Symbiosis Skills and Professional University

Kiwale, Pune

PROJECT REPORT

On

“Optimization of Agriculture Pridiction”

<u>Submitted by</u>

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<u>Under The Guidance of</u>

Ritviz sir

STUDENT DECLARATION AND ATTESTATION BY TRAINER

This is to declare that this report has been written by me. No part of the report is plagiarized from other sources. All information included from other sources have been duly acknowledged. I aver that if any part of the report is found to be plagiarized, I shall take full responsibility for it.

Signature of student

Gaikwad Pawan Ramesh

Signature of trainer

Ritviz sir

CERTIFICATE

This is to certify that the report entitled, "**OPTIMIZATION OF AGRICULTURE PRIDICTION**" submitted by **"Gaikwad Pawan Ramesh**" to Symbiosis Skills and Professional University, Pune, Maharashtra, India, is a record of bonafide Project work carried out by him under my supervision and guidance and is worthy of consideration for the completion of certificate course in 'Data Associate".

Signature of Trainer

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Date: 10/ 08/ 2021

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Date:

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I'd want to express my heartfelt gratitude to Kushal Sharma, who provided me with the excellent opportunity to work on this wonderful project on this issue, as well as assisting me in conducting extensive research and learning about many new things.

2. Plan of Project

2.1 Purpose of Project -

The goal of this research is to use machine learning to help optimise land for maximum crop yield by efficiently utilising land resources in food crop cultivation. Crop output is heavily reliant on how well basic land requirements are met; land relates to soil type, soil nutrients, water content, temperature, humidity, and water quality, among other things.

The ultimate goal is to maximise production by automatically reducing water consumption, fertiliser use, and the amount of arable land. The goal of this work is to find the best agricultural production plan by merging numerous criteria into a utility function while keeping a set of restrictions in mind, such as land, labour, available capital, and so on. We used multicriteria techniques to extend procedures for the analysis and modelling of agricultural systems for this goal.

2.2 Problem Statement –

Agriculture is the backbone of the Indian economy, contributing to the country's overall economic growth. It also determines the living standards of more than half of India's people. However, Indian agriculture is currently beset by a slew of issues, some of which are natural and others which are man-made.

Rural people borrow large sums of money on a regular basis to meet their production, consumption, and social obligations. As a result, the debt is passed down the generations. Crop failure, limited income resulting from low crop prices, and exorbitantly high interest rates levied by money lenders all contribute to Indian farmers falling into debt. As a result, the debt is passed on through the generations. Crop failure, limited income due to low crop prices, exorbitantly high interest levied by moneylenders, manipulation and use of loan accounts by moneylenders, and usage of loan for different unproductive social objectives all contribute to Indian farmers falling into debt traps.

3. Objective of the Project

- **To provide a system that allows farmers access to relevant information**

--- Average farmer has access to crude sources of information such as TV, radio, newspapers, fellow farmers, government agricultural agencies, farm supply, and traders. there is, therefore, a need for a system that allows farmers access to relevant information

- **To Provide them correct solution/Information**

--- Farmers will always need information to refer to, most especially when growing crops that are not common in their land so we provide them with correct solution.

- **To Provide a mobile application interface**

--- Most farmers do not have access to a central repository of relevant information that will help them make full use of and optimize their farmland. This work provided a mobile application interface that allows farmers to access their farmland information and guarantees them the services they need instantly

4. Literature Survey

S/N	Author(S)	Year	Problem	Method	Contribution
1	Priya et al. [3]	2018	This work was concerned with the use of the random forest algorithm to generate predictions for crop yield and improvement.	The random forest algorithm was used for yield production using a dataset with four features or parameters. A training set as used to train the algorithm rules which were then applied to the remaining datasets	The results showed that we can attain an accurate crop yield prediction using the random forest algorithm. Random forest algorithm achieves a largest number of crop yield models with lowest models
2	Jeong et. al. [4]	2016	This work aimed at examining the performance efficiency of the random forest algorithm in crop yield prediction for the wheat crop, potato crop, and maize crop.	The random forest algorithm was used to train the datasets, and the same datasets were applied to an MLR model as a benchmark for the random forest algorithm	The work showed that the random forest algorithm is far more effective in crop yield prediction
3	Liakos et. al. [2]	2018	&is work involved a research into the use of machine learning agricultural production systems.	This work applied artificial neural networks	This work showed that machine learning models have been used in several agriculture-related areas. Mainly in crop production and aiding management

