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Precision Farming for Indian Agriculture

Riya Thakur[1*], Subhash Sharma[2], Anmol Negi[3], and Chinglembi Laishram[4]

[1]Department of Social Sciences, Ph.D Scholar
Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan (India), 173230
[2]Department of Social Sciences, Associate Professor
Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan (India), 173230
[3]Research Associate, Silviculture and Forest management division
Forest Research Institute, Dehradun, Uttarakhand (India), 248006
[4]Department of Social Sciences, Ph.D Scholar
Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan (India), 173230

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Abstract:

Indian traditional agriculture was converted to a conventional or modern farming style after the green revolution. India is the world's second-largest populated country and more than 50 per cent of the Indian workforce is employed in the agriculture and allied sector. Being the world's largest arable land and second largest producer of agricultural crops, India lacks behind its growing share in the economy. Therefore, Precision farming has numerous opportunities for farmers to identify better high-yielding location-specific crops and in fact, a farmer turns into a breeder to produce better and higher-yielding varieties by using the Precision agriculture system. Precision farming is a highly skilled and costly technology that works at high efficiency which is a major constraintto its wider affordability and adoption in Developing countries such as India. Rather, support from local government bodies, role models, and extension workers for awareness among farmers towards technology and perceived risk reduced towards usage and providing financial support in terms of the subsidiary are all of equal importance to achieve maximum efficiency.

Introduction:

In the years before and after independence, Indian agriculture experienced significant change. Indian traditional agriculture was converted to a conventional or modern farming style after the green revolution. India offers extensive and diversified agroclimatic conditions that allow a large range of crops to be grown nearby. India is the world's second-largest populated country and more than 50 per centof the Indian workforceis employed in the

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agriculture and allied sector(Census, 2011).Agriculture now has to be industrialised and intensified more than ever because of the rising need for food, both in terms of quality and quantity. But still, the agriculture sector is having enormous difficulties dealing with the issue due to the rise in global population, rise in food production need, decline in the labour in rural regions, and rise in production expenses. With more than 156 million hectares of fertile land, India is one of the top agricultural producers in the world (HLEG Report Agriculture). The GDP share of the agriculture sector compared to the industrial and service sectors has historically lagged behind (Ministry of Statistics and Program Implementation, 2021). The primary cause of this is a lack of automation in Indian agriculture. The bulk of people in India is rural dwellers who rely on labour-intensive farming methods dueto a lack of capital to buy machinery.

To feed an ever-growing global population, it is imperative for India to increase its crop production by leveraging sustainable, high-tech, and smart farming practices. Smart farmingis a farm management concept with the usage of the Internet of things (IoT) to overcome the current challenges (Patil and Kale, 2016). Smart farming promotes precision agriculture with modern, sophisticated technology and enables farmers to remotely monitor the plants (Dhanaraju et al., 2022). Smart farming helps agricultural processes, such as harvesting and crop yields, as the automation of sensors and machinery has made the farming workforce more efficient (Grady, 2017).The world's food system is in a precarious state as a result of growing global warming, resource depletion, soaring food demand, and rising labour prices. The main challenges to India's food system are fragmented land ownership, abrupt climate change, including drought and flood, declining productivity, seasonal output, growing labour costs and depletions, excessive use of natural resources, and high demand for food grains. The recently developed precision farming can be a way to combat these conditions by boosting agricultural production and making this industry lucrative for farmers by making the most use of scarce resources. The most significant barrier to precision farming's acceptance is the price of the necessary equipment.

Concept

Precision agriculture (PA) is a farming management concept based on observing, measuring, and responding to improve the crop yield and assisting the management decision using high sensor tools for optimizing returns while preserving resources. PA is also

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sometimes referred to as precision farming, satellite agriculture, as-needed farming, and site-specific crop management (SSCM). Precision farming is generally defined as doing the right practice at the right location and time at the right intensity(Mulla and Khosla, 2015).It is a new concept First conceptual work on PA and practical applications go back to the late 1980s(Schnug et al., 2006). Since its inception in the early 1980s, precision farming has been adopted on millions of hectares of agricultural cropland around the world to maximize the effectiveness of crop inputs. It primarily focuses on site selection data such asfarm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, yield mapping, etc. Being site-specific, it is essential torequire data on soil such as quality, fertility, nutrient profile, water absorption capacity, weed density, and weather conditions such as rainfall, and temperature (Bhakta et al., 2019).

