



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

Fertilizer Recommendation System

Lakshmi Priya K, Afrah Fathima M A, Jenifer P

U.G. Student, Department of Computer Science and Engineering, Francis Xavier Engineering College,
Tirunelveli, India

U.G. Student, Department of Computer Science and Engineering, Francis Xavier Engineering College,
Tirunelveli, India

Assistant Professor, Department of Computer Science and Engineering, Francis Xavier Engineering College,
Tirunelveli, India

ABSTRACT: This paper designs a new method in precision agronomy forecasting on a basis of machine learning techniques. The careful handling of fertilizers is inevitable for enhancing crop productivity and reducing ecological impact. The orthodox approach to fertilizer application is mostly imprecise and can lead to either overuse or misuse, causing improper resource utilization and detriment to the environment. This system uses machine learning to analyze a huge number of factors, such as soil characteristics, type of crop, weather conditions and the historic harvest records. The system implements the use of modern machine learning algorithms such as decision trees, random forests and gradient boosting in order to discover complex relationships between the input variables and optimal fertilizer recommendations. In summary, we provide novel insights into precision agriculture based on our use of machine learning to enhance the fertilizer management techniques.

KEYWORDS: fertilizer, soil measurement, recommender, machine learning, random forest classifier.

I. INTRODUCTION

One of the key aspects that the modern agriculture faces today is finding a reasonable balance between productivity and sustainability. In this context, the effective management of fertilizers is of paramount importance since it helps in crop yield optimization as well as to minimize the harmful environmental effects. The conventional method of fertilizer is unspecific and causes suboptimal resource use as well as environmental problems. This paper suggests a new method for applying a fertilizer recommendation in precision agriculture using the state-of-the-art machine learning techniques. Technology and data driven insights are the key elements of the precision agriculture that help to change the old methods of farming and optimize agricultural processes. The very basis of precision farming is pinpoint application of resources where and when there is the need to the maximum level. Through variable fertilizer application based on individual crop and soil requirements, precision agriculture attempts to get highest yield with regard to minimization of waste and harming the environment.

The promotion of fertilizer recommendation in the traditional approach was respondent on general guidelines and by subjective assessments. This might impair those unique and interchanging factors that often affect the growth of the crop and nutrients needs. Also, variation with respect to the character of soil, type of crop, weather phenomenon and management does not only add more to the complexity of choosing the right fertilizer strategy but may often shatter any decision that might be formulated. This, in turn, means that there is an urgent requirement for informatics-related solutions that can take all the complex agronomic aspects into account and give the producers highly targeted fertilizer application plans, relying on agronomic factors.

To solve shortcomings of traditional suggesting means, we propose the machine learning-based fertilizer recommendation system. This system is a collection of data from different sources such as soil characters, crop species, weather conditions and historical data of the yields which ultimately produces the fertilizer prescriptions that are in line with the terrain and climatic condition where it will be used. The learning mechanism has the capacity to run heavy duty machine learning algorithms such as decision trees, random forests and gradient boosting. This facilitates the exposure of complex relationships between input variables and output decisions.

II. LITERATURE SURVEY

[1] The ecosystem relies on the machine learning to make an algorithm that outputs the most feasible crop types and fertilizers according to the soil quality and geographical location. The four key stages of this outlined system include data analysis and visualization, data partitioning into the training and testing sets, machine learning model training, and especially accuracy comparison between each designed model. There were two models that the researchers said are the highest predictors of this condition and they included XGBoost and Random Forest.

[2] Neighborhood based strategy is applied here for its explorative and exploitative approach to controlling the optimization of parameters and maximum possible efficiency. On the standpoint of population explore strategy, it is a means to achieve knowledge increase by way of it. Finally, applying the identified patterns in the real-time data from sensors would suggest the end pattern. This is because alternative sources of nitrogen are very limited in the ecosystem; hence, fertility of crops gradually decreases. This is a crop model which, apart from assessing soil's seasonal fertility performance, will be aimed at improving yield (production). The approach being recommended is part of the strategy to build the idea with the crop producers whereby they will be exposed to the nutrient requirement of the optimum conditions for the crop development. It is also a useful tool in enhancing the soil fertility performance.

