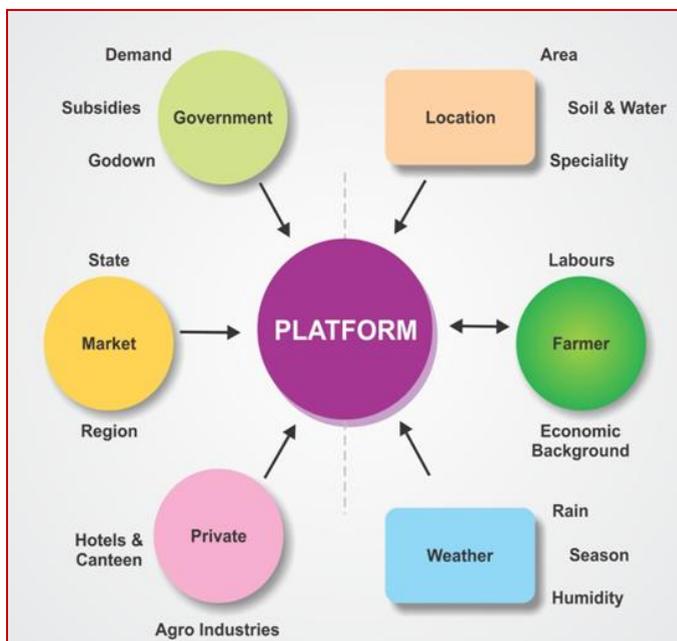**Fig. 2** GPS technology involves using drones. [22]

Fig. 3 Proposed model for crop deciding platform.

drones. In addition, this technology made switching state of pump easy; it also provided data and algorithms useful to farmers.[22]

Smart farming project of Brazil[23] employed technologies such as digital revolution, AI, mobility with intelligent sensors. This project resulted in recognizing innovative products, procedure optimization and helped in devising effective ways to manage agricultural production. In addition, it explored the possibility of using remote sensing technology in agriculture.

The data about variations of sunlight, temperature, rain and humidity was collected from Meteorological department to gather knowledge on deviation in seasons against previous years data. Also, data was collected using satellite images about the Normalized Difference Vegetation Index (NDVI), which helped in indicating the amount of photo-synthetically active vegetation in the area. It further helped in formation of data-oriented models. The NDVI associates with green leaf biomass and green leaf area, found (accidently) that India's NDVI values were very high, indicating it to be helpful in boosting sustainable farming in India.[24]

3. Proposed idea:

3.1. Factors for crop deciding platform

It is mentioned that there are several advances in agriculture sector to support our farmer. The farmer has to decide how much land, labour, water, soil and type of technology to produce in available environmental conditions. Finally, farmer has to earn a profit from own farming to support his livelihood by utilizing these knowledge. The farmer would efficiently use the available resources to increase profits through deciding among the best alternatives available. During this decision making process, farmers cross check the suitability of proposed crop/cropping systems with their existing resources and other conditions. Thereby, they justify choosing or

rejecting a crop/cropping systems based on situations. This process enables the farmers to undertake a farming analysis internally which in turn guides them to take an appropriate decision while farming. Farm planning is essential to help the farmers to move to a higher level of production and income.

In this context, we herewith are suggesting a basic platform in farming as challenges to our farmer as shown. Initially, we are focusing the factors which are needed for crop analysis and its productivity as shown in Fig. 3. In future, this work will be extended with the help of technologies like Machine learning to provide a detailed analysis of every crop and its solutions. The challenges where analysis has to be carried out to get agricultural productivity are explained here and are in agreement with the help of current research progress in agricultural for our nation at individual level.

Factors like challenges are categorized in two ways as: Farmers factors and Market factors

3.2. Farmers factors

3.2.1 Poor and declining soil fertility/quality of land

Awareness whether the crop/cropping system suitable for local soil type, pH and soil fertility. Soil quality and sustainable management of soil for enhancing crop productivity are the essential factors for farmers. If farmer is known to soil quality then he can take efforts to improve its productivity but if it is unknown to farmer then it will be time consuming. Soil quality measurement tools can be helpful in this analysis. Adverse effects on soil quality arise from soil erosion, loss of organic matter, localized nutrient depletion or excessive fertilization, soil pollution. There is a need for greater as well as more reliable agricultural yield to feed the growing population. Interest in soil quality is increasing throughout the world as humankind recognizes the fragility of earth's soil, water, and air resources and the need to protect them for sustained agricultural production.

