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MACHINE LEARNING APPROACHESIN AGRICULTURE: A TABULAR STUDY

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ABSTRACT
Agriculture satisfies people's fundamental requirements, additionally considered as wellspring of work around the world. Agriculture is the supporting pillar of India from proving employment to sustaining economy and contributes in the Gross domestic product of India. Artificial Intelligence (AI) has helped further developing of horticulture activities in India. Machine Learning is a subset of AI that serving in limiting the Loss in the cultivating by giving rich suggestions and insight about the crop yields. Machine Learning (ML) techniques like big data, deep learning, and IoT-enabled devices have led to improve the yield and maximize the profit amount. This paper explains different types of agriculture domain where machine learning play a significant role. And presents the tabular study of machine learning applications in agriculture.

Keywords: *Machine Learning, Soil Management, Water Management, Yield Prediction, Disease Detection.*

INTRODUCTION

With the surge in global demand for food supplies, a great deal of strain has been put on the farmlands and the farmers around the world and keeping up with the rising demand of the world is proving to be a major challenge for agriculture. Climate change and growing population requires need to develop new approach to maintain the rate of food production and the robustness of the crop in these changing times. Machine Learning is not a new approach but recently its advances in past years have increased drastically as more and more people adapt to machine learning like in cars, smart homes, and robots and also it has shown its effectiveness in agriculture as well. The sudden advancement in Machine learning in recent years has been made possible by the amount of labeled training data as well as the advancement in the computation hardware improvement. With the advancement inthe Machine Learning field it can be implemented in agriculture to increase productivity to maintain the demand of the population and reduce the amount of loss in the crop yield by the farmers. A Machine learning terminology is derived by the process of learning from experience for evaluating required work. Machine learning is a subset of Artificial Intelligent that gives machines the capability to study from past experience [1].

Figure 1: flow of machine learning

The experience is described as set of features or variables based on which the machine evaluates the result. In Figure 1, Training data is the data which is treated as the input to the machine learning algorithm.The training data can be labeled or non-labeled. Machine learning approaches or algorithms check and train the data. After that ML rules governs the appropriate model. Test data is use for input in this model and according to new models rules predict the outputs. On the basis of these input categories the learning system is classified into either supervised or unsupervised learning. Supervised Learning in this the input along with the correct output is given to fed into the algorithm as input and then the algorithm tries to find the optimal path in order to come to the output that was fed as an input. Unsupervised Learning in this no label are provided, hence the machine learning algorithm has to generate features based on its input. Deep learning a part of machine learning have more advantage in image processing like Convolution neural network can be used to identify the quality of crop and disease with high accuracy. Many research and study have been done using image processing in the field of agriculture like count wheat spikes and spikelet's with 95.91% and 99.66% accuracy [2]. Image processing to count the number of saplings and variety of crop yield can be monitored fractional of cost of manually counting and maintain.

Machine Learning in Agriculture

Machine Learning plays a significant role in different fields of agriculture like management of soil, water, prediction of yield, disease and weed detection, and crop quality and species identification. Soil management is important aspect of agricultural activity which gives the best production. Production is directly depending on proper management of soil. Soil as a diverse natural resource, composite processes having information about the temperature of the soil can give us insight about the effect climate change can have on the crop field. Machine Learning algorithms are used to study the effect of evaporation, the amount of moisture content in the soil which help researchers decide the dissipation processes, soil dampness and temperature to grasp the elements of ecosystem [3].

