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PRECISION AGRICULTURE: IMPORTANCE, PERCEPTION AND VIEWPOINTS

[1] Rohitash Upadhyay, [2] Megha Kamble

[1]Research Scholar, [2]Associate Professor

[1,2]Department of Computer Science and Engineering,

[1,2]LNCT University, Bhopal, India

Abstract: The advancement in agricultural domains is growing faster due to technology-driven approaches and among all the existing option precision agriculture is leading now. The technologies used in Precision agriculture are basically helping for the management of all the required resources well in order to produce greater amount of yields thus improving all aspects such as proper water preservation, waste reduction and minimum damage due to environmental impacts. So, crops' health refinement by guided requirements of crops and soil to achieve optimal productivity. This paper explains the need of technology in agriculture sector and importance of precision agriculture along with its potential impacts. The main focus is to understand the modern effective technologies which may lead to improved sustainable agriculture.

Index Terms - Precision Agriculture, Technology, Importance, Impact, Livestock Farming

I. INTRODUCTION

Being one of the most momentous industry, Agriculture is passing over some budding troubles due to globalization. The rising population marks in finishing of survival resources. Therefore, essentially we have to cultivate and produce healthy food without damaging the ecosystem as already a struggle of climate change and a warmer planet is existing. Climate state affects the food ecosystem in terms of production as well as demand, supply, prices and farmers' revenue. It leads to generate the risk of basic incomes for the farmers and results in leaving this business [1][2]. The agriculture industry is strongly hang on water and consumes almost 70% freshwater of the world. The latest technology offers more productive and effective schemes, but has few fallbacks too. With the help of latest equipment certain crops achieve overproduction but result in high pollution, wastage of food and degradation of soil quality. In emerging countries, farmers don't care for environmental safety. Old farming techniques need more pesticides and fertilizers that is creating big damage to the food as well as environment.

Due to fast urbanization agriculture industry is in problem and farmers become enforced for land selling. One more challenging threat over food security is pests and create a bit additional pressure on our food system [3]. Thus, this industry is confronting several different types of challenges like growing population, food security and climate disaster. The agriculture should go through a smaller number of inputs, lower pesticide and fertilizer quantity, less water, and smaller area. Or else, planet is going towards destruction. So, the essential and only solution for sustainable production demands more food production on existing surface area using limited resources.

To encounter all above said problems, agricultural shareholders must adopt and implement innovative technologies to decrease all the possible vulnerabilities in this sector and Precision Agriculture (PA) is able to solve multiple problems in this domain [4][5]. Figure 1 represents the important mechanisms of precision agriculture. Data Driven approach for agriculture is a promising method to resolve many problems in agriculture domain. Using artificial intelligence over the collected data from different segments of the farm, the farmers will be able to forecast for various parameters and appropriate actions may be implemented on time. We have different machines capable to perform precision operations and enables farmers to connect with the capabilities of big data for growing crops. PA applies enhanced and better farming practices and techniques to encounter the budding requirements for food. The name "precision" safeguards for the sustainability feature by implementing an enhanced and resource-efficient scheme for managing crop as well as livestock.

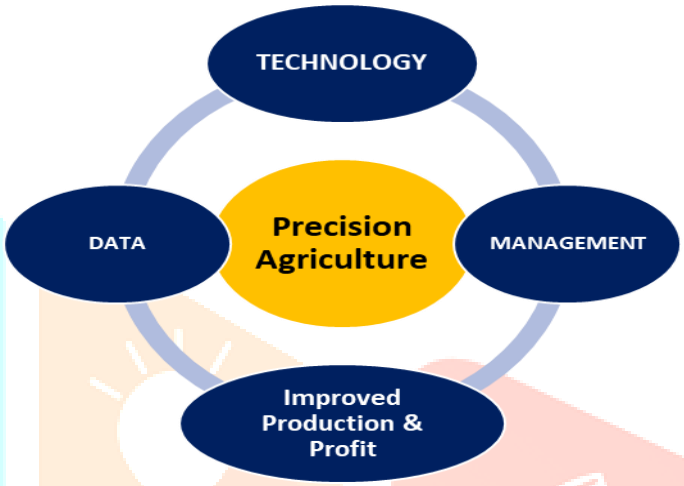

Figure 1: Mechanisms of Precision Agriculture

Improved agricultural schemes integrate current technologies for crop quality improvement to accomplish high profit by minimizing the probable waste. In short, PA is the application of technology-based solutions in agricultural systems in order to increase yields by optimizing the snags in existing resources. It tries to encourages sustainable practices in agriculture domains. For identification of Real-time problem zones, it initiates and implements optimal solutions[6][7].

