MANAGING AGRICULTURAL SUSTAINABILITY WITH THE HELP OF TECHNOLOGY IN INDIA

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ABSTRACT

Agriculture plays a vital role mainly in developing country for economic wellbeing this is a main source of income, and employment, also it plays a significant role in international trade because most developed country is not engaging much in the agricultural activities, it provide the large source of revenue to the government by transportation (majority of trains and trucks carry the agriculture products, finally a very main point is food security.

INTRODUCTION

Today the world is digitalized, with traditional agriculture system it is very difficult to manage the large operation for instances the person who want to manage a agriculture field from urban city to rural area, there are many challenges like monitoring, operation, labour etc., the digital agriculture will make all this easy by data training or intense approach (Konstantinos, et al, 2018) this will help the farmers by just in time approach (maximum output with minimum effort and raw material) the data is provided by different sensors e.g. (V2 Plant Seedlings Dataset, Worldwide food feed production and distribution, Agriculture Crop Production In India)with 300 different language inbuilt ,ML data will accessed with the help for past trained data the result can be predicted for individual farms in agriculture sector and make most out of it. Machine learning Technology is an area of AI computer is automatic data learning without human intervention it has a greater impact on global economy, especially machine learning made a huge different in world trade mainly in communication barriers by making the availability of three hundred languages, banking, and finance (by making automatic communication with client and reduces the risk of abuse) and agriculture sector (crop management, soil management, livestock management etc). Sustainable agriculture helps find a balance between the volume of food production and proper maintenance of the ecosystem. It also promotes the economic stability of the farmers while agriculture continues to be the largest source of earning for the world population, with nearly 40% of its population relying on agriculture for their hands to mouth. Increased practice of sustainable agriculture is capable of meeting our food and textile needs, without compromising the needs of the current or future generations through the preservation of the ecosystem. This style of farming aims to produce food without the rampant use of pesticides and chemical fertilizers.

Artificial Intelligence based technologies have already started to shape agricultural practices in India. Some of the Indian farmers having a large volume of cultivable land are now

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getting inclined to adopt smart farming strategies powered by AI enabled sophisticated technologies, autonomous tractors fitted with GPS and various other sensors including digital cameras to plant crops, apply fertilizers, spray pesticides, manage the weeds, determine the need for irrigation, predict the yield etc. in more efficient ways than ever before. ICRISAT, headquartered in Hyderabad, India, is collaborating with the software giant Microsoft to enable Indian farmers to harness the power of AI to increase agricultural yields while maintaining environmental sustainability. Tech giant IBM is now providing Indian farmers and agritech start-ups the opportunity to use its weather monitoring tools developed by its subsidiary, The Weather Company, free of cost to support smallholders and supply chain-focused start-ups with decision-making. In the near future, there may not be enough people to put their labour towards harvesting the required enormous volume of food and a robotic solution may hold the key to a sustainable food future that will benefit both the producers and its consumers. Harvest CROO Robotics established a few years back has developed a robot that helps farmers to pick and pack their crops. On the other hand, PEAT, a Berlin-based agricultural tech farm has developed a deep learning based application, called Plantix which is capable of detecting potential defects and nutrient deficiencies in the soil in some efficient way.

According to the World Health Organization (15th July 2019) about 820 million people did not have enough to eat in 2018, which was 811 million in the previous year, this makes it the third year of increase in a row. The second Goal of UNDP is "No Hunger" and some of the targets set under this goal are: by 2030, double the agricultural productivity and income of small-scale food producers, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flood and other disasters and that progressively improve land and soil quality. And here comes the importance of AI assisted sustainable smart agriculture. Data-driven approaches integrating AI and machine learning with big data technologies and high-performance computing could drive agricultural productivity while minimising its environmental impact. Keeping this in mind the workshop will focus on the relevance of AI assisted smart Agriculture, tools and techniques needed for that. The workshop will discuss some of the advanced applications of AI in agriculture. It will also emphasize on how an agricultural ecosystem can be developed so that the benefits of AI can reach small farmers.