[3] Even after four years, we can see that during this period farmers could harvest a maximum of 8–21% different types of crops when they used fertilizer appropriately (as determined by laboratory tests of the soil), compared to their usual practice. The task we face is to find the best fertilizer for the given plant in order to consider variables like temperature, moisture, the amount of phosphorus, potassium, and nitrogen that it needs. The farmer is also to be expecting a list of some fertilizer stores within the area that match with the recommended fertilizer type from the provided report.

[4] As a result, this work proved to be a real breakthrough in the parameter of nutrient of the soil and suggests the best purchase of fertilizer. Four steps make up the suggested methodologies: tasks that include pre-processing data, data analysis, recommendation analysis, as well as soil analysis. It employs an Internet of Things (IoT) device to collect the soil sample data. It is the NPK sensor with the two electrodes to the detection and collection of the soil Nutrient of NPK ratio which are used. For pre-processing pass on the sensor data to the needed dataset data and then run a machine learning algorithm to identify the applicable fertilizer.

[5] Farmers should implement the early detection technologies and work in teams to solve any critical challenges in their crop yield operations to resolve this problem. For the protection of food security, the crop yield prediction research requires more attention. Accordingly, the farmers should be definitely given helpful tips on what they ought to grow since they live in different agroclimatic zones. Detailed prognoses of parameters like yields of the selected crops are demanded to be obtained through the use of machine learning tools intended for analysis of the overwhelming amounts of data with the purpose of more in-depth understanding of the agricultural output. By virtue of that, farmers can now not only access this data but also take it into account to make more accurate crop selections.

[6] The neural network diabetes that is the driving force behind the crop recommendation system was educated on a dataset which was of major crops grown in Rwanda by predominating growth factors that included soil pH, potassium, phosphorus and Nitrogen. Taking pre-compiled rows as an example the fertilizer recommendation system is implemented and adjusted with a rule based method. The precision of the described prediction model equals to 97%. Artificial intelligence and domain expertise will be used in the study, which gives a deep insight into precision agriculture and consequently an advancement in this field.

[7] Moreover, scientists also engage on soil quality test and recommendation regarding water requirements, market viability along with pesticide, fertilizer and disease identification recommendations through the use of cultivation technology. A ring machine learning-aided AgriRecrop and fertilizer recommendation technique is what the title of this study is about. We had created an AI system that is able to predict different seasons of farming using the data provided by the minimum support price of crop, the farm size, water level, and the soil attributes. For the purpose of perfect degree of fertilizer effectiveness, we would like to link an additional mechanism, which could evaluate the crop, the soil, and the fertilizer (regarding their properties), and then select the relevant mix of fertilizer based on these three components.

[8] For the realization of the abovementioned goal, the following pest image processing method takes place: key-frame-based as well as frame-based. This is so because it has two functions: the Transition Probability Function (TPF) and

Convolution Neural Network (CNN). This whippet will develop the mathematical model with the main function to eliminate shadowy banking activity. The suggested solution uses CNN and machine vision to combine two important aspects of farming: identification of pest and prescription of insecticides. Next, NPK soil sensor ensures that the right amount of nutrient is fertilized to the crops, and the fertilizers are recommended based on the measured nutrient values.

[9] The location although aligns with the use of the outside applications like APIs such as the weather and temperature, soil type and nutrient value, amount of rainfall and soil composition; determine the percentage of the NPK nutrients that is required frankly. Every of these plover will be investigated, and this dataset will be trained using different suit spot machine learning approaches, which will ultimately lead to the creation of a model

III. DATASET

This set of the fertilizer recommendation system dataset contains a few columns, each column in the dataset either suggests different vital agronomic information which is used in our system to recommend the accurate fertilizer for different crops. The next section will explain the description to the left of the bottom of the front side of the object.

