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Precision Agriculture: Modern Approach of Farming

Mohammed Qasim Ali Dadan[1], Chaitya Sudhir Mehta[1], Shiburaj Pappu[2], Nargis Shaikh[3]

U.G. Student, Computer Engineering Department, Rizvi College of Engineering, Mumbai, India[1]

Professor (Head of Department), Computer Engineering Department, Rizvi College of Engineering, Mumbai, India[2]

Professor (Head of Department), Electronics Engineering Department, Rizvi College of Engineering, Mumbai, India[3]

ABSTRACT: Precision Agriculture is modern technology driven method of farming aided with specialized analytics methods. It is method of variable farming specialized according to requirements of crop. It utilizes technologies such as GPS (Global Positioning System), remote sensing to collect data which drives Decision Support System (DSS) for optimize yield. In comparison with conventional farming practises, it requires precise usage of irrigation, fertilizer in accordance with soil requirements. This results in providing appropriate nutrition to plants and reduced environmental impact of cultivation. It also improves economical results of farming practise by minimizing costs and using variable rate application of fertilizers.

KEYWORDS: Precision Farming, Decision Support System (DSS), Variable, VRT (Variable Rate Technology)

I. INTRODUCTION

Precision Agriculture is defined as technology associated with variable application of farming methods to maximize yield according to specific geomorphology features of farm lands. It is amalgamation of modern Information Technology with modern farming and cultivation methods. It takes into consideration various diverse features of farm land such as terrain features (topography), soil moisture, nitrogen, pH, potassium levels to optimize farming methods. Topographical features of farm land are used for variable irrigation. Precision Agriculture utilizes GPS (Global Positioning System) technology for determining variability of farm lands. Remote Sensing data can be used to determine NDVI (Normalized difference vegetation index) of farm plot for understanding the performance and nutrition of soil. NDVI data can provide insights about cultivation land and can be used by farmer to better plan agriculture activity. There is also another module involved called DSS (Decision Support System) which aids farmer in understanding multiple parameters of the farm land and plan out methods accordingly. DSS systems uses collected data about the land to suggest actions to farmer. GIS Dashboard provided to farmer can provide intuitive information about land in geospatial manner which is easy to understand and implement for farmer. Remote sensing data provides better understanding of topography of farm land and various other factors that drive the crop results.

II. RELATED WORK

In [1] authors proposed that in India by using precision farming technology, farmers can substantially improve average yield obtained by implementing Precision Farming technology. It has also proposed that availability of remote sensing data and GPS technology can improve the inputs given to this system. Authors have proposed using various sensors to collect multiple parameters of farm land which can give sparse information related to it. In [2] author has proposed that traditional farming methods won't be sufficient and economical to feed the world population in future due to lower yield and higher economical costs. It has also proposed usage of GIS (Geographic information system) for planning agriculture activities. Author describes that conventional practices require farmer to have superficial information about the land, which in the case of precision farming is augmented with the help of GPS technology which provides more information to farmer and thus results in better understanding of cultivation land. Precise and less usage of fertilizers adds to economic benefits of farmer. It is environmentally sustainable to carry out farming practice with less chemical/fertilizer run-offs. It requires less irrigation and water requirement, it also aids in preventing salinization of farm land due to over irrigation. It is said that it can improve per hectare yield for farmers due to better nutrition of plants, better irrigation.

III. PROPOSED METHODOLOGY

In Precision Agriculture, topography information of farm plots are added as input to GIS system first, along with details such as elevation, geo-fencing of plots using GPS technology, assigning yield data of previous years to specific plot. Normalized difference vegetation index(NDVI)is computed and assigned to plot, and data from various sensors are also added as input to assigned plot. After providing input data, Decision Support System analyses current inputs as well as historic yield data for generating a cultivation plan which will be used as reference by farmer to plan fertilizer usage, level of irrigation, and pesticide usage accordingly. After end of current cultivation cycle, yield returns data is once again added for further usage in next cultivation cycle.