LITERATURE REVIEW

The article is divided into two level one –explanation of algorithms limited to the field of agriculture, level two segregated in three general categories; namely, crop management, water management, and soil management. Crop management is categorized into crop yield, crop quality, and weed and diseases detection, the research is searched in Scopus, web of science also in pubmed, article considered the period from 2000 to current year

Machine Learning

In simple term Machine learning is a data which teach the computer human like and these data are known as trained data, which makes human work accurate and easy and improves the experiences ,data in machine learning will be in four category ,Numerical data ,categorical data , time series data ,text (Alina Zhang, 2017) to measure the Performances of ML various statistical tools is used to predicted the result (Figure 1).

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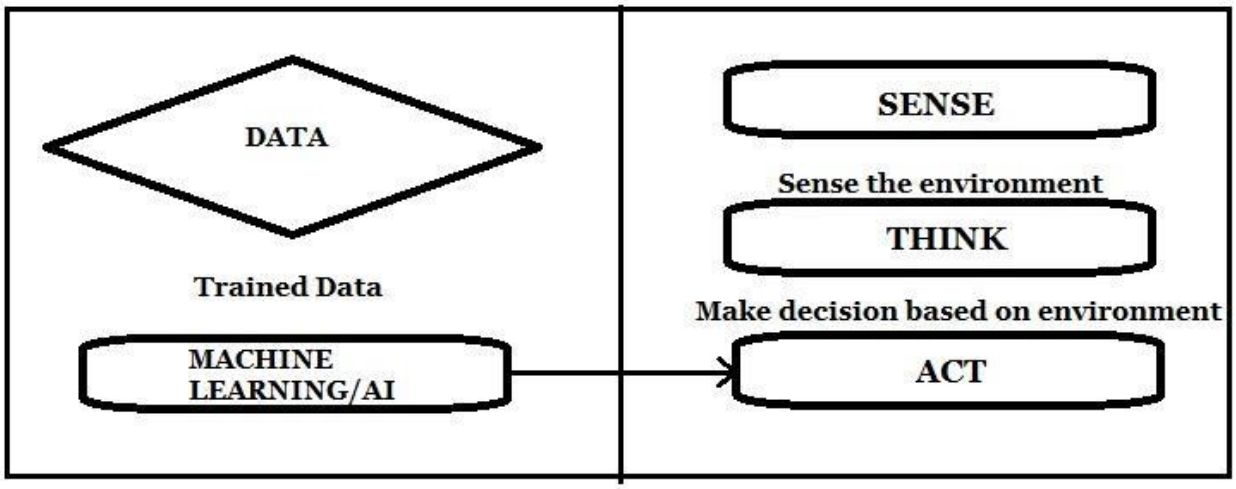


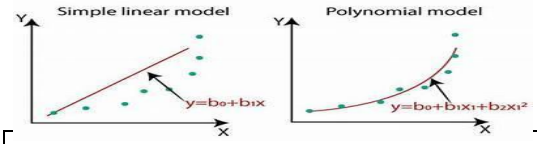
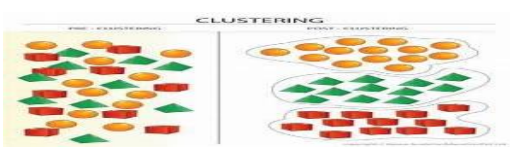
FIGURE 1
MACHINE LEARNING APPROACH

Machine learning means data inferring and giving a output with trained data these data are classified into two types one is supervised and unsupervised data refer Table 1.

Machine Learning Algorithm Models

Machine learning algorithm is a code which runs on a data and produces the decision making output .the output or a result in a prediction made using the past experiences (wold, 1985) eg in agriculture weather prediction is made when the temperature is less than 17 degree soil will get moist and hence it's not a good time to crop or yield, the research limit to unfold the explanation which is relevant to agriculture (Table 1).

Table 1
AUTHORS MODEL, PICTURE SOURCE (MAYASSA, 2020)

Task learning	Explanation	Types	Pictorial representation
Supervised	Data are labeled and trained	1)Regression-True/False	
unsupervised	Datas are not labeled machine will make inferences of data with close similarity and association	1)Association -Rule based approach 2)Cluster-similar object	

Supervised Learning Models -Regression

Regression help to find out the relationship between two variable, and it is mainly use to predict the causal effect, regression is classified into typo types 1-single regression 2-Multiple regression under which (i) linear regression (ii) non linear regression is sub categorized in single

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the features or variable will be one in case multiple variable there will be more than one feature, in machine learning regression has Linear regression, polynomial, support vector, decision tree, Random.