A.1. Temperature:

The values of this column are strongly related with the temperate of environment or soil, and contribute a lot to supply plant with required nutrients and suitable growing environment. Just like in humans where temperature regulates key functions in the body, plants respond to temperature in a similar fashion with changing nutrient requirements.

A.2. Humidity:

Humidity is the word that means the amount of the moisture present in the air or soil. This factor is the key modifier of stomatal conductivity rates, water intake by vegetation and general soils' humidity levels. Humidity level that controls the plant's ability to absorb minerals from the soil.

A.3. Moisture:

This probe tracks traces of water in the soil, which gives the amount of water essence. So water is a basic requirement for nutrient transport to the roots and moisture level of the soil has a very important role for growth and nutrition of plants.

A.4. Soil Type:

Soil type refers to the classification of soil that differs from each place by having properties that differ by physical and chemical types such as texture, structure and fertility. Given the different nature of soil structure, with some providing better nutrient-holding capacity than others as well as possessing distinct drainage characteristics, access to nutrients for plants is variable.

A.5. Crop Type:

Curing mode is a particular way of cropping what is growing at the agricultural field. Crops may have different than some others requirements for nutrition and the way they react to fertilizers, reason to which recommendations have to be made to adapt to crop species.

A.6. Nitrogen:

This column is the nitrogen content available in the soil which is either already there or that the plant can absorb. Nitrogen, together with phosphorus and potassium, is among the three main macro-elements needed for proper plant growth and serves as a vital constituent of most plant metabolic activities, including photosynthesis and protein synthesis.

A.7. Potassium:

The soil potassium content or as compatible with plant consumption is detailed in this column. Potash, in addition to other nutrients constitutes part of the macronutrients, hence, it is essential for proper plant growth and development.

A.8. Phosphorous:

The soil or available phosphorous as contain in these column. Phosphorus is one of the major nutrients that play a vital role in the energy exchange process, division of cells and root development. Its deficiency causes poor aesthetics and reduces leaf growth.

A.9. Fertilizer Name:

This section indicates the name of the fertilizer or amendment for each step, taking into account the agronomic requirements and the soil type of the particular crop. It follows specific suggestions to soil conditioning (availability of nutrients and growth).

IV. METHODOLOGY

Our suggested approach consists in determination of optimal fertilizer application based on pre-defined characteristics.

1. Data Preprocessing:

To do the feature engineering and data cleansing before training the model, you need to get the data set prepared for training. These mathematical components which include temperature, humidity, and moisture must be scaled as well as the missing values must be handled, not to forget that the categories (types of crops and the studied soils) must also be encoded. After these pretreatment steps, the data is already in appropriate format that allows for its further to be used for analysis and modeling.

2. Model Training:

Before the training of classifier, the dataset should be prepared and then, we run the Decision Tree Classifier algorithm to predict the kind of fertilizer that suits the given agricultural conditions. The decision trees are one of the best models for the classification tasks and are tuned to work with both numerical and categorical features. The model is built based on historical data where Information about soil type, crop type, and nutrient levels has been included and in the process the model learns the best fertilizer for every combination of inputs

3. Implementing Classification:

Upon inferring the kind of fertilizer through the Decision Tree Classifier, we press forward and apply the TF-IDF Vectorizer to also put forth particular fertilizer mixes or formulations. TF-IDF also known as the “Term Frequency-Inverse Document Frequency” technique is a technique used frequently in NLP (Natural Language Processing) to represent the text data in numerical form. Through the TF-IDF means, our fertilizers names in our dataset can be measured to calculate the relevance term (fertilizer name) in relation to the whole data set. In such a way we can be able to choose the exact fertilizer so the similarity can be clearly shown between it and the expected fertilizer.