Thus, PA has the facility of dividing the big blocks into smaller zones for better management of fields which is not present in our traditional system. It initiates actions precise to the identified zones if there is a possibility of deteriorating due to several reasons. The necessary actions may be decided as per the identified problem such as fertilizer quantity regulating, irrigation regulation, and analyzing onset of unwanted plant, pests, and infestations. The efficient and Effective schemes for management helps to control waste and costs for addressing mitigating problematic factors. Figure 2 presents the process along with all important activities at a particular stage. PA techniques are also implemented in the field of livestock farming. The tools provide optimization schemes for razing over the decided field rotation. Moreover, it is also useful to get health condition of each animal individually for monitoring and permits for a quick response and inhibition of major alarming factors. Livestock is critically important to know and identify precise information about what is happening with planted fields. The Data derived with the help of different sources supports required streamline procedures minimizing the possible downsides.[8]

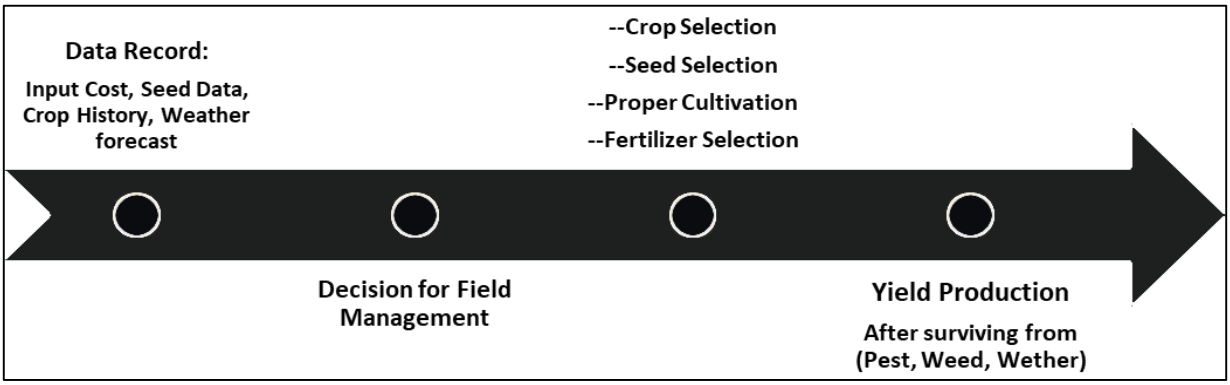

Figure 2: Represents the process of Precision Agriculture.

II. IMPORTANCE AND IMPLEMENTATION OF PRECISION AGRICULTURE SURVIVING

PA delivers catering across the globe to approximately 8 billion individuals with limited resources. With the help of latest technology, farming is possible in vast fields and modern equipment are being used which are controlled by satellites for better precision. For maximum benefits, there is a need to manage and supervise the crop production process to improve accuracy in terms of all the important factors such as water, feed, fertilizers etc[9]. The very first time, precision agriculture was specified by Dr. Pierre Robert, by indicating the need of variable fertilizer spreading rate due to requirement of different nutritional quantity in the different areas of a field. The idea was accepted globally as variable rate technology (VRT) leading to design and development of variable rate field management systems (VRFMS)[10]. The technology uses an automatic machine capable of variable flow rate, integrated seeding or spraying segment trained to a particular crop. The initial trial for crop monitoring was started in 1992 flagged the operation of PA and recorded visible difference in yields in a field. Using grid sampling, it can be revealed very easily about the available nutrients and how distribution should be channelized aiming the growth consistency. In figure 3 five important aspects are being denoted which plays very significant role in Precision Farming.