Classification- Bayesian Models (BM)

IN Bayesian models (BM) probability is used for the output result .the Bayesian model can be used both in classification and regression some of the Bayesian model algorithms are Naive bayes, Gaussian naïve bayes ,mixture of Gaussian ,Bayesian network (Ouda & Hart 1973).

Instance Based Model (IBM)

Instances based learning is also called as memory based learning ,instead of analyzing generally it analyze with new problem with the trained data ,the major setback with this problem is analysis will wait till new instances ,sometimes instances based model is also called as lazy some of the instances based algorithm learning method is k-nearest neighbours algorithm, Radial basis function network (Walter & Bosch, 2005).

Decision Trees (DT)

Under decision tree data are endlessly split until the preferred parameter, the decision trees are classified into nodes and leaves. It is called decision trees because of the tree like structure with roots and nodes, the tree is built with (CART) algorithm with is classified into Classification and regression (Belson, 1959), Decision tree ask question like yes /no based on it sub category is divided .Main purpose of using decision tree is: Decision Trees has a human thinking ability during decision making, It is easy to understand with simple classification and tree like structure (Table 2).

Table 2
THE TERMINOLOGIES OF DECISION TREE

DECISION TREE TERMINOLOGIES	
Root node	starting node for decision tree
left Node	Final output node
Splitting	Processing of dividing decision nodes
Branch /subtree	Tree formed expect from parent node
Pruning	removing the unwanted branches
Parent/child node	Root nodes is Parents others are child node

Artificial Neural Networks (ANNS)

ANN is adopted and design similar like human brain neurons networks ,which has a interconnection analyzing system or processing unit ,the number of layers are arranged into (i)Input layers (ii)hidden layers(iii)output layer (Hecht Nielsen,1987) (Figure 2).

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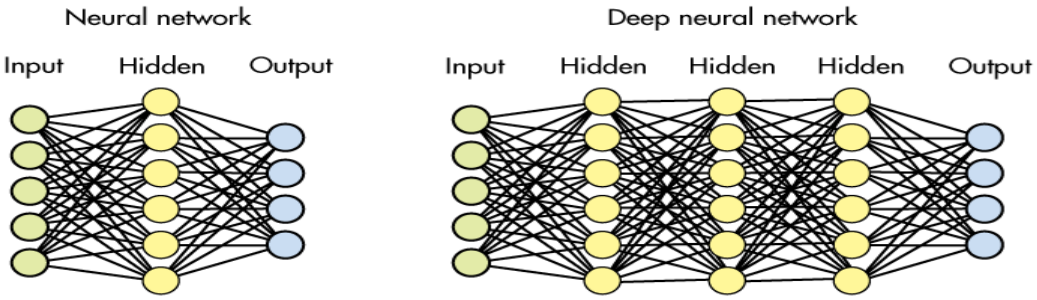

FIGURE 2
EXPLAINS THE PROCESS OF DEEP LEARNING (HIDDEN REPRESENT HIDDEN LAYERS OF EXTRACTION), PICTURE SOURCE ELECTRONIC DESIGN .COM

Support Vector Machines (SVMs)

(Vapnik, 1995) propounded Support vector machines (SVMs) with statistical culture theory the hyper line is created in extreme points ,these are called support vectors ,hence these point supports the decision making hence its termed as support vector machine.

Machine Learning and Agriculture

Crop Management: The method of training the machine and producing the decision is widely used for predicting the future, machine learning is a simplified human thinking with break down the complexity of the problem with easy future decision making result, in that way agriculture plays a very important role in global economy, global crop yielding is important part to address for the purpose of global food security, predict and reduce the climate changes (Amatya et al, 2015). Crop yielding forecast is a significant agricultural hitch. The yield depends on the weather setting (rainfall, high temperature, etc), and pesticides. Precise information regarding the past crop yield is significantly in decisions making related to manage agricultural risk.(Ali et al 2016) the research paper reviews the following for crop management (i) Fruit picking and forecasting the research paper cherries (Amatya et al, 2016) automatic fruit picking during harvest the purpose of the paper is to study about less labour involvement study two green citrus detecting the ingrown citrus ,in this circumstances machine learning will provided information for growth and help the farmer for maximum yield (Sengupta & Lee, 2014) the research paper by (Senthilnath, 2016) tomatoes were detected and picked another paper coffee fruit yield prediction by harvestable not harvestable and fruit is ready to pick immediately for yield ,overall harvestable fruit will be detected and calculate the yield another study for crop prediction and wheat prediction by satellite imagery (Pantazi, 2016) method is based on ANN and sensory data (Table 3).