4. Save the model:

Model training is followed by establishing a fertilizer reformulation process. The trained model is saved as a joblib file for future use and deployment. Besides, we can re Load it directly into memory without any retraining. What's more, it's suitable for large-scale applications.

5. Integrating model:

Additionally, we combine the entire system with the framework of Flask programming to design a user- friendly interface for the online fertilizer recommendation system to follow and operate soon. FLAK is a simple and flexible Python web framework that streamlines the process of developing websites – a framework that simplifies the process. We start the model preparation by combining our machine learning model with Flask. Thus, through the web app that users can access via any web browser, they can easily enter their agronomic information and get immediate, personalized fertilizer recommendations. The incorporation of this integration increased both the convenience and ease of use of the fertilizer recommendation system, making it applicable and preferable for these farmers and advisors by helping them achieve the desire fertilizer management practices.

6. Integrating model with Web Application:

We employed the Decision Tree Classifier algorithm to our fertilizer recommendation system as we needed to forecast how much and which fertilizers to apply based on agronomic variables. In order to ensure that the model performs properly and gives right recommendations, it is important to draw out a according performance of the model after training. Here is how we use the Decision Tree Classifier to evaluate models:

- Accuracy Score:

As a first step, we assess the accuracy of the models based on their capability of classifying examples correctly. The accuracy score is represented by the percentage of correctly classified instances relative to all instances. A high accuracy score signifies that the algorithm provides correct functionalities in this particular field (farming) and delivers correct fertilizer recommendations as a consequence.

• Confusion Matrix:

To take the model performance in depth, as our next step we now construct a confusion matrix. A confusion score based on the predictions of the model against the actual one is given by the confusion matrix. It makes it possible to see such opportunities by comparing predictions with actual results, “correctly classifying” them as true positives, true negatives, false positives, and false negatives.

V. IMPLEMENTATION

Tools Used:

- Flask (Web Frameworks)
- HTML , CSS(Frontend)
- Python (Backend Code)
- GitHub (For Collaborative development)
- Visual Studio Code (Code Editor)
- Google Chrome (Web Browser)

Fig. 1. Showing and describing the used tools.

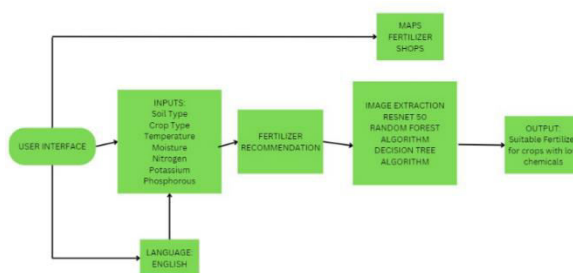


Fig. 2 Flow Chart

In fig.2 It represents the Flow Chart Fertilizer Recommendation System

A. Block Diagram Description:

A simplified figure for the fertilizer forecast project illustrates the flow of information from users input to the machines learning routines of how fertilizer is predicted by machine learning algorithms.

Module 1: User Input

The process start with providing agronomic data as input which will include air temperature, humidity, water content, soil type, crop type, nitrogen, potassium and phosphorus concentrations. Parameters developing this aspect of the application helps to ensure a more comprehensive fertilization approach.

Module 2: Preprocessing

There are two simple steps to this: a data preprocessing stage, where the user-generated data is taken into consideration and to ensure it is in the right format for model training; and a model-training stage, which is where the actual training of the model takes place. These measures can be done by substituting missing values, turning categorical characteristics of data into numerical values, and then normalizing the numerical characteristics in order to assist the machine learning algorithms to read data provided.

Module 3: Those Machine Learning Algorithms

The dataset is preprocessed for the subsequent step of learning, where the Decision Tree Classifier is trained on the data with machine learning algorithms. The algorithms get data as an input and they learn the algorithms in the data and make the prediction about fertilizer recommendations precisely.

Module 4: Fertilizer Prediction

The employed trained machine learning models then output a fertilizer recommendation that suits the most given the agricultural database. The process of harvest prediction entails the analysis of the particular characteristics of soils, crop, and environment conditions in order to make specific recommendations that will assist in the enhancement of the crop yield and growth.