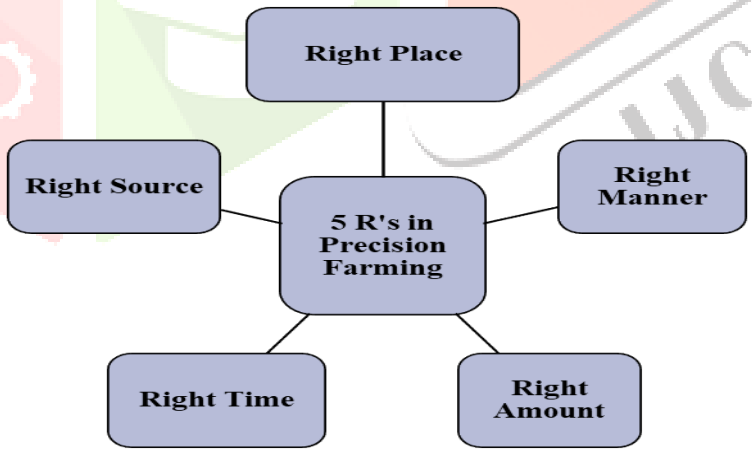

Figure 3: 5 R's in Precision Farming

For implementation of PA, exploitation of research data over weather patterns, humidity, soil temperature and growth can be managed for better operations. In order to moderate salts accumulating irrigation rate monitoring and Crop rotation is very significant for diversity improvement. precision agriculture technique PAT is helping farmers to identify the requirements of inputs and corresponding rates. In this way, PAT offer assistances to generate efficient mechanisms for modern agriculture. The other popular practices include Soil characteristics, Soil types, Crop yield data collection, Drainage level, Soil sample collection, Aerial imagery, Crop or soil color index maps and many more. In geo-referencing schemes the whole field is segmented into manageable areas to reduces waste thereby increasing production possibilities [14]. Thus, the Farmers have more chances to increase yield contributing a constant food supply.

III. COMPONENTS OF PRECISION AGRICULTURE [11]

The modernization of technology, enables streamlining of business operations effectively and efficiently and PA is one of the prominent examples. Some important technologies powering it are as follows:

3.1 Mobile Devices

Recently, mobile devices have transmuted by providing a variety of handy gadgets, such as smartphones and tablets. It helps to access information in real-time, permitting instant measures.

3.2 GPS

Global Positioning Systems (GPS) was started in early 90s. It is quite helpful for simplifying precision agricultural procedures by identifying correct location of crop and observation of growth.

3.3 Imagery

It has developed as a game changer for farmers by providing up-to-date choices for crops. It implements realm of data driven information for crop health, soil quality, and many other aspects to reduce waste thereby resulting in augment yields.

3.4 Robotics

The purpose of robotics technology in agriculture is to service this domain for increasing profit and efficiency of the processes. Robotics technology is very advantageous for large size industrialized farms where it is really challenging to monitor and process large quantities of produce. It is widely used in agricultural procedures for handling complex activities like crop nursing, spray to needy plants only, detecting soil PH level, seed planting, fruits/vegetables harvesting. Thus, it helps to modernize the field operations, increase efficiency, lower labor overheads.

3.5 Irrigation [12]

Productivity in agricultural domain won't continue if lacking due to proper irrigation. Therefore, farmers need appropriate tools and techniques to support water supply decisions and to get efficient usage of irrigation systems. Priorly, these conclusions used to draw from past experience and also referral from previous incomplete weather statistics. If the irrigation systems lack proper usage, it may lead to wastage of existing water, yield production, loss in farmers' revenues, also contrary results for environmental sustainability. Precision irrigation systems facilitates cultivators, remote controlling and monitoring of every possible side of irrigation process. New technologies help to monitor soil moisture, weather stats, variable rate irrigation (VRI), mobile drip irrigation resulting into increased productivity.

3.6 Internet of Things (IoT)

IOT is most advanced technology for data access to streamline farming operations by connecting devices through Internet. Using IOT in PA, helps cultivators to regulate the precise quantity of fertilizers, chemicals and herbicides desired for a particular segment in a specific field by deploying field sensors. Similarly, it supports optimization of fuel, electricity and water requirements. It results in profit for environment by reducing harmful waste [13].

3.7 Sensors

Sensors have the capability to observe plant health analytically thereby providing early detection of disease.PA needs to collect data for several factors parameters such as Soil fertility, water availability, Soil compaction, Leaf area index, Leaf temperature, Plant water status, Local climate data. The innovative sensor technologies allow precise water supervision. Humidity sensors are used to decide advance schedule water supply [13].