					decision making processes
4	Ming et. al. [5]	2016	This work involved classification of land cover based on image and remote sensing.	Random forest machine learning algorithm was used in the classification of image data	Random forest is an efficient classification algorithm and performs effectively without using special selected features
5	Nitze et al. [6]	2012	This work compared the effectiveness of several machine learning algorithms: support vector machine, artificial neural networks, and random forest	several classifiers, Naïve Bayes for ML, random forest (RF), multilayer perceptron in case of ANN, and LibSVM for support vector machine, were used in this work for the classification of crops.	Even though classification results depended strongly on the number of images used, the SVM classifiers performed much better than the RF and ANN in most of the cases

5. Introduction

5.1 Introduction -

Agriculture is significant for the event of the planet. We, humans, enjoy agriculture a method or the opposite, agriculture has become a popular subject of study as a result of this. Farmers will always need information to ask, above all when growing crops that aren't common in their land or culture. The average farmer has access to basic information sources of data like TV, radio, newspapers, fellow farmers, government agricultural agencies, farm supply, and traders. As a result, a system that provides farmers with timely information is required.

Machine learning is one of the most popular technologies, and as a result, there are a variety of technologies and systems that use it. Several machine learning methods in agriculture have been explored and developed recently. The performance of numerous machine learning algorithms in agriculture and other application domains has also been investigated, as machine learning is a very powerful tool for resource efficiency, prediction, and management, all of which are important in agriculture. The ability of an electrical processing system to acquire and apply knowledge is known as machine learning

The focus of this research is on food crop agriculture and the use of machine learning to help optimise land for maximum crop yield while utilising land resources economically. Crop production is highly dependent on how well basic land requirements are met; land refers to topography, soil type, soil nutrients, water content, sunlight, and other elements that affect crop development on farmable land. There are many natural conditions that impact the farming outcome, still if the contemporary kind of technologies is used in the farming, there are potential chances that the process efficiency and the outcome could be significantly improved in the system. Farmers can keep track of and regulate every parameter, including humidity, temperature, and wetness. Farmers stand to gain significant insights from Predictive Analytics as these factors become more integrated, allowing them to make better decisions.

Crop output on existing land must be boosted by the implementation of new technology. Increasing earnings while reducing waste and maintaining environmental quality is a win-win situation. Farmers are provided with decision support systems that recommend the appropriate dose/action at the appropriate location and time. Agriculture also plays a significant role in the economies of all countries. With the rapid advancement of technology, collecting, storing, and analysing data in order to derive usable information will become easier. In agriculture, IT may be used as a direct tool to boost productivity as well as an indirect tool to encourage farmers to make better decisions.

Precision agriculture is based on evaluating vast amounts of real-time data from many sources such as soil, weather, air, equipment, availability, and so on. Productivity in rural areas is too low because farmers in rural areas lack understanding of contemporary technologies and still rely on old farming methods. Every day, 2.5 quintillion bytes of data are generated, according to estimates. Furthermore, it was discovered that the growth of big data had doubled by the end of 2015. Using typical tools and procedures to manage and govern these data is extremely tough. As a result, it is necessary to learn about big data and its connected fields.

The agriculture sector's vulnerability as a result of climate change has far-reaching effects. Economy of Macedonia Given that the majority of the rural population is reliant on agriculture, Agriculture, rural populations, and notably farmers, will be particularly vulnerable to the effects of climate change. Climate change will pose new issues in the future. The rural poor will be the most affected by the detrimental effects of climate change on agriculture due to their heavy reliance on agriculture, limited ability to adapt, and large percentage of food in overall costs. Severe climate change might have disastrous consequences for their financial power, food supplies, and the country's economy as a whole, including exports.

5.2 Predictive Analytics in Precision Agriculture -

Optimizing crop yields in which 90% of crop loss is due to weather, minimizing large variable cost for Labour, and use of Intelligent Pesticide, Herbicide, and Fungicide spraying. Predictive analytics collects, integrates, and analyses massive farming data using business intelligence. Models are then created to anticipate the situations in which pests are most likely to strike.