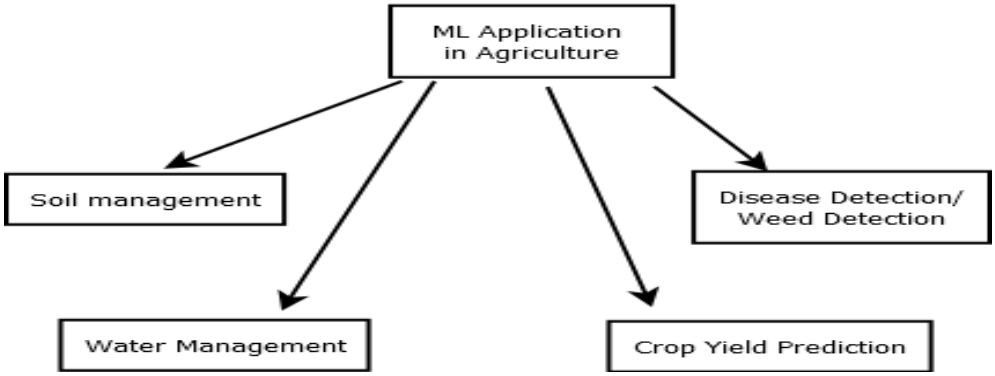

Figure 2: Machine learning in Agriculture

Figure 2 shows the different domain of agriculture where ML play important role in agriculture, Water management has a deep impact including aspects such as climate change, Water utilization, and agricultural ecosystembalance. Machine learning applications allows more effective use of irrigation system and help in predicting day to day dew point temperatures, which lends hand in identifying expected weather phenomenon and also estimating evaporation. Agricultural land also requires a vast amount of water for irrigation purpose so there is dependability on water availability. Along with depletion of aquifers at higher rate than they can recharge required water management mechanism that can conserve as well sustain crop yield. With the help of geo-informatics system and remote sensing can provide a base for solving the problem by monitoring various parameters that led to growth of crop and water management. Yield Prediction is the field of precision agriculture as it clearly states estimation and yield mapping, aligning of crop supply with the demand, and also crop management. Now a day's Computer vision technologies to provide accurate data, analysis of weather, crops, and economic conditions to increase yield for farmers [4].Crop Quality is important parameters. While comparing with the human experts, machines can in turn make good use of raw data and find some new qualities which will play pivotal role in enhancing overall quality of the crops. If crops are of higher quality more price can be demanded for that which in turn can benefit farmers in increasing their earnings. The differentiating factor between higher and normal quality product is determined the time at which it was harvested. Henceforth having a mechanism that can precisely determine the phase when the harvesting needs to be done can help farmers. This indirectly also deal with the food waste hence modern machine learning can cope with the problem with waste management as well. Disease detection is another important part for agricultural system that detects and diagnoses the crop disease. Machine learning is now used as a part of the agriculture management, in which we can spray those agro-chemicals with respect to time, place and affected that too with high precision. An automation process is used in this condition which detects the infected plant using machine learning and image processing, so now the use of pesticide can be limited to just the plant that are infected and not whole filed in general. Similar strategy has been used by the researchers in identifying the deficiency of nutrients in plants by observing their colour and physical appearance, thus giving the best case use of fertilizers and fungicides as required by the plant. Weeds are in-fact more difficult to detect and discriminate from original crops. With the help of Computer vision and ML algorithms one can improve the ability of detecting and discriminating weeds from other crops and that too at very low cost and with no environment side effects.

Tabular StudyofML Application:

In this phase we will present the tabular study of different researches with different ML enabled applications in the field of agriculture. In column number first represents the References,Column number second attributes, column number third use for

various ML Approach used by researcher for achieving the goals in their paper and Fourth column is use for remark/output of particular research.

TABLE 1: SOIL MANAGEMENT

References	Attribute	ML Approach	Remarks
M.S. Suchithra et.al [5]	Activation functions, Soil fertility indices, Soil pH	ELM classifier	Accuracy scores for pH (78.99).
Sk Al ZaminurRahman et.al [6]	Soil series, Land type, Chemical feature, Geographical attribute	weighted K-NN, Gaussian Kernel based SVM, and Bagged Tree.	SVM highest accuracy
VaishaliPandith et.al [7]	parameters namely accuracy, precision, recall, specificity and f-score	K-Nearest Neighbor, Naïve Bayes, multinomial Logistic Regression, Artificial Neural Network, RF Random Forest	KNN and ANN predicted best performance.
Anguraj.K et.al[8]	The Parameters Moisture, Temperature, Humidity And Ph Are Collected.	Random Forest, Naïve Bayes	Best Recommend/ accuracy =96.89%.
Kingsley John et.al [9]	60 composite soil samples, Environmental Covariates by digital elevation model (DEM) and Landsat 8 operational land imager (OLI) and a thermal infrared sensor (TIRS)	Random forest , Cubist regression, Artificial neural networks ,Support vector machine , and Multiple linear regression	The RF random forest model is best.
Sanjay Motia et.al [10]	Soil parameters,Soil Properties for Agricultural Soil Health	Study of All ML Technique	SVM and RF are best for soil management.
Janmejay Pant et.al [11]	data samples taken from soil testing laboratory, BhimtalUttarakhand during the year 2018-19.	ANN classifier	K-F accuracy = 95.52%.
T. VenkatNarayanaRao [12]	Chemical Parameters ,Physical Parameters ,Biological Parameters	Decision Tree Algorithm,Random Forest Algorithm	Random Forests best classifier
JanezTrontelj ml et..al [13]	nutrients prediction; soil spectra; soil analysis; soil category; precision farming	LS-SVMLeast-Square Support Vector Machine and ANN	For local farm-ANN and Global soil dataset the best strategy is LS-SVM.

Table 1 shows the contribution of researchers in the field of soil management. In study find the best approaches of machine learning in the field of soil management are (SVM) Support vector machine, (KNN) K-Nearest Neighbor, (ANN) Artificial neural networks, and (RF) random forest.