3.2.2 Background of farmer

The economic condition and background of farmer plays vital role. Not necessary who has very strong financial background but at least he can sustain nonproductive farming. If he is familiar to farming then one can get knowledge with the help of technology and take the decision for crops whether to go ahead or not?

Strong financial background leads to use of adverse technology and use of advance equipment in farming. Educated person can get knowledge by conducting workshops based on successful farming and also its utilization in crop productivity. This encouragement can help to motivate to others also.

3.2.3 Adverse weather conditions

Frequent droughts and floods; and erratic, unreliable and unpredictable rainfall have over the last two decades adversely affected crop production with major repercussions on economic growth and development. The frequency as well as the intensity of these hazards has tended to increase over the last two decades. Here the many minute factors which can't

always predict but at a certain point we can notify the farmer he should do it to prevent his crop from unexpected weather conditions. We can also analyze various parameters where the crop is suitable and this includes rain the most crucial part. The practices of choosing a crop to grow in a particular area has been determined by several factors including temperature, precipitation, humidity, wind, soil, vegetations cover, radiation energy and socioeconomic conditions of farmers. In short, climatic conditions, physical relief features and human preferences determine what crops could be grown in an area. However, choice of crops to be grown in particular seasons has been complicated with increased impact of climate variability especially in semi-arid areas. As a result, effective crop productivity has been declining due to not only inadequate rainfall but also poor decision making of smallholder farmers. This can be achieved by taking expert opinion and also crop analysis.

3.2.4 Crop management practices

Even in cases where high yielding crop varieties have been adopted, there has been no remarkable increase in crop production under smallholder farm conditions. Part of the problem is due to poor crop husbandry and management practices, such as late land preparation, late planting, inappropriate plant population densities, late weeding, poor fertilizer management practices, and poor post-harvest handling and storage.

3.2.5 Uncontrolled insect pests and diseases

Insect pests and diseases adversely affect crop performance. Smallholder farmers do not have the capacity to control large-scale infestations of migratory insect pests, such as red locusts or army worm; and/or new diseases which can damage crops at higher level.

3.2.6 Technology adoption barriers

For farm-level adoption, barriers include small farm size, widespread poverty and lack of capital, inadequate credit, risk aversion, lack of access to information, lack of human capital, inappropriate transportation infrastructure, inadequate incentives associated with tenure arrangements, poor linkages among various stakeholders, inappropriate government policies, and less knowledge of government policies.

3.3. Market factors

3.3.1 Government policies

The main component of crop price, as well as crop decision, is the government's godowns. Many times the government has a maximum of the part reserved in their godowns and so the price reduces as well. Another factor is that schemes which government keep on notifying for the different crop may it be

from loans to different subsides to important crop. Limited collaborations with Researchers and nearby countries can be a problem associated with government policies. Educated people can get more benefits to adopt new ideas and their implementation in farming. Interest in farming has to enhance by adopting research schemes or projects. The general picture obtained from the expert opinions is that there is limited collaboration among scientists from different institutions (public, semi-public, international and private institutions). The international and private research bodies do not appropriately extend their resources with the public and semi-public research institutions to boost their collaborative work. Additionally, the problem arises from the fact that researchers fail to closely work with extension workers to jointly work on priority problem areas of the farmers. This limits the development of technologies that would be readily disseminated to farmers and with enhanced acceptability by these end users. This in turn limits the rate of agricultural productivity growth. Workshops for farmers have to be arranged to get the platform for new ideas or to present farmer's new ideas.