This enables farmers to make exact judgments about where and when pesticides are needed on their crops. Predictive analytics is no longer just a buzzword in agriculture; it is now a reality as actionable insight to make decisions based on data and information to improve agronomic opportunities, such as application timing, product decisions, product amounts, and decision-making profitability, and it is all being used today, with new developments coming all the time. Management and consequences of decisions can be more easily made by learning from historical and future data based on measured variables, which can have a significant impact on efficiencies and processes.

Precision farming is one of many options for meeting a 55 percent increase in global demand for agricultural goods on present agricultural land by 2050 while using fewer fertilisers and conserving water.

Precision agriculture, which entails applying inputs (what is required) when and where they are required, has emerged as the third wave of the contemporary agricultural revolution (the first was mechanisation, the green revolution, with its genetic alteration, was the second). Precision agriculture or applying what is needed when and where it is needed, has enhanced farm management efficiency even more with the advent of data-based digital systems that expand producers' knowledge of their fields; this is known as Agriculture 4.0 or Digital Farming. Precision farming has the potential to alter the agriculture sector by increasing the efficiency and predictability of traditional farming activities. The expansion of the precision farming industry is being fuelled by rising global food demand, increased profitability and crop output, and crop health monitoring for greater yield production.

5.3 Precision Farming and Optimization

5.3.1 Optimization:

A process, or methodology of making something (such as a design, system, or decision) as fully perfect, functional, or effective as possible.

Decision-making is the focus of optimization. Optimal or best decisions can be made using optimization techniques. The concept of optimization is now well-established as a guiding principle in the examination of a wide range of difficult decision and allocation problems. It provides a level of philosophical elegance that is difficult to dispute, as well as a level of operational simplicity that is often required. It provides a level of philosophical elegance that is difficult to deny, as well as an indispensable level of operational simplicity.

Agriculture faces a number of issues, including irrigation water management, land allocation, climate change, human and other agricultural resources, all of which can be managed through proper crop planning optimization entails maximising profits with the least amount of resources by optimising the objectives. Agriculture is crucial in ecosystem management; employing bio-fertilizer and green manure can improve soil fertility without causing any chemical reactions' planning. Crop planning's major goal is to increase profit and production while keeping input costs and resources low. The crop planning problem has numerous variables, some of which can be optimised and others which cannot. Algorithms, optimization tools, decision-making tools, software, and other technologies are available to handle crop planning problems.

Crop planning considerations in traditional agriculture were primarily influenced by the farmer's opinion and experience. However, with advances in agriculture and technology, increased demand for land and other resources, combined with the development of more formal planning approaches based on the design and analysis of a mathematical model has been spurred by greater specialisation and the use of capital-intensive production systems. Mathematical programming models have been used in the agricultural sector, either directly or indirectly, since their inception, and have made significant contributions to the analysis of policy issues such as resource allocations, investment decisions, comparative advantage, risk analysis, and so on.

The act of attaining the best feasible result under given circumstances is known as optimization. All such judgments are made with the purpose of minimising effort or maximising benefit. Typically, the effort or benefit can be stated as a function of design variables. As a result, optimization is the process of determining the conditions that lead to a function's greatest or minimal value.

- **Scope of optimization techniques:**

The FAO (1993) recommendations on land use planning, which identify three major levels: national, district, and local, can also be used to optimise. In this set of guidelines, the term "district level" does not always mean "administrative level." land areas that fall between national boundaries, as well as districts. both at the national and local levels A hamlet or a group of villages is referred to as the local level a tiny water catchment or a village.

Profit maximisation and/or cost minimization for a farmer are two basic objective functions. The knowledge and contributions of local people aid in the formulation of models and policies that meet the people's goals. Because each farmer has limited resources at their disposal for every planning period, the technical coefficients are also easy to determine at the local level. A farm's production potential, on the other hand, is limited because it is constrained by fixed resources for a specific period of time.

5.3.2 Precision Farming:

To use new technologies to increase crop yields. Precision farming is an integrated crop management system that monitors the agricultural field at ground level using remote sensing (RS), GPS, and geographic information systems (GIS). Within a field, differences in crop or soil parameters are documented and plotted.