The widespread adoption of precision farming depends upon the reliability of the results obtained and the ease to use it. (Larschied and Blackmore, 1996) considers three levels of technology adoption in precision farming, where the first level is conventional practice and the third level has variable application rate capability. This was adopted to increase production, reduce labour time, and ensure the effective management of fertilizers and irrigation processes.

In general, the most important motive for PA adoption seems to be the increased profit; however, the cost of PA technologies may exceed their benefits (Batte et al., 2003). With precision farming, nitrogen application can be reduced from an average of 220kg/ha to an average of 160 kg/ha, without affecting the yield (Mandal and Maity, 2013).Even small farms can manage large fields or a group of small areas. One of the important aspects behind this concept is the economic utilization of resources with same time maximizing the output (Patnaik, 2009). In addition to the economic benefits of PA technology measured in net returns, (Brown et al., 2016) highlighted the environmental advantages of decreased input utilisation such as seeds, pesticides, fuel, working hours, etc. as part of long-term sustainability and mitigating the climate change due to GHG emission ((Balafoutis et al., 2017).

Tools and Equipment

Precision Farming is a combination of application of different technologies. All these combinations are mutually inter related and responsible for developments.

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1. Global Positioning System (GPS)
2. Geographic Information System (GIS)
3. Grid Sampling
4. Variable Rate Technology (VRT)
5. Yield Maps
6. Remote Sensors
7. Proximate Sensors
8. Computer Hardware and Software
9. Precision irrigation systems
10. Precision farming on arable land

Challenges:

Land tenure system

Land tenure represents one of the major challenges that farmers face, especially in developing countries. Many small-scale farmers, especially women, work on land that they do not own, exacerbating their poverty.

Cost of Technology

This Precision farming technology performs the task at high accuracy while minimizing the workforce. The implementation of this technology requires a huge amount of capital investment. Most developing countries like India, where the majority of the workforce is employed in the agriculture sector have experienced extreme poverty. Therefore, farmers face difficulty to afford any new technology or changes in their traditional farming system when they look beyond their conventional tools

Lack of Financial Resources

The majority of farmers in developing countries are marginal and small farmers, and for them, access to financial resources is a serious barrier. If farmers did not receive the projected output, maybe as a result of unanticipated disasters like drought, flood, pests, and illnesses affecting the crops, financial supporters could not offer sufficient loans to them. They refrain from taking risks and spend money on expensive new technologies.

Literacy Status of Farmers

In developing nations, education level is a crucial factor and one of the biggest obstacles to the adoption of new technologies. The farmers' attitude toward learning the skills

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and technical ability to use any tool rises with their degree of education. The majority of farmers in underdeveloped countries lack education and skills due to a lack of interest in learning new things or awareness of emerging technologies. Farmers employ generic icons based on conventional knowledge and have thought that usage is too sophisticated, sometimes unable to recognise the symbols used in a mobile application. As a result, it is a factor in why farmers prefer traditional farming over smart farming.

Land size

In India, the majority of farmers have marginal and small land holdings. Implementing precision farming land size has become an important challenge. (Franco et al., 2018) found that land size has the highest positive impact on PA adoption. That is the reason why countries with generally larger farms (e.g. Australia, Brazil, Canada, and the USA) have higher adoption of different precision farming technologies (Say et al., 2018)

Conclusion:

To achieve long-term sustainability in agriculture precision agriculture is having scope to utilize the resources efficiently at right time and the possibility to shift to advanced modern agriculture. These technologies, however, are insufficient on their own to increase the productivity of the entire agricultural production process without any support from any government body or organization. For its commercial and wider applicability, precision agriculture needs collaboration between private and public sectors.Further,the government may help with this process by providing the business with soft loans to encourage them to get involved in agricultural and Precision agriculture operations. Hence, high-tech Precision agriculture may contribute to the next green revolution in India and can generate enormous rural riches in a sustainable and ecologically responsible manner.

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