3.3.2 Market demand and availability of market infrastructure

Farmers should have awareness about the information about crop selling prices, has to get answers of questions like where to sell? When to sell? Whom to sell to? What form to sell in? Etc. The real time market information and market intelligence on proposed crops information can get from adopted technology. Numerous apps or data systems are available also with the help of technology but network problem is the critical factor in ruler areas. So, the access where farmer get this information has limitations.

3.3.3 Private companies

Many private sector companies have relations with farmer. The link can be provided through the platform to farmers as well as industry. Another component in the private sector may be the hotels and canteens which need different farm products constantly we can also link many farmers and give them a competitive price.

We can surely get an optimal crop to grow farm and get the sure market price too. The main thing is to be understood that this is not an online buying selling platform but this a crop deciding platform using technology.

4. Proposed model for implementation of factor analysis

By analyzing these above factors, our proposed platform aims the implementation of analysis to real situation using
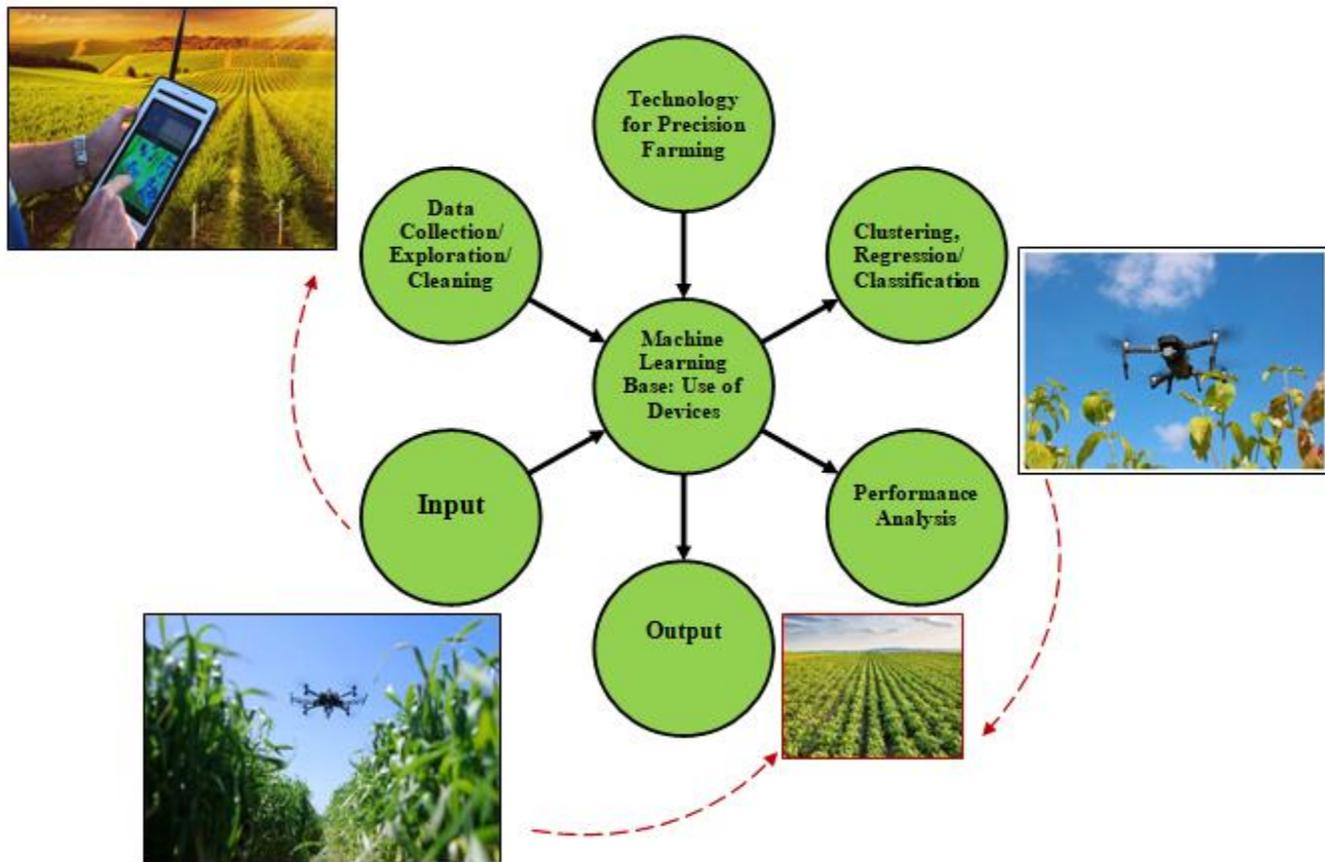
Fig. 4 Machine learning data processing system.

