An Analysis on the Scope of Precision Farming in India

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Abstract:

Precision farming is a satellite farming method which aims at optimising returns while preserving resources by observing, measuring and responding to variability within and across fields. Precision Agriculture Technology (PAT) uses information technology and software to ensure crops receive accurate input to avail optimum health and productivity. PAT has been experimented in Indian states like Punjab, Tamil Nadu, etc. These experiments have recorded an increase in productivity for the adopted farmers. This has impacted the socio-economic status of the rural farming community . A SWOT analysis has been undertaken to highlight the effectiveness of this method. The objective of this paper is to provide policy suggestions regarding education and improvisation for farmers and for better implementation of this method.

Introduction:

Agriculture being the backbone of our country has now lost its support to remain in the same situation due to several reasons such as scarcity resulted by growing needs for food. Several other external factors also play their part in declining the status of agriculture. This may include the current acute scarcity of water, the excessive use of pesticides in agriculture and most importantly the poverty of the farmers. The problems of agricultural sector can positively be solved by adopting precision farming. The term Precision Farming itself states its meaning - doing the task of farming in a precise way. It helps to preserve the resources while optimizing the returns. PAT is a complete farm management approach which relies on technology. Over the last few decades, many new technologies have been developed to enhance the future prospects of agriculture. Some of these are, GPS (Global Positioning System), GIS (Geographic Information System), automated steering system, remote sensing, geo-mapping, and Variable Rate Technology (VRT). GPS provides real time information to map soil and crop maintenance. These GPS receivers usually work up to 300ft. of area. GIS is a computerised map system that uses statistics and spatial methods to analyse characters of geography. VRT is automatic and can be used for a variety of farming activities. It sets the delivery of inputs depending on the soil condition noted by soil maps. Also, Rate controllers are used in PAT to control the delivery rate of a chemical (liquid/granular). These control speed, flow rate and pressure of material in real time (**Hakkim V.M et al)**[1]**.** Used in combination, these new technologies provide a large amount of high-resolution information related to farm management practices such as tillage, seeding, fertilization, pesticide application, and harvesting. Precision agriculture technology prescribes and warns the farmer of the inputs, diseases and weather conditions that help him take accurate mitigation or remediation, when it is needed. Though the concept

[1] Abdul Hakkim V.M, Abilash Joseph E, Ajay Gokul AJ, Mufeedha K. Precision Farming The future of Indian Agriculture. J.App Biol Biotech,2016;4(06): 068-072 DOI:10.7324/JABB.2016.40609

of PAT first began in the United States of America in the 1980s, it became popular in India only at a later stage. The PAT has begun developing and disseminating in a regionally differentiated manner through 22 Precision Farming Development Centres (PFDCs) located in different parts of India. PFDCs are working for the popularization of PAT and hi-tech applications to achieve increased production in addition to imparting training to a large number of farmers (**Dugad et al 2006[2])**This method of PAT has been experimented in particular districts of several states such as Tamil Nadu, Punjab, Kerala, Karnataka and Andhra Pradesh. The results of Precision Agriculture done in two states namely Punjab and Tamil Nadu are taken as samples and highlighted in this paper to show the prospects of PAT in India.

Importance of Precision Farming in India:

Our agriculture excelled and it was on the ascendancy till the mid nineties but after that, growth slowed down. Since 1996-97 the growth rate of agricultural GDP has been, on an average, 1.75 % per year in contrast with the rate of 4% that is required (**Indian Council for agricultural research**[3]). India is a country with a total population of 124.72 crores and Census 2011 says there are 11.89 crore (118.9 million) cultivators across the country. The percentage of cultivators has been coming down steadily from nearly 50% in 1951 to 24% in 2011, which means the number of farmers has come down by half. But the agricultural labourers have increased from 19% in 1951 to 30% in 2011. During the decade 2001-11, the census results show a fall of about 9 million in cultivators and an increase of about 38 million in agricultural labourers (**Prachi salve 2014)**[4]. Precision Farming can prove more advantageous, particularly to a country like India where a majority of the population is engaged in agriculture. Thus PAT may become a necessity to use the resources in a more efficient way and to make the 9 million farmers survive as cultivators. Also the increasing number of agricultural labourers shows that the demand for agricultural labourers is ever increasing and PAT may result in the precise use of available labour to get optimised returns.

Precision Farming in Punjab:

Drip irrigation is an essential feature of precision farming. The following study in Punjab justifies it.