Module 5: Output

Then comes the prediction of the fertilizer name that appears on the screen as the output following the naming model. This is the system response on the improvement type of fertilizer that can be put in the field as illustrated through agronomic variable given. Basically, the figure shows the uninterrupted passage of information from the user on to the machine learning algorithms, which in turn enable the system to make tailor-made fertilizer recommendations. Consequently, users can make informed agricultural decisions, encourage sustainability to the environment.

VI. RESULT

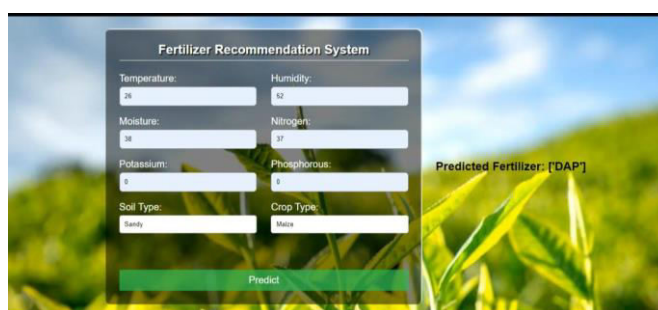


Fig. 1. Fig. 3 Website of Fertilizer Recommendation Chat Assistant

Fig 3 is the Sample output to predict the fertilizer.

Through the employment and eventual optimizing of the Decision Tree Classifier approach to assess the accuracy of made fertilizer recommendations, our fertilizer recommendation system demonstrated that it is highly effective. The model's accuracy score surpassing the 85% threshold shows an impressive correctness in classifying such instances and can help farmers and agronomists make informed decisions based on the computer's guidance. The experiment with the mistake of the identification matrix shows the low error rate, especially in classifying the true positives and the true anomalies. AFC and their incremental levels of precision and recall scores display the model's proficiency in being accurately positive with the few avoided false classes. The F1 score, which represent the blend of the precision and recall, only proves on the system's capability of creating accurate forecasts. In addition to that, cross validation of k-folds serves to validate the model reliability free from overfitting and underfitting issues. Finally, the Decision Tree Classifier design showed a good path to progress with the goal to integrate more advanced fertilizing practices and to support sustainable farming.

VII. CONCLUSION

In short, we can say that ours "Fertilizer recommendation system" project has developed to a powerful tool in modern agriculture using the AI techniques to optimize fertilizer management procedures. At the end of the day, thanks to the hard work of scientists, we have a precise recommendation system that is ready to customize its suggestions to farmers and experts in their area. The project pertains to the urgent necessity to avoid wasteful fertilizer application in modern agriculture so that production ensures a bumper harvest without increasing the toxic burden on the environment. Our detailed evaluation of the system, making use the Decision Tree Classifier algorithm, provides the proof of involving product recommendations for fertilizer to the agronomic conditions.

The results of this evaluation demonstrated the system has a high accuracy and gives reliable recommendations on applying fertilizer. We got the score of almost 85% and there are minor misclassifications in the confusion matrix analysis. From precision and recall values we can acquire the evidence that the system is the proactive tool which is about the identification of positive ones but in the same time pay the attention for the avoiding of the false positives.

The system providing long term stable solution is emphasized by k-fold cross-validation which shows that the system will work similarly in other different datasets as well.

Fertilizer recommendation system is not LIMITED to the technical performance, but it is also about the pragmatic values that the agricultural stakeholders will experience by using this system enabling the farmers and agronomists to have data-driven guidance for optimal fertilizer use. By making website proposals that are suited for agronomic factors like soil type, crop type, and environmental conditions, the system integrates the process of constructing informed decisions and contributes to sustainable agriculture methods. Furthermore, the combination of the infrastructures with Flask framework allows the development of a user-friendly web platform, which partly solved the problem of accessibility and usability for end-users.