machine learning for suitable crop. Computer simulations can be used to conduct early crop tests and to analyze when faced with different sub climates, soil types, weather patterns and other factors. Basically, these data collection cannot replace by physical trials but can help farmers to more accurately predict the performance of crops. The instance at which new variety germinates, machine learning has boosted in creating more thoroughly vetted product than ever before.
The required study is based on the analysis of Data exploration, Data cleaning, Modeling, Performance analysis.

Initially, data collection as input is needed. Information regarding the crop variety to be tested is used as input.

4.1. Data exploration and cleaning
This step involves data collection from various sensors and other information source and also classifying data to analyze it separately as required.

4.2. Modeling
In this step, we decide the appropriate model for the factors affecting the crop decision according to the type of data and type of outcome.

This step gives the outcome of the crop and required parameters accordingly

4.3. Performance analysis
The accuracy of platform, data analysis is analyzed at this final step.

The information is passed through either supervised or unsupervised machine learning approach like convolution neural network CNN, support vector machine SVM etc. The approach helps to extract and analyze data for concerned problem. The feasible output is classified, clustered or regressed.

5. Future Scope

All aspects mentioned in present article can be used to offer precision farming related to basic platform. The platform requires basic use of computer simulations. It must also enhance capacity building, especially among extension workers, to teach precision farming to the farmers. Markets need to be developed to absorb the additional output that will come with special emphasis on value addition through processing of the product. Otherwise, the benefits of farming will be lost due to low prices. Finally, advanced farming makes agriculture less risky and more engaging which will draw youngsters into the profession. It is also a good way to ensure India's food security.

Despite technology's promise, there remains a need for substantial increase in old-fashioned investments to catch up with the backlog in physical infrastructure and education to achieve a geographically more dispersed development away from the 100 big cities. Around 25% of Indian adults cannot read or write, and the gender divide must be addressed with investment, particularly in rural women's education and training. Geographical application of new technologies is still

limited in rural areas; many farmers remain unaware of these advances. Insufficient connectivity in rural areas along with a lack of basic computer knowledge and literacy hinder development. Substantial investment is needed in physical infrastructure, power, broadband, transportation and education, particularly in rural regions.

Loss of food items could be reduced with structural development work like godowns, cold storages and market yards etc. We can encourage value added services by promoting the food processing industry. By increasing quality of our products, we can attract other countries to import our food products. With use of this India will recognize as "Brand India" at the international level. The government is promoting agri-business with a view to provide maximum benefit to the farmers. Amazon, Alibaba, E-bay and Wallmart E-commerce agencies have brought revolutionary changes through artificial intelligence and machine learning. In line with the revolution of E-commerce, a platform of E agri/digital agriculture is being prepared with the help of which agri-business schemes will reach the major urban and town areas.

Home delivery agencies like Big Basket and Gofers have helped in paving the way to develop beneficial agri-business for their own with the help of agriculture specialists. Green farm house, poly house and small bio farms for growing vegetables etc. are becoming beneficial for the farmers due to their quality and fair prices. This can be the encouragement to farmers to learn new technology and even its implementation with the help of researchers.

We can transform this challenge of worldwide spread of the Corona pandemic into an opportunity as due to the epidemic, there is matter of concern of lack of food items in the whole world. Due to this concern, there is a huge gap being observed in the supply and demand because people have started storing food items. This situation can turn into opportunity and farming can be economic prosperity for our farmers. The positive attitude will automatically provide opportunity and will achieve the target for India in the agriculture sector.

Acknowledgement

Supporting information
Not applicable

Conflict of interest
There are no conflicts to declare.

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