Precision agriculture is more of a management philosophy or approach to the farm than a specific term system that is prescriptive It highlights the key elements that restrict yield, as well as the controllable factors that limit yield. It also determines the inherent spatial variability. It essentially entails more precise farm management. Modern technology has made this possible. Variations in crop or soil qualities that occur within a field as a result of continuing monitoring, are noticed, plotted, and management actions are made as a result of continued monitoring Precision agriculture necessitates the use of specialised techniques and resources to recognise the inherent spatial variability associated with soil properties and crop growth, as well as to prescribe the best management strategy for each site. It has the potential to make a significant difference in terms of productivity adoption of site-specific management to examine the geographical heterogeneity within that field remote sensing (RS), global positioning system (GPS), and geographic information system (GIS) systems (GIS).In the context of Indian agriculture, the better definition for Precision Farming is Agricultural inputs are precisely applied based on soil, weather, and crop a need to maximise long-term production, quality, and profit.

Precision farming is a method of increasing average yields by using exact amounts of inputs in comparison to traditional gardening approaches. As a result, it is a holistic system designed to maximise production by combining important elements of information, technology, and management in order to improve production efficiency, product quality, crop chemical usage efficiency, preserve energy, and protect the environment. As a result, precision farming is an enticing notion, and its principles logically lead to the hope that farming inputs may be used more effectively, resulting in increased profits and less environmentally damaging production. Today's precision agricultural advancements may supply the technologies for tomorrow's environmentally friendly agriculture. Precision farming, particularly in the case of small farmers in developing nations, holds the possibility of significant yield growth with minimum external input use.

Need of Precision Farming –

The global food system is currently confronted with significant issues, which are expected to worsen significantly during the next 40 years. With enough determination and commitment, much may be accomplished right away with present technologies and expertise. However, dealing with future concerns will necessitate more drastic adjustments to the food system as well as increased investment in research to develop innovative answers to fresh problems. Total productivity declines, diminishing and degrading natural resources, stagnating farm incomes, a lack of an eco-regional approach, declining and fragmented land holdings, agricultural trade liberalisation, limited non-farm employment opportunities, and global climatic variation have all become major concerns in agricultural growth and development.

Management strategies, soil attributes, and/or environmental factors all play a role in these variances. Because of the huge sizes and changes caused by annual adjustments in leasing arrangements in the farm region, maintaining a degree of awareness of field conditions is difficult. As a result, the entire farm must be divided into small farm units of 50 cents or fewer. Precision agriculture has the potential to automate and streamline the data collection and processing process. It enables management decisions to be made and implemented swiftly on tiny parts of bigger fields.

Components of Precision Agriculture –

The field is divided into "management zones," sometimes known as "grids," depending on soil pH, nutritional status, pest infestation, yield rates, and other parameters that affect crop output in precision agriculture. Precision agricultural tools such as GIS, GPS, and others are used to control zone inputs, and management decisions are based on the needs of each zone. With the aid of one of the most important precision farming technologies, the Global Positioning System (GPS), the exact location can be detected, and application on the exact spot may be produced with the use of advanced equipment. To do so, the farmer needs install a GPS receiver on the tractor/system that is administering the chemical, so that the equipment knows where it is in the field. The fertilizer/pesticide (or anything else needs to be administered) must be stored in an in-vehicle computer, which must be compared to the field position data recorded by the GPS sensor. Plant population can be chosen to optimise soil nutrients, and plant variety can be chosen to take advantage of field circumstances, in addition to fertilizer/pesticide requirements. Crop yield can also be tracked to build maps that illustrate where a field produces the most and least, allowing for better management decisions.

6. Materials and Methods

6.1. Materials

- Database/Crop Datasets:

The plant growth parameters that were utilised to create the individual decision trees in the random forest are among the data that make up this database. Irrigation, spacing, nutritional requirements, location, temperature, and other relevant aspects are among the data sources, which come from a number of reliable databases. The machine learning approach is used to aid decision making in the &is plant growth condition database.

6.2. Method.

Machine learning was utilised to integrate what had been used to establish parameters into a dataset on a mobile application in this study. The goal of this machine learning algorithm was to maximise land proportion. The dataset includes parameters for a number of inputs that are essential for plant growth. The machine learning algorithm creates a solution for the output by defining the relationship between these input factors and certain internally stored prediction parameters. The database values have been transformed to of 0 to 1 range system; the requirement for conversion to the same range was necessitated by data incoherence; data was derived from several sources and was thus inconsistent, necessitating a specific conversion.