A field judgement study of the project area was conducted by the PFDC (Precision Farming Development Centre), Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana during June 2016. Through their solar lift irrigation project (solar powered community lift and micro irrigation project) worth Rs 40.93 crore, 1200 farmers of 14 villages in Talwara and Hajipur areas got access to water to their lands which accounts for nearly 1700 acres or 664 hectares through Drip irrigation and fountain irrigation systems. 46 motors are running on the solar panel and one motor is of 20-25 horse power with the capacity to lift 70-75 meter (head) water. 3798 solar panels have been installed to operate these submersible motors whereas the project has been divided into 378 micro parts to ensure its smooth functioning with 18 water distribution lines connected.These systems also help in the conservation of water. This also encourages the farmers to throw out traditional crop

[2] **https://mpra.ub.uni-muenchen.de/73233/**
[3] **https://icar.org.in/node/1890**
[4] https://www.hindustantimes.com/india/how-many-farmers-does-india-really-have/story-431phtct5O9xZSjEr6HODJ.html

cycles and undertake innovative techniques in the field of agriculture. This solar panel has the capacity to generate 1100 kilowatt of electricity per day. (**The statesman News Service, 2018)**[5]

The following table shows the changes in the productivity before and after installation of the system which enables better water supply and innovative techniques of agriculture.

Table 1: Representing Increase in Productivity after Adopting Solar Lift Irrigation Project

CROP	AVERAGE YIELD LEVELS BEFORE INSTALLATION OF SYSTEM	AVERAGE YIELD LEVELES AFTER INSTALLATION OF SYSTEM	DIFFERENCE
Wheat	8-10 quintals per acre	16-20 quintals per acre	8-10 quintals per acre
Mustard	2.0-2.5 quintals per acre	6-8 quintals per acre	4-5 quintals per acre
Maize	6-8 quintals per acre	12-15 quintals per acre	6-7 quintals per acre
Vegetable	Not grown	One farmer started growing vegetables	
Orchard	No planned orchards	three farmers have planted mango orchards	

Source:(http://dswcpunjab.gov.in/contents/SCMIP_Benefits_Project.html)

From the table 1, we see that the productivity has increased by 8-10 quintals per hectare, 4-5 quintals per hectare and 6-7 quintals per hectare for wheat, mustard and maize respectively. It is very obvious that there is a tremendous change in the agricultural field after the implementation of this system. Thus it is highlighted by this study that productivity has increased in the selected areas of Punjab by the use of solar lift irrigation project, which is a part of Precision Agriculture Technology (PAT) and had been undertaken by the PFDC (Precision Farming Development Centre), Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana.

[5]https://www.thestatesman.com/cities/solar-lift-irrigation-a-hit-in-kandi-area-1502668141.html

Precision Farming in Tamil Nadu:

In Tamil Nadu PAT was implemented under the Tamil Nadu Precision Farming Project from the year 2004-2005 covering an area of about 400ha (hectares). It was first implemented in Krishnagiri and Dharmapuri districts in 2004-05 on 250 acres, then in the next period, i.e., in the period 2005-06 the coverage of land area was doubled and 500 acres were brought under this method and in 2006-07, 250 acres were covered. Krishnagiri, being a district with semi-arid tracts and a low rainfall might be very apt for the implementation of the Precision Farming technology and it has the most number of precision farmers compared to other districts of Tamil Nadu. Though only a few farmers were covered in the initial stages, the success of these farmers motivated the others to adopt PAT. Due to the drought, many farmers were frustrated and were in the mindset of moving away from agriculture and refused to undertake PAT in the initial stage. But the success of the other farmers under PAT encouraged them to undertake it. Under such circumstances, PAT has become a motivational move for such farmers and may induce them to sustain in agriculture. It was found that Subsidy played a vital role in attracting farmers towards Precision Farming. Farmers use four types of fertilizers: they are, straight fertilizers (urea, potash), farm yard manure (cow dung, poultry manure and vermin compost), bio-fertilizer (trichoderma) and water soluble fertilizer (19-19-19, Multi K). The percentage of cost in the case of Precision farmers and conventional farmers may be tabulated as below.

Table 2: Representing Cost Involved in Conventional and Precision Farming

Type of Farming / Expenses	***Conventional Farming (% of cost)***	***Precision Farming (% of cost)***
Human Labour	27.38	27.17
Fertilizer	15.76	19.11
Farm Yard Manure (FYM)	8.29	9.10

Source: Ravikumar, 2016

The Tech Mahindra research in 2007 has also analysed the impact of PAT on resource poor regions and underprivileged farmers in Dharmapuri district of Tamil Nadu . It has shown that there is an output difference caused by technology and input which is positive. The study suggests that subsidies for water soluble fertilisers and pump sets will increase adoption of PAT. (**Tech Mahindra, 2007[6])**

[6] Tech Mahindra: Precision Agriculture and Potential Market in India, 2007 https://www.techmahindra.com/sites/ResourceCenter/White%20Papers/New_Gen_Services/PrecisionAgriculture-PotentialMarket-India.pdf

Strengths of Precision Farming:

Precision Farming may be more advantageous for a country like India where a majority of people are engaged in agriculture and are also in the urge to leave agriculture any time if they find an alternative. This may be mainly attributed to the scarcity and inefficiency in the use of resources, backwardness in agriculture, illiteracy of farmers and their poor access to technological awareness. Precision agriculture technology (PAT) uses information technology and software to ensure crops receive accurate input to avail optimum health and productivity.This method can thus ensure the more efficient and accurate use of resources. Secondly, PAT helps to increase the productivity. Thirdly, under a situation where the whole world may face an acute scarcity of water, the PFDCs can pave way for finding new techniques of water conservation, as it has been proved by the PFDC (Precision Farming Development Centre), Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana during June 2016 where it invented the solar lift irrigation project (solar powered community lift and micro irrigation project). The same project also proved the conservation and easy generation of electricity by generating 1100 kilowatt daily. Though Green Revolution was very essential to fight the famine and also to boost up the food supply in the 1960s, at present, many people are aware of the hazards of the excessive use of fertilizers and also their impact on the fertility of the soil. So it is mandatory to ensure that the fertilizers, pesticides and manures are used in the most precise amount which is one of the main features of Precision Farming Technology. Finally and most importantly, PAT helps to reduce pollution by avoiding unnecessary use of chemicals on the soil and thus prevents soil degradation. Statistical data provide farmers a better understanding of the variations in soil conditions. Hence, they can use precise input and procure optimum output.

Weaknesses of Precision Farming:

The first and foremost drawback of PAT (Precision Agriculture Technology) is its high capital costs that discourage the farmers to adopt it. Secondly, this method is not popular among the farmers and it requires expert advice for implementation which stands as a barrier to it. This is mainly due to the illiteracy and the lack of awareness among the farmers for which they alone cannot be blamed. Moreover, farmers who have always sailed in the ship of tradition may hesitate to shift to modern techniques of agriculture unless they see live examples of success of implementing these techniques**.**

Table 3: representing distribution of operational holdings:

S. No	Size-Group	Percentage of number of operational holdings to total	Percentage of area operated to total
1	Marginal (below 1.00 ha.)	67.10	22.50
2	Small (1.00 - 2.00 ha.)	17.91	22.08
3	Semi-medium (2.00 - 4.00 ha.)	10.04	23.63
4	Medium (4.00 - 10.00 ha.)	4.25	21.20
5	Large (10.00 ha. & above)	0.70	10.59

(Press information bureau, government of India, 2015[7])

The percentage of marginal holdings was 67.1% in 2010–11. The percentage of all other holdings (medium and large) has gone down marginally in last 20 years. The percentage of large holdings has been found 0.7% in 2010–11. The percentage of medium holdings was 4.3% in 2010–11. (**Kush, 2017)[8]**. This shows that a large number of farmers in India are marginal farmers with less than 1.00 hectares. With such small land holdings being the possession of a large number of Indian farmers it may be difficult for the farmers to go in for PAT. Hence fragmentation and subdivision of land holdings caused by excessive population and splitting of inherited property may be an issue in India. Inflation has been reduced. However, the result is a non-food inflation which causes transfer of income from the rural to urban areas. Hence, it becomes difficult to adopt PAT as spending in the agricultural sector has fallen and so has farmer income. Agricultural labour is available in plenty. However, they are not trained with handling technology. This lack of skill can be seen as a major factor knocking down the progress of PAT.

Suggestions:

Though there have been initiatives from the government to encourage PAT, the number of Precision Farmers is still low. The following policy suggestions may be adopted to bring more farmers under the scope of Precision Farming.

- The use of GPS (Global Positioning System) can be replaced by the use of the Indian Regional Navigation Satellite System (IRNSS) which will pave way for the simultaneous development of the primary (agriculture) and tertiary sector (telecommunications).

[7] http://pib.gov.in/newsite/printrelease.aspx?relid=132799)

[8] https://medium.com/@luv_kushwah/why-precision-agriculture-in-india-will-remain-a-failure-20a03f275b22

- Spending can be increased in the agricultural sector to ensure more sustainable farmer income.
- Labour targeted in other employment schemes of the government can be redirected towards agriculture as a large number of labourers are required for the method of PAT.
- Every village in India has a society or an organisation for the development of agriculture. Precision Farming Development Centres (PFDC's) can be made as a separate section within the campus of these societies, so that PAT can be made approachable to farmers of all villages irrespective of how remote it is.
- Precision farming requires large acres of land, Hence land integration is the key aim here.
- As shown in table 3, the cost of precision agriculture is high compared to conventional farming methods. To support the farmers in this process, the government should provide consistent financial support and subsidies and also work on creating technical awareness among farmers.
- A proper work culture and trust should be developed between the farmers and the government.
- Soil management, productivity management and optimising inputs are the main areas that require attention.

Conclusion:

Precision farming can address both environmental and economic issues that surround agriculture today. Though there may be difficulties in the implementation of this method, there are evidences for the success of this method through the experimentation done in some states of India. These experiments give empirical evidences to the fact that there is an increase in productivity under PAT. Creation of awareness among farmers along with constant support and subsidy from the government can further enable the success of this method throughout India with the cooperation of small and marginal farmers in the near future.

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