Table 3
MACHINE LEARNING METHOD FOR CROP MANAGEMENT

References	Crops	Type	Functionality	Method used	Algorithm
Crop Management					
Amatya et al, 2016	**Fruit Picking and**	Coffee	Categorized coffee fruit into ready for harvest, not fit for harvest lastly fruits which is matured by over seen for	Colored digital imagine	SVM

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	yield management		harvesting		
Sengupta & lee, 2014		Tomatoes	Segregated between green red and yellow tomatoes and picked which is ready for harvest	RGB image	Clustering/ EM
Senthilnath, 2016		citrus fruit	Identify number of ingrown in outside condition and grown in green gas	Digital image	ENG
Amatya et al, 2015		cherry	identify fruit with foliage	RGB image	SVM
Pantazi,2016	**Crop**	Wheat	yield prediction	Soil parameter and satellite imagine sensor	ANN
Diseases Detection					
Pantazi, 2017		Wheat	Detecting yellow rust and nitrogen stressed	hyper Spectral reflectance and imaginary data	ANN
Moshou, 2017		Rice	Detecting fungus diseases like bakanae in rice seedling	Morphing and colour traits	SVM
Moshou et al, 2015	**Crops**	Wheat	Detecting Yellow rust and water stressed	Spectral reflectance	SVM/LS
Ebrahimi et al, 2017)	**Fruit**	Strawberry	Detecting patricides and thrips	Reign index	SVM
Weed Detection					
Pantazi et al, 2017		Weed	Detection of Silybum marianum	Spectral reflectance	ANN/CP
Pantazi et al, 2016	**weed**	Weed	Diffracting weed 56 percentage accurate and maize 100 percentage accuracy rate	hyper Spectral reflectance and imaginary data	ANN/SOG /MOG
Binch Fox 2017		Weed	Grass vs weed	imaginary data	SVN

Disease Detection

The common treatment for disease plant is spraying chemical in the farm the major advantage of ML is that in traditional method chemical pesticide is sprayed in the enter farm land in order to prevent the diseases but in ML the trackers are attached with camera and computer will detect the diseased crop and spray only in that area instead of spraying chemicals exactly (Pantazi,2017) another method by author (Ebrahimi et al, 2017) detection of Parasites and thrips in strawberry in greenhouse and made controlled environment ,The method of screening the bakanae diseases in crops the aim of the study is to detect the disease and optimize the maximum yield, the following study describes the diseases detection in wheat crop ,wheat is prominent source used worldwide (Pantazi, 2017) found the health wheat canopies based on genetically super nature imaginary data ,another study by (Moshou, 2017) found the differences between water drenched wheat canopies affected by Septoria spots also known as yellow leaf spots by and healthy onces the ML method of Least square algorithm is used with optical sensor similar the yellow rust infection detection by (Moshou et al, 2015) between healthy wheat with self organizing algorithm with neural network with image sensory reflection ,the aim of the study is to detect the yellow shade before it is visible to naked eye .lastly the paper reviews (Ferentinos, 2018) found the method in CNN based algorithm with image sensors.

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Weed Detection

Weed is unwanted leaves are grown and it will take all the nutrients from the crops and plant removing the weed is a major problem in agriculture the first study of weed deduction in machine learning is found by (Pantazi et al, 2017) based on counter based image sensor captured with drones (UAS) identify the carduus marianus and those were removed another study by (Pantazi et al, 2016). He categorized weed and main crop perfectly in order to be accurate in weed detection, lastly the research reviews (Binch Fox 2017) weed detection by SVN in plain crop.