A.*BLOCK DIAGRAM*

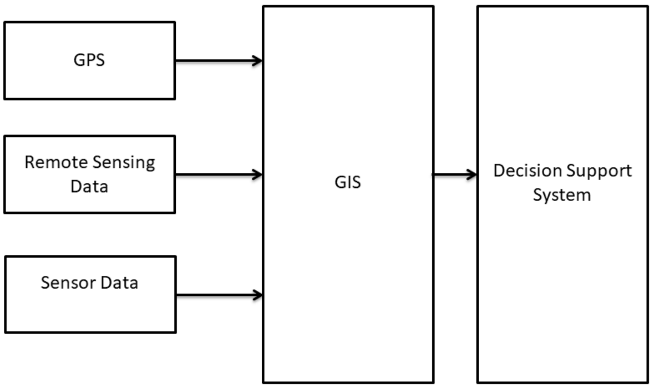

Fig. 1 Overview of Precision Farming

B.*FLOW DIAGRAM*

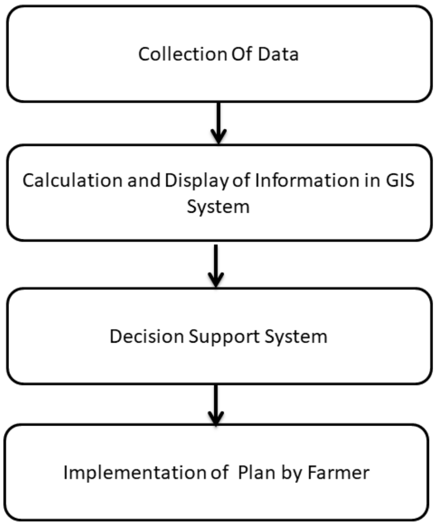

Fig. 2 Flow of Precision Farming Method

Geographic Information System (GIS):

GIS module is system designed for representing and working with geospatial data. It is used in precision agriculture to display and manage various geospatial information related to farming and cultivation. It can be used to model remote sensing data. Data collected from various sensors and also on-field observations can be included as input, which can be represented spatially for having better understanding of the farming conditions. It can be also used to do analysis and prediction of yield by considering cultivation and farming inputs of previous years. This analysis can be used to develop cultivation plans which are considered as precision farming.

Fig. 3Geographic Information System

Decision Support System:
Decision Support System module is used for preparing cultivation plans by considering analysis of historic data of yield, irrigation, Fertilizer Irrigation and Pesticide Data (Plot wise) usage for optimizing agriculture output (yield) and conserving resources for economic and environmental benefits. It also takes present inputs of field using real-time sensors and geospatial data. It can provide plot/field wise suggestions for farmer which is used for VRT (Variable Rate Technology) to carry out farming activities specific to given plot.

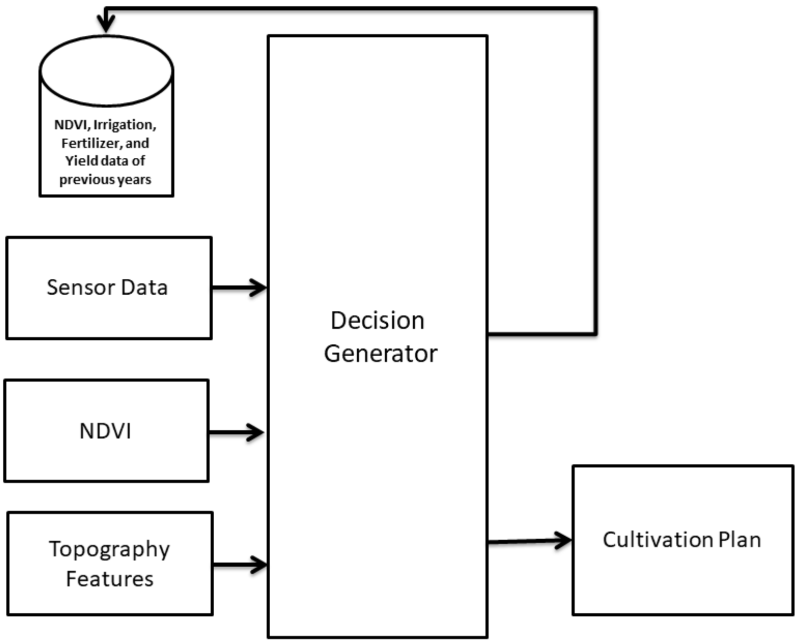

Fig. 4 Decision Support System

Variable Rate Technology (VRT):

Variable Rate Technology is used for refining agriculture methods specific to individual plots / fields for better optimization of cultivation process. It takes into consideration specific parameters of plot such as topography, chemical and fertilization characteristics and irrigation as parameter for better orientation of agriculture methods to specific plot. Various plans developed by Decision Support System is utilized and accordingly cultivation activities are carried out.