6.2.1. Output Layer.

All of the inputs and their weighted values were translated to a 0 to 1 range system.

6.2.2. Decision Layer(s).

This comprises of decision layers that aid in the classification of incoming data into appropriate groups, as well as the making of decisions and setting of parameters.

6.2.3. Output.

This is composed of results from classification.

6.2.4. Classification.

This entailed determining which categories a new observation would belong to. The goal of data classification in this case was to group the crops into classes based on their data; these classes are based on which crops grow together most efficiently on a specific piece of land. Because the technique consists of numerous decision trees, the actual classification was done using random forests to allow all inputs to be considered many times for higher accuracy.

6.3 Methodology.

The steps in the intended methodology are as follows:

- Collecting the data which contains the essential requirements for farming/plant growth parameters.
- Then this Inputs will forward toward the machine which will matches the data with the internal stored dataset.
- By ML algorithm it will perform some actions and give output which matches to the input parameters and gives the result.

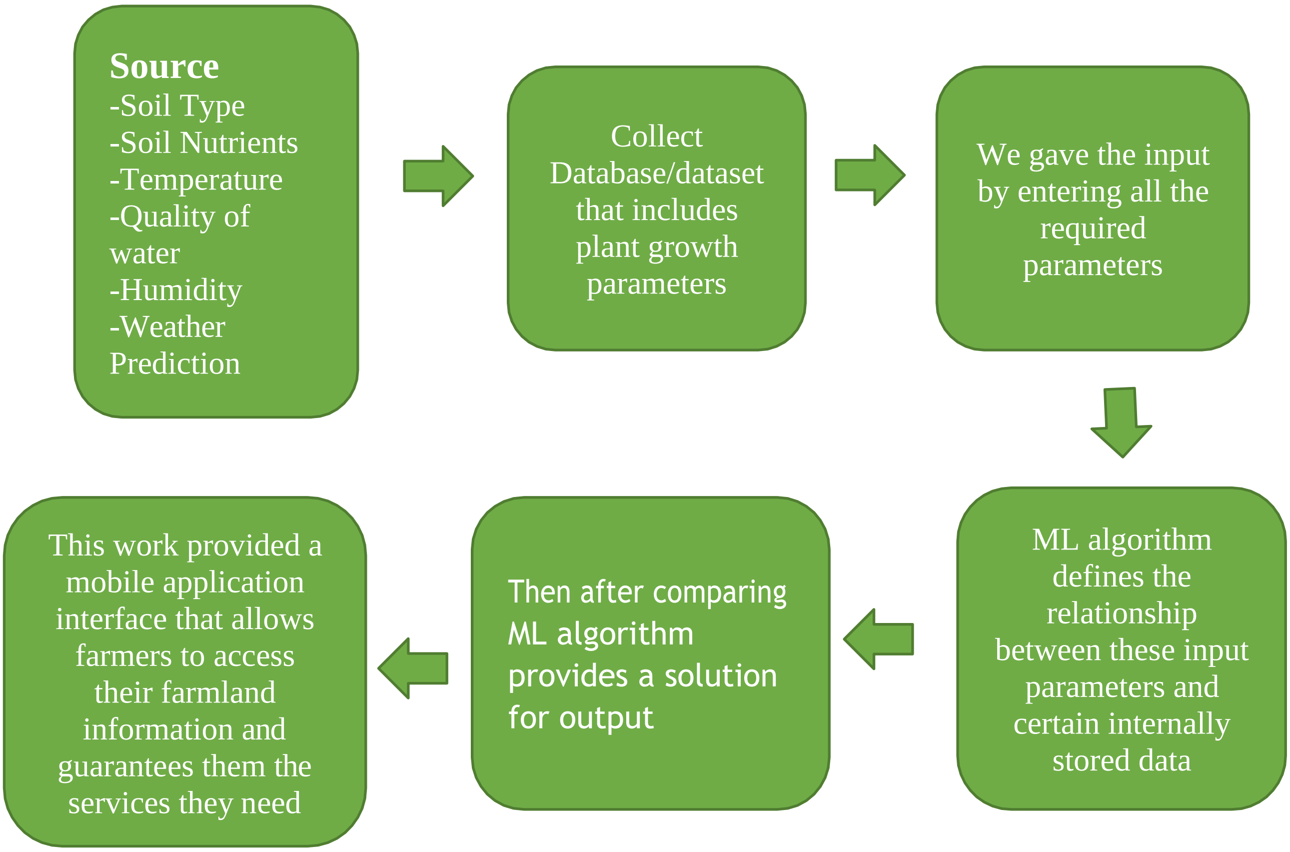

Fig: Proposed Model

7. Results

The suggested system contains an input collecting system that takes user input and processes it using the optimiser algorithm. The random forest technique is used to divide crop features into groups. The process data is made available to the consumer as feedback.