IV IMPACT OF PRECISION FARMING

PA aims profit and efficiency by referring different sources of data to decide precise actions for farming procedures considering environmental protection. The data referral from satellite imagery helps farmers to determine soil health, yield, and crop growth. Using data analysis, farmers are able to adopt precisions for the better management of a certain farm [15][16]. PA provide the option of segmentation by dividing farms into various zones, on the basis of explicit physical characteristics. Using precise data, it can be identified easily about the specific input and specific quantity thereby leading to lower waste and higher production. Data analytics provides help to decide immediate and future actions such as suitable time to provide fertilizer. Agronomist is an expert who identifies the crop infection and the remedial pesticide instantly [17] [18]. Similarly, PA guides farmers to take befitted actions and sidestep unwanted mistakes. The data investigation supports farmers for increasing production and abating labor cost /work. GPS supervision enables tractors to steer automatically to reduce human error as per the field coordinates and the driver need may be eliminated here. PA implements the derivation of food traceability to guarantee food safety and integration of data from sensors and imaginary, soil health may be improved. The technology is minimizing the cost and improves the profit by helping to decide the quantity of pesticides, water and fertilizers to put in a field leading to waste minimization. The improved profit and production will increase the land worth for owner as well as the whole society. As per a survey, one-third population across globe doesn't have fresh water access. However, 70% of the world's fresh water is used by agriculture sector. Due to climate change and water crisis around world, technology help farmers to manage lower waste and high yield. With the help of sensors, farmer can get full vision of the soil and choose better opportunities [19]. Access to precise data creates a big transformation in profit as well as yields quality. The figure 4 presents the global market situation for precision agriculture. Thus, the technology and its proper modelling is helping farmers for finding various solution in the direction of people's most demanding modern encounters. PA is helping to feed the rapidly growing population by controlling the damaging consequence due to agricultural activities over the natural resources.

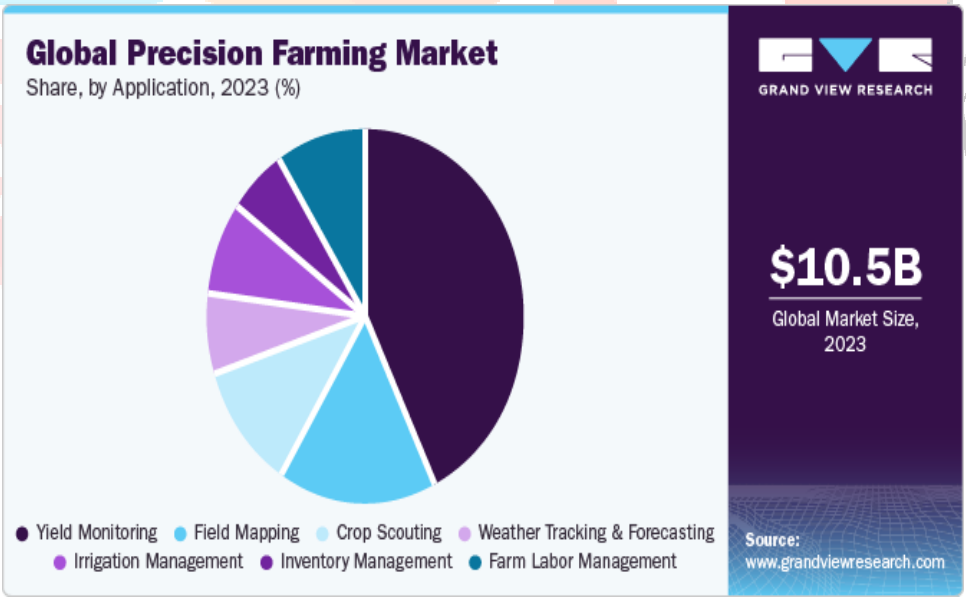

Figure 4: Global market situation for precision agriculture [20]

V CONCLUSION

This paper represents the trending concept of Precision Agriculture developed recently over two to three decades. The latest technology provides in this domain provide solution to multiple challenges in traditional systems due to environmental issues and climate change. Precision agriculture offers improvement of quantity as well as quality consuming lower input. Thus, the technology and its proper modelling is helping farmers for finding various solution in the direction of people's most demanding modern encounters. PA is helping to feed the rapidly growing population by controlling the damaging consequence due to agricultural activities over the natural resources. Still, many barriers are there associated to the implementation of the offered techniques in this domain. The requirement of technical skills, lack of adequate advisory support are bounding the development in many countries.