Water Management

Water plays a vital role in agriculture management of it is difficult by traditional method due to accuracy in prediction in climatic changes also balance in agronomical ,the paper explore in evaporation transpiration (it's a time period between the absorption of water by land to atmosphere and by evaporating it other surface plants) of daily and monthly forecast ,this system will help farmers to manage and store the water and plant the field accordingly, (Mehdizadeh, 2017) he study dried and semi dried land evaporation the formed climate data on monthly bases connected with weather forecast station ,next study by (Feng, & Peng, 2017) Daily evapotranspiration data is collected from weather forecast station between (1960-2014)study was conducted by (Patil & Dika, 2016) by adopting ELM model for evapotranspiration with two stations (Table 4).

Table 4
MACHINE LEARNING METHOD FOR WATER MANAGEMENT

References	Type	Functionality	Algorithm
Mehdizadeh, 2017	Evapotranspiration	done with monthly mean with arid and semi arid region	MARS
Feng, Y.&Peng, 2017	Evapotranspiration	Done daily weekly and monthly interconnected to weather forecast station(6) and trained and tested with trained data	ANN/GRN
Patil & Dika, 2016	Evapotranspiration	Same test conducted with connecting with two weather forecasting station and data where tested	ANN/ELM

Soil Management

The soil is the important source for the continued existence on earth .the layer of the soil is used for planting and other layers are used in soil fertility ,microbes etc ,the condition of soil is important in agriculture to predict the accurate health of soil, machine learning plays a vital role in soil management ,to predict the climate change soil temperature alone will play a major role in prediction ,Firstly (Coopersmith, 2014) the aim of the study is to find the soil dryness with datas and evapotranspiration ,the purpose of this study is to provide information for remote decision making ,another study done by (Morellos, 2016). He studied the soil components in order to manage the soil efficiently. The method of the study is wet samples of unprocessed land is collected and soil organic carbon, nitrogen and moisture content is checked with VIS-NIR method, third study by (Nahvi et al, 2016). He developed a self evolution method which is called SAE_ELM where soil is tested with six different depths from 5-100 cm, the aim of the study is accuracy in soil management (Table 5).

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Table 5
MACHINE LEARNING METHOD FOR SOIL MANAGEMENT

References	Type	Functionality	Algorithm
Coopersmith,2014	Soil drying	study is to find the soil dryness with datas and evapotranspiration ,the purpose of this study is to provide information for remote decision	IBM/KNN
Morellos,2016	Soil conditioning	Testing soil organic carbon, nitrogen and moisture content	SVM/LS-SVM
Nahvi et al,2016	Temperature	where soil is tested with six different depth from 5-100cm	ANN/SAE

Applicability of IOT & AI/Ml in SSA Practice

Smart sustainable agriculture [SSA] is becoming a need of the hour. The present day pollution due to chemical based production of crops is actually devastating the environment. Not only the environment, but also the health of human beings and the formal community is at risk. If this scenario continues in the existing period, the chances of a slowdown of the economy will increase. This is because to satisfy the needs of an ever increasing population, the government needs to import the food product from other countries of the world.

Fortunately, the solution to this intense problem is known to scientists. The applicability of modern technology to the field of agriculture can reduce the issue of pollution due to cultivation practices and will also lead to availability of abundant food crops for the consumption of people. Artificial Intelligence [AI] and Machine Learning [ML] along with Internet of Things [IOT] can prove beneficial in reducing the adverse agricultural impact on the environment and people.

Physical Hardware & Storage Layer

This layer basically comprises strong hardware required to store the virtual technology. IOT has to be hosted with set of powerful physical appliances is there data backups and cloud storage can be maintained systematically

AI and Data Management Layer [DM]

This layer deals with various processes including in the segment of collection, storage, classification, arrangement and analysis of the data collected from the SSA clouds.

Network Layer

This is the most crucial layer, where networking between various components serves to fulfil the actual demand of the architecture. The networking panel uses recent technologies to establish the connection of flow of data from one aspect of the SSA model to another. The modern technology network fulfils the criteria include Wi-Fi, Internet, GSM/CDMA, etc. With the help of these features data flow within the entire system becomes all the more convenient.

Security Layers

AL algorithms are basically hindered in many cases by security of the data inputs. The present layer will enable its functional capabilities in managing the danger arising from malware,

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viruses, data theft related to all the SSA layers. In case of absence of this layer the entire process can give either defected conclusions or may altogether be unable to generate one.