7.1. Implementation

7.1.1. Classification Model Output

The random forest classifier is used in this study to divide crop resource characteristics into ten subclasses, which are then divided into three primary classes. The crop is customised to its optimum level based on the primary traits of a variety. Two strategies were used to generate crop subclasses in this study. The first strategy used BigML to produce four random forests; these models were created and assessed, and the findings were compared to the performance of the second model, which used weighted linear equations to make decisions.

For each weight, the sets correspond to a set of values. The characteristics to consider include light demand (Lt), water requirement (W), space requirement (S), location (L), pH requirement (P), soil type (St), and companion (C).

7.1.2. Subclass Models: Method One

The outputs from each model generation were comparable, hence four subclass models with two tree samples each were constructed and studied in this study. The parameters for the generation of each of the models were chosen at random, resulting in a variety of results. This was added to allow features to be fitted to certain subclasses when some parameters were missing.

7.2 Data Analysis

Agriculture is the lifeblood of the Indian economy. A crucial component of rural development is agricultural development. The data were evaluated with appropriate statistical methods to determine the levels of development, and the results are shown below:

Maharashtra's land usage pattern is as follows:

In Figure 1, the land use pattern in Maharashtra is clearly displayed. In Maharashtra, the percentage of area covered by forest in 1990-91 was 8.86%, but it fell to 8.28 percent in 2009-10. Other types of land, such as barren and uncultivable land, land used for non-agricultural purposes, cultivable waste land, permanent pastures, land under various trees and valleys, and other fallow, have all experienced a comparable loss in area. Terrain that is barren and uncultivable, as well as land that is not used for agriculture. land under miscellaneous usage, cultivable waste land, permanent pastures, and land under miscellaneous use in 1990-91, the percentages of trees, grooves, and other fallow were 2.75, 2.12, 1.59, 2.07, 0.46, and 2.03 percent, respectively, whereas in 2009-10, they were 2.64, 2.09, 1.47, 1.96, 0.41, and 1.90 percent. Despite a drop-in land in several categories, there was an increase in current fallow and area seeded multiple times.

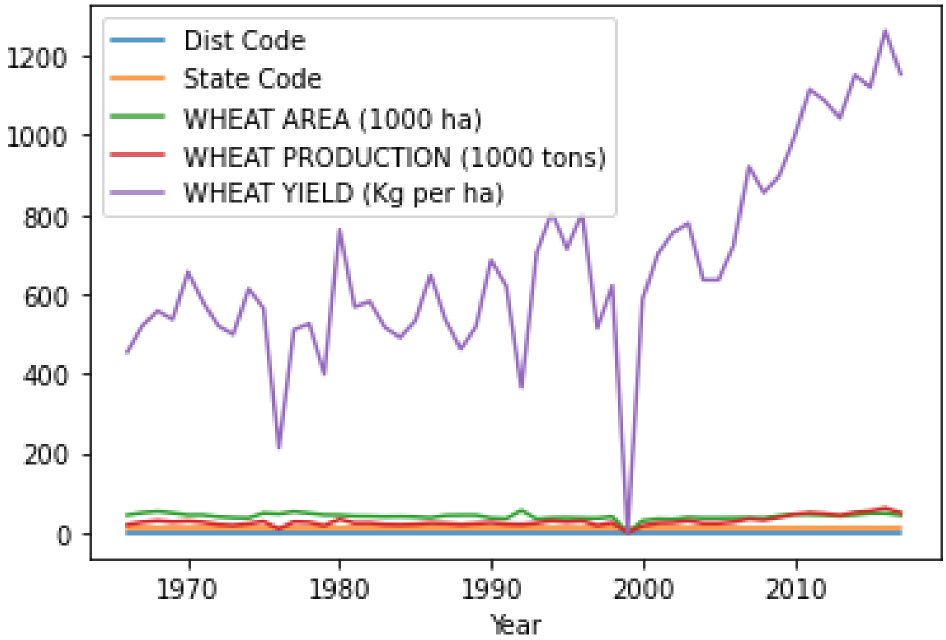

Fig: Growth of Wheat Production(1970-2010)