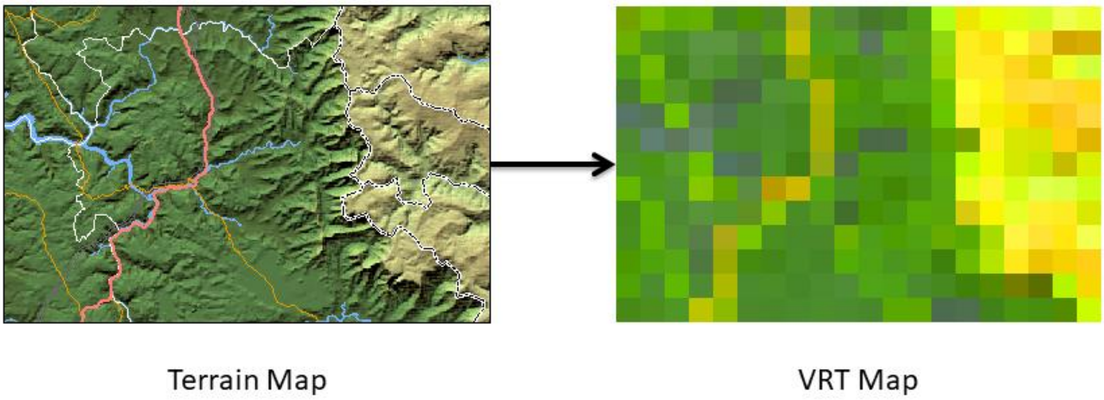

Fig. 5Variable Rate Technology (VRT) Map for Applicator

Normalized difference vegetation index (NDVI):

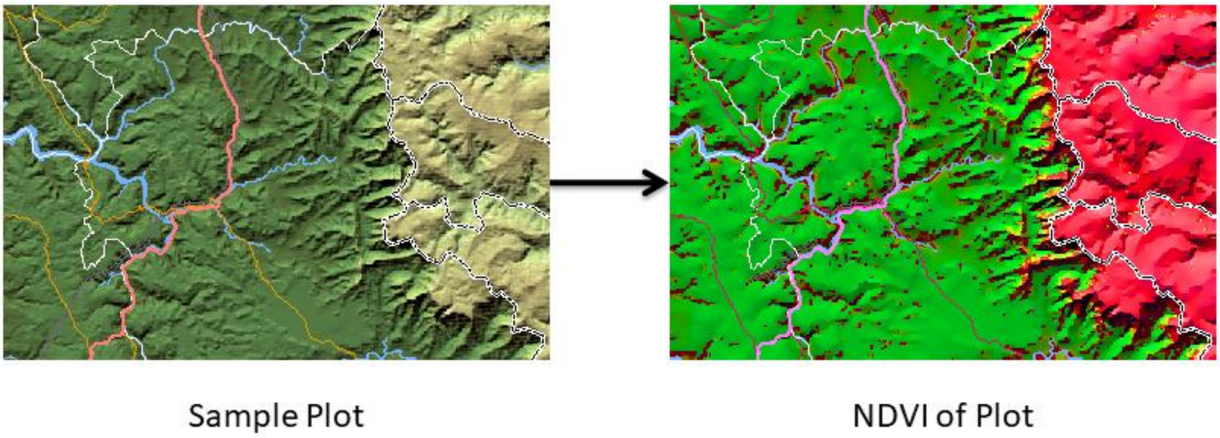

Fig. 6 NDVI Index of given plot

Normalized difference vegetation index is graphical assessment of vegetation of given area. It can be used to determine cultivation output of plot. NDVI is used to measure health of vegetation, cultivation life cycle and green cover of crops. It is having index range of 0-1 where 0 represents no vegetation cover and 1 represents maximum cover. Variations of NDVI within time span can be used to evaluate growth life cycle of crops and can be used to measure results of Precision Agriculture methods

$$NDVI = \frac{NIR - R}{NIR + R}$$

NIR = Near infrared light
R = Red Component of Light

IV. RESULT

In accordance with proposed solution outcome of this given solution will be improved agricultural output and increase in utilization of cultivation land. There will be observable difference in per hectare yield and also resulting economic benefits. There will be less usage of fertilizers which can have environmental benefits. Less or appropriate irrigation will result in reduced salinization of plot and conservation of water which also add to environmental benefits. Increase in yield will help in feeding increased population demands and environmental benefits will serve as sustainable method for feeding the population with reduced environmental impact.

V. CONCLUSION AND FUTURE WORK

The proposed solution provided method for sustainable agriculture and cultivation with suggested improvement to overcome drawbacks of traditional farming practices. It is suggested as one of the methods through which demands if rising population can be met while maintaining environmental conservation trade-off. It can be incorporated or integrated with other modern methods of farming such as vertical farming, Hydroponic and Aquaponics system which will result in further improvements of results.

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