Application Layer

This comprises full or partial monitoring of the data flow and the implication of all the layers to the ultimate SSA layer. The data flow here is monitor using integrated mechanism in in agriculture applications including monitoring of cropping culture using drone, disaster management, geographical area spread, potential acquaintance of area under cropping and many more.

Internet of Things [IOT] and Sensing Layers

This is the most crucial layer applicable to collection of data related to agricultural practices. It is basically using the sensor required to track the element directly or indirectly by controlling the agriculture parameters such as sensor sensing humidity, moisture, temperature, biological elements, etc.

Domain SSA Layer

The base layer around which all the layers are rotating. Various agriculture domains are included in this layer which has to be modified with the help of other layers.

The growth of agricultural products in a sustainable manner is the need of the hour. today all the possible experiments are carried out to come up with smart sustainable agricultural practices, so that with putting pressure on existing natural resources and degrading the environment the cultivation period can be reduced along with the improvement in quantity, quality, volume and variety of crops available for mass consumption. This can be achieved only with an integrated approach where IOT & AL/ML can be combined with SSA practices.

Discussion

General discussion –Total number of article involved in the study is 40, the search thread covered the partial crop management and water management and soil management in the popular method used between period 2015-2021, all the methods are briefly discussed in tabulation format it is slightly unlike to cover the entire paper,the review research is value to threat and validity (Šmite et al., 2010)

Specific discussion –Search strategy is thin downed with relevant scope of the research, manual search is done with using word like machine learning and yield prediction with Google scholar engine, Scopus and web of sciences exclusion category was made like publication in other language, article which is not available open source, publication before the period 2014 all those which comes before 2014 used for common algorithm terms for Machine learning.

Summary

Sustainable agriculture promotes the economic stability of the farmers while agriculture continues to be the largest source of earning of the world population, with nearly 40% of its population relying on agriculture for their hands to mouth. Machine learning Technology is an

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area of AI computer is automatic data learning without human intervention it has a greater impact on the global economy.

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Precise information regarding the past crop yield is significantly in decisions making related to manage agricultural risk.

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Future Scope and Limitations Of The Study

Agriculture is seeing rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) both in terms of agricultural products and in-field farming techniques. Cognitive computing in particular is all set to become the most disruptive technology in agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency. Providing some of these solutions as a service like chatbot or other conversational platform to all the farmers will help them keep pace with technological advancements as well as apply the same in their daily farming to reap the benefits of this service. Currently, Microsoft is working with 175 farmers in Andhra Pradesh, India to provide advisory services for sowing, land, fertilizer and so on. This initiative has already resulted in 30% higher yield per hectare on an average compared to last year. Such types of systems should be incorporated in all the regions of the nation.

CONCLUSION

There are many algorithm model is used the paper summarize total eight Model in which crop management has SVM, EM, Least square ,Regression, Cluster ,SOG/MOG,SVN for soil management models like IBM/KNN, SVM/LS-SVM,ANN/SAE is used finally for water management MARS ,ANN/GRN ,ANN/ELM is reviewed (Table 6).

Table 6
MACHINE LEARNING TERMS AND ABBREVIATIONS

Abbreviation	
SVM,EM	Support-vector machine, Expectation–maximization algorithm

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SOG/MOG	Self-calibrated brain network
KNN	K-Nearest Neighbor(KNN)
LS	Least square

Machine learning is used in agriculture sector mostly in crop management predication in which majority study on crop yield prediction and diseases detections ,Machine learning has shown a vast development in the field of agriculture sector like fruit picking ,crop analysis from drones and satellites with ninety five percent accuracy weed eradication with digital imaginary camera and spraying the pesticides in the weed alone ,real time weather forecasting like seeing temperature, rainfall and humidity with solar radiation ,the prominent work ML can do to agriculture is Autonomous tractors ,intelligent machines ,decision making with algorithms ,remote monitoring ,the study shows there is frequent usage of ANN,SVM for crop management as well as soil and water management ,using machine learning in agriculture can develop the country as a whole for future study he government scholar and expects should spread the usage of machine learning to real time farmers and normalizing the machine learning like traditional study will save the farmers as well the impact of lands .

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