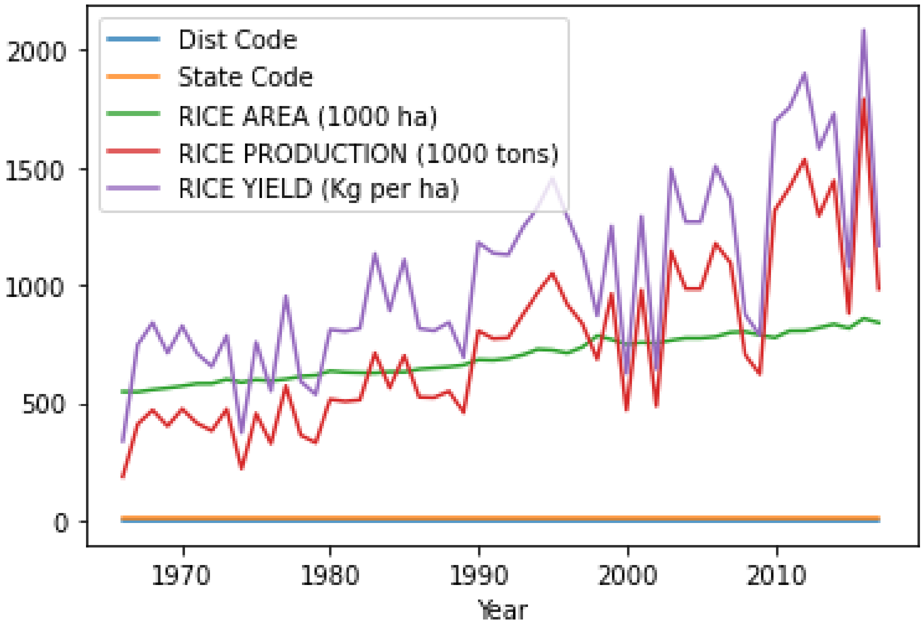

Fig: Growth of Rice Production(1970-2010)

Based on the statistics presented, it can be inferred that:

– Between 1990-91 and 2009-10, the growth rate of non-agricultural land, barren land, permanent pastures, current fallow, area seeded more than once, and gross cultivated area rose significantly.

– The majority of crops showed positive growth rates in terms of area, production, and productivity.

– The rate of growth of phosphatic fertiliser increased dramatically, but the rate of growth of nitrogenous fertiliser remained insignificant.

– In Maharashtra, well irrigation was the primary method of irrigation. The urban population, literacy, total road length, and number of cooperative organisations all showed dramatic increases in socioeconomic metrics.