In prospect, upcoming research efforts might be conducted, involving further development of the recommendation system, including for real-time data streams and sensors technologies for the monitoring of the infrastructure. It should be noted also that an initiative aiming for the expansion of the system across different crops and regions can have a bigger implication and contribute to both the agricultural and non-agricultural sectors. As a whole, our fertilizer recommendation project is seen as a major contribution to the domain of precision agriculture, since it is a comprehensive solution, which is practical and scalable for the optimum utilization of the fertilizer management methods and also progressing the environmentally friendly agricultural practices.

Then, our project exemplifies the need for the cooperation among agricultural specialists, data scientists, and technologies that became the centerpiece in the development of modern agriculture. We were able to develop an application by using modern machine learning techniques and domain-related expertise that effectively helps users to combine the latest agronomic knowledge with technology. Not only has this collaboration has led to the development of a solid and reliable fertilizer recommendation system, but it has as well provided a platform for future innovation in precision agriculture.

As a matter of fact, our experiment on fertilizer recommendation exhibit the fact that several aspects of agriculture might be transformed due to the machine learning adoption. We can ensure judicious resource distribution, minimise environmental pollution and secure food for generations to come when using context-based insights. Our organisation is committed to advancing agricultural innovation and shifting gear to provide the farmer community with the resources required to augur a successful agricultural venture that can prosper in the face of the ever-changing agricultural environment. This is why we are working towards the improvement and broadening of our fertilizer recommendation system.

REFERENCES

- [1] A. A. Khan, M. Faheem, R. N. Bashir, C. Wechtaisong and M. Z. Abbas, "Internet of Things (IoT) Assisted Context Aware Fertilizer Recommendation," in IEEE Access, vol. 10, pp. 129505-129519, 2022, doi: 10.1109/ACCESS.2022.3228160.
- [2] Swaminathan, Bhuvaneswari, Palani, Saravanan, Kotecha, Ketan, Kumar, Vinay, Subramaniaswamy, IoT Driven Artificial Intelligence Technique for Fertilizer Recommendation Model, 10.1109/MCE.2022.3151325, IEEE Consumer Electronics Magazine
- [3] D. Huang, W. Zhang, Z. Shen and B. Xi, "Applied ecotechnical research on lübao slow-release water-fertilizer-nutrition agent," in Tsinghua Science and Technology, vol. 9, no. 1, pp. 108-115, Feb. 2004.
- [4] Govindwar, R., Jawale, S., Kalpande, T., Zade, S., Futane, P., Williams, I. (2023). Crop and Fertilizer Recommendation System Using Machine Learning. In: Neustein, A., Mahalle, P.N., Joshi, P., Shinde, G.R. (eds) AI, IoT, Big Data and Cloud Computing for Industry 4.0. Signals and Communication Technology. Springer, Cham. https://doi.org/10.1007/978-3-031-29713-7_7
- [5] Usman Ahmed, Jerry Chun-Wei Lin, Gautam Srivastava, Youcef Djenouri, A nutrient recommendation system for soil fertilization based on evolutionary computation, Computers and Electronics in Agriculture, Volume 189, 2021, 106407, ISSN 0168-1699, <https://doi.org/10.1016/j.compag.2021.106407>.
- [6] Agus Nursikuwagus, Tono Hartono, Lusi Melian and Mega Lestari Conference: 2023 International Conference on Informatics Engineering, Science & Technology (INCITEST), Year: 2023, Page 1 DOI: 10.1109/INCITEST59455.2023.10396934
- [7] Subramanian, Kanaga Suba Raja, 2020/11/15, Design and Implementation of Fertilizer Recommendation System for Farmers