TABLE 2: WATER MANAGEMENT

References	Attribute	ML Approach	Remarks
Ali El Bilali et.al [15]	Berrechid aquifer ,Irrigation water quality, Sensitivity, Uncertainty, Prediction performance	ANN, SVM Random forest, Adaptive boosting (adaboost)	Adaboost model is best
Emmanuel A.Abioyeet.al [16]	precision irrigation; water; machine learning; mobile app; web app; smart agriculture; digitalization	Supervised, Unsupervised, Reinforcement	Supervised and unsupervised learning best
J.Cardosoet.al [17]	Smart Irrigation	Decision Tree, Support Vector Machine, XGBoost, Random Forest	XGBoost was best
Gumiere SJ et.al [18]	hysics-based model, soil water dynamics, irrigation management, precision	random forest	ML model easy to execute

	agriculture		
Ramya, S. et.al [19]	Ensemble, Evapotranspiration, Irrigation Management	Ensemble,SVR,	Prediction of agriculture. Parameters.
Anas H. Blasi et.al [20]	Knowledge Discovery in Database (KDD) method for data collection.	Decision Tree (DT) algorithm	Proposed Model accuracy= 0.98.

Table 2 shows the researchers contribution in water management. In study find the best approaches of machine learning in the field of water management are Adaboost, XGBoost and Decision Tree, Supervised and unsupervised learning.

TABLE 3: CROP YIELD PREDICTION

References	Attribute	ML Approach	Remarks
T. van Klompenburg, et al. [21]	Crop yield prediction Decision support system	Deep learning, Machine learning	Neural Networks widely used.
S.K. Sharma et al. [22]	Crop yield prediction	SVM, K-Nearest Neighbour , Decision Tree.	Decision Tree Regression is best for crop prediction
A.P.S Manideepet al. [23]	Crop Yield Prediction	Linear Regression, Decision Tree, Random Forest, Gradient Boosting and Linear SVR	random forest is more accurate
SonalAgarwal et al. [24]	Crop Prediction	SVM, LSTMLong-Short Term Memory,RNNRecurrent Neural Network, DT Decision tree, ANN, RF random forest	Combination of SVM, LSTM,RNN
M.Champaneri et al. [25]	Predict crop yield.	Random Forest Classifier	accuracy = 75 %
Saeed Khaki et al. [26]	crop yield prediction	deep learning, Convolutional neural networks, recurrent neural networks	CNN-RNN model validation accuracy Corn =75.04 and Soybean =77.84.
M. Suganya et al. [27]	Machine-Learning-Classification method	Logistic Regression, K-Nearest Neighbor, Random Forest, Decision Tree, Support Vector Machine	Logistic Regression best accuracy=100%

Table 3.shows the researcher's contribution in Crop Yield Prediction. In the study find the best approaches of machine learning are Decision Tree, random forest, Logistic Regression.

TABLE 4: Disease /Weed Detection

References	Attribute	ML Approach	Remarks
NajmehRazfar, Et Al. [28]	WeedDetection	Mobilenetv2 Model,3,4,5 Layer CNN, Resnet50,	4-Layer-CNNS Validation=97.70%
G.S SujawatEt Al. [29]	Disease Detection	Convolutional Neural Network (CNN), Feed Forward ANN,	CNN- Best Accuracy
Abu SarwarZamaniEt Al. [30]	Leaf Disease Detection	RBF-SVM, SVM, ID3,Random Forest,K-Means Algorithm	RBF-SVM Better
NahinaIslamEt Al. [31]	Weed Detection	Random Forest , Support Vector Machine , K-Nearest Neighbours (KNN),	Random Forest (RF), Accuracy =96%
MansoorAlamEt Al. [32]	Crop Weed Detection	Random Forest Classifier	Accuracy = 95%
UrmashevBEt Al. [33]	Weed Detection	K-Nearest Neighbors, Random Forest And Decision Tree Algorithms, As Well As Yolov5 Neural Network	Best Accuracy Yolov5 – 92 %.
MohitAgarwalEt Al. [34]	Disease Detection	Convolution Neural Network	Accuracy = 94%

Table 4.shows the researcher's contribution in Disease /Weed Detection. In the study find the best approaches of machine learning are CNN convolution neural network, YOLOv5 and random forest.

CONCLUSION

This research paper shows that a tabular study of machine learning in Agriculture. Researcher's uses various approaches of machine learning in the field of soil management are (SVM) Support vector machine, (KNN) K-Nearest Neighbor, (ANN) Artificial neural networks, and (RF) random forest. In water management domain machine learning algorithms are Adaboost, XGBoost and Decision Tree, Supervised and unsupervised learning. Work in the field of Crop Yield Prediction of machine learning isDecision Tree, random forest and Logistic Regression. Disease or Weeddetectionfieldmachine learning isconvolution neural network, YOLOv5 and random forest. In Overall perception the Random forest algorithm of Machine learning technique is cover maximum domain of agriculture.

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