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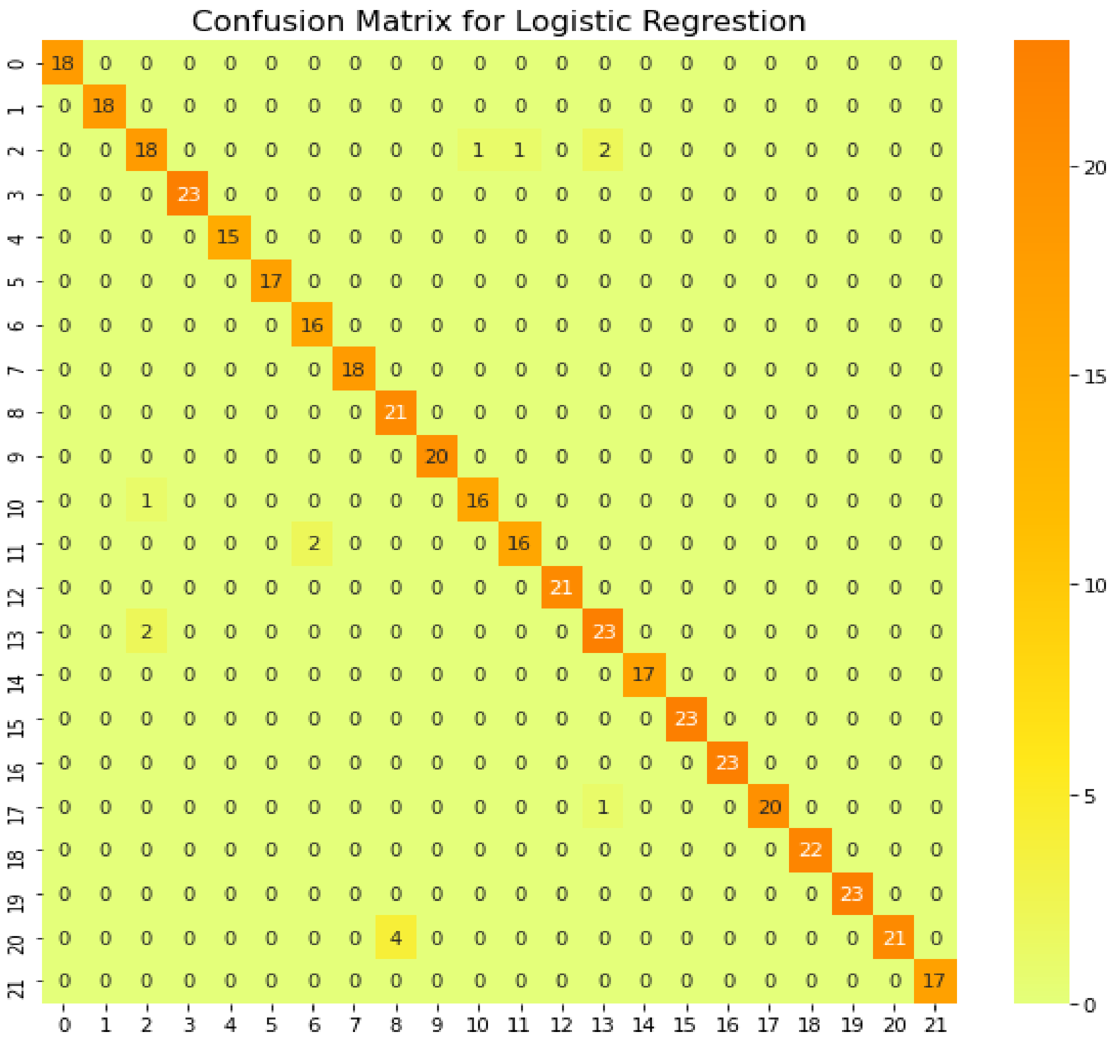

8. Conclusion

The majority of farmers do not have access to a central source of pertinent data that can assist them in making the best use of and optimising their acreage. &is work created a mobile application interface that allows farmers to quickly access information about their field and receive the services they require.

Precision farming is still a concept in many developing nations, and strategic support from both the public and private sectors is required to accelerate its implementation. However, there are at least three phases to successful adoption: exploration, analysis, and implementation. Precision agriculture has the potential to address both the economic and environmental challenges that currently plague production agriculture. Cost-effectiveness and the most effective methods to use the technological tools we currently have remain unanswered questions, but the concept of "doing the right thing at the right time" has a strong intuitive appeal. In light of today's pressing need, a concerted effort should be made to leverage new technical inputs to turn the "Green Revolution" into a "Evergreen Revolution”.

9. Future Work

In the future, the machine learning models used to inform parameter setting in the mobile application might be developed using the system's embedded machine learning algorithm and utilised to anticipate outcomes.

Precision Agriculture research will continue to be available. Chemicals, fertilisers, tillage, and seed will be applied to a field in diverse ways, and yield or plant biomass will be collected by position across the field. We will be able to observe variance within a field during the growing season in relation to imposed management modifications using remote sensing technology. Surface water and groundwater samples are collected using monitoring equipment to determine the environmental impact of surface runoff or leaching. The technology exists to absorb nitrogen or pesticide volatilization from the field into the atmosphere as a result of improved practises. The ability of the scientific community to conduct this type of study, with confidence from the environmental and producer communities that reforms will benefit the environment and increase the efficiency of agricultural production, will determine the future direction of agriculture.

Data Availability

On request, the data used to support the findings of this study can be obtained from the corresponding author. The following website provides information on ecological requirements: http://www.nafis.go.ke/agriculture/maize/ecological-requirements/.

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