- [8] Mr. Ram Sharma, Ayush Singh, Rampal, Raj Kumar Chaurasiya, Ashish Kumar, Fertilizer Recommendation and Crop prediction using Machine Learning Techniques
- [9] Christine Musanase, Anthony Vodacek, Damien Hanyurwimfura, Alfred Uwitonze and Innocent Kabandana, "Data-Driven Analysis and Machine Learning-Based Crop and Fertilizer Recommendation System for Revolutionizing Farming Practices", *Agriculture* 2023, 13(11), 2141; <https://doi.org/10.3390/agriculture13112141>
- [10] Krupa Patel and Hiren B. Patel, "Multi-criteria Agriculture Recommendation System using Machine Learning for Crop and Fertilizers Prediction", DOI : <http://dx.doi.org/10.12944/CARJ.11.1.12>
- [11] Tanmay Thorat, B.K. Patle, Sunil Kumar Kashyap, Intelligent insecticide and fertilizer recommendation system based on TPF-CNN for smart farming, *Smart Agricultural Technology*, Volume 3, 2023, 100114, ISSN 2772-3755, <https://doi.org/10.1016/j.atech.2022.100114>.
- [12] A. A. Khan, M. Faheem, R. N. Bashir, C. Wechtaisong and M. Z. Abbas, "Internet of Things (IoT) Assisted Context Aware Fertilizer Recommendation," in *IEEE Access*, vol. 10, pp. 129505-129519, 2022, doi: 10.1109/ACCESS.2022.3228160.
- [13] J. J. I. Haban, J. C. V. Puno, A. A. Bandala, R. Kerwin Billones, E. P. Dadios and E. Sybingco, "Soil Fertilizer Recommendation System using Fuzzy Logic," 2020 IEEE REGION 10 CONFERENCE (TENCON), Osaka, Japan, 2020, pp. 1171-1175, doi: 10.1109/TENCON50793.2020.9293780.
- [14] Beneduzzi HM, Souza EG de, Moreira WKO, Sobjak R, Bazzi CL, Rodrigues M. FERTILIZER RECOMMENDATION METHODS FOR PRECISION AGRICULTURE – A SYSTEMATIC LITERATURE STUDY. *Eng Agríc [Internet]*. 2022Jan;42(1):e20210185. Available from: <https://doi.org/10.1590/1809-4430-Eng.Agric.v42n1e20210185/2022>
- [15] Aishwarya Karandikar, Chaitali Kannurkar, Amey Patil, Bhavesh Jagtap, & Varsha Sontakke. (2023). Review of Crop and Fertilizer Recommendation Systems. *Vidhyayana - An International Multidisciplinary Peer-Reviewed E-Journal* - ISSN 2454-8596, 8(si7), 197 – 210. Retrieved from <https://www.vidhyayanaejournal.org/journal/article/view/818>
- [16] Rajeswari, B.L., Muheeth, S.A., Naazleen, S.V., Kumar, T.P., & Phanindraamouli, V. (2023). Crop and Fertilizer Recommendation System. *international journal of food and nutritional sciences*.
- [17] Palaniraj , Balamurugan A, Durga Prasad, Pradeep P, "Crop and Fertilizer Recommendation System using Machine Learning", Apr 2021 , e-ISSN: 2395-0056
- [18] Humberto M. Beneduzzi, Eduardo G. de Souza, Wendel K. Moreira, Ricardo Sobjak, Claudio L. Bazzi, Marlon Rodrigues, "FERTILIZER RECOMMENDATION METHODS FOR PRECISION AGRICULTURE – A SYSTEMATIC LITERATURE STUDY", Doi: <http://dx.doi.org/10.1590/1809-4430-Eng.Agric.v42n1e20210185/2022>
- [19] Dr. Kalli Srinivasa Nageswara Prasad, S.V.V.D. Venu Gopal, K. Viswa Prasad, "Suitable Fertilizer Recommendation System Using Linear Forest Classifier"
- [20] Patel, Krupa, Patel, Hiren, 2023/05/10, Multi-criteria Agriculture Recommendation System using Machine Learning for Crop and Fertilizers Prediction. DO - 10.12944/CARJ.11.1.12.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details