REFERENCES

1. Bongiovanni R, and Lowenberg-Deboer J. Precision Agriculture and Sustainability. Kluwer Academic Publishers. Precision Agriculture, 2004; 5: 359–387.
2. Fraser, A. (2019). Land grab/data grab: Precision agriculture and its new horizons. Journal of Peasant Studies, 46(5), 893–912. https://doi.org/ 10.1080/03066150.2017.1415887
3. Gardezi, M., Adereti, D. T., Stock, R., & Ogunyiola, A. (2022). In pursuit of responsible innovation for precision agriculture technologies. Journal of Responsible Innovation, 9, 224–247. https://doi.org/10.1080/ 23299460.2022.2071668
4. Gardezi, M., & Stock, R. (2021). Growing algorithmic governmentality: Interrogating the social construction of trust in precision agriculture. Journal of Rural Studies, 84, 1–11. https://doi.org/10.1016/j.jrurstud. 2021.03.004
5. Gardezi, M., & Bronson, K. (2019). Examining the social and biophysical determinants of U.S. Midwestern corn farmers' adoption of precision agriculture. Precision Agriculture, 21(3), 549–568. https:// doi.org/10.1007/s11119-019-09681-7
6. Brisco B, Brown RJ, Hirose T, McNarairn H, Staenz K. Can. J. Remote Sensing, 1998; 24: 315-327.
7. Mandal D. Ghosh SK. Precision farming – The emerging concept of agriculture for today and tomorrow. Current Science, 2000; 79 (12): 1644-1647.
8. Mandal SK. Maity A. Precision Farming for Small Agricultural Farm: Indian Scenario. American Journal of Experimental Agriculture, 2013: 3(1): 200-217. Palmer RJ. In Proc. Site-Specific Management for Agric. Syst. Scientific Publication of ASA-CSSA-SSSA, Madison, WI, 27-30 March, 1996; 613-61.
9. Pearce D. Atkinson G. Capital theory and the measurement of sustainable development. As Indicator of Weak Sustainability. Ecological Economics, 1993; 8(3): 103–108.
10. Pearce D. Atkinson G. Measuring of Sustainable Development. In: D. Bromley ed., The Handbook of Environmental Economics, 1995; 166–181.
11. Benyezza, H., M. Bouhedda and S. Rebouh. 2021. Zoning irrigation smart system based on fuzzy control technology and IoT for water and energy saving. Journal of Cleaner Production 302 doi: 127001.
12. Bucci, G., D. Bentivoglio and A. Finco. 2018. Precision agriculture as a driver for sustainable farming systems: state of art in literature and research. Calitatea 19(S1): 114-121.
13. Heisel T, Christensen S, Walter AM (1996). Weed managing model for patch spraying in cereal. In Proceedings of the Third International Conference on Precision Agriculture (pp. 999-1007).
14. Roberts DP, Short NM, Sill J, Lakshman DK , Hu X et al. (2021). Precision agriculture and geospatial techniques for sustainable disease control. Indian Phytopathology 74(2): 287-305
15. Ray SS. Panigrahy P. Parihar JS. Role of Remote Sensing for precision farming – with special reference to Indian situation scientific note SAC/RESA/ARG/AMD/SN/01/2001, Space Applications Center (ISRO), Ahemadabad. 2001; 1-21
16. Shanwad UK. Patil VC. Gowda H. Precision Farming: Dreams and Realities for Indian Agriculture. Map India Conference Proceedings, 2004. Dharwad. Solow R. The Economics of resources or the resources of economics. American Economic Review, 1974; 64(2): 1–13
17. C. Prabha, M. Malik, S. Kumari, N. Sharma, A. Sharma and M. S. Khan, "A Review on Sensors and Technologies in Smart Farming Using AI and IoT Perspective and Their Challenges," *2023 IEEE 2nd*

International Conference on Industrial Electronics: Developments & Applications (ICIDeA), Imphal, India, 2023, pp. 322-327, doi: 10.1109/ICIDeA59866.2023.10295251.

18. Adeyemi, O., Grove, I., Peets, S., Norton, T. (2017). Advanced monitoring and management systems for improving sustainability in precision irrigation. Sustainability, 9(3), 353. DOI: 10.3390/su9030479.
19. Lindblom, J.; Lundström, C.; Ljung, M.; Jonsson, A. Promoting sustainable intensification in precision agriculture: Review of decision support systems development and strategies. Precis. Agric. 2017, 18, 309–331.
20. https://www.grandviewresearch.com/industry-analysis/precision-farming-market.