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WILLINGNESS OF CHILLI GROWERS TOWARDS ADOPTION OF PRECISION AGRICULTURAL TECHNOLOGIES IN GUNTUR DISTRICT OF ANDHRA PRADESH

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ABSTRACT

Precision agricultural technologies (PAT) are emerging as a potential game changer significantly transforming the agricultural sector. This study explores the factors influencing a sample of 144 chilli growers in Guntur district of Andhra Pradesh towards adoption of PAT in their farming operations. The data pertains to the months of June to July, 2024. Primary data was utilised and the information obtained was anlayzed through binary logistic regression. The model was statistically significant (χ = 94.544, $p < 0.001$) with strong explanatory power (Nagelkerke R^2 = 0.677). Farm size (OR = 1.926, $p < 0.001$) and Mass media exposure (OR = 6.445, p = 0.045) significantly increased the likelihood of adoption of PAT. Social media usage (OR = 0.241, p = 0.004) and access to storage facilities (OR = 0.066, p = 0.003) were also significant predictors. While larger landholdings and greater media exposure enhanced adoption, higher farming experience and access to storage were associated with a lower likelihood of adopting precision agricultural technologies. Thus, targeting large farmers, enhancing technology dissemination by leveraging social and mass media platforms and facilitating financial support mechanisms can enhance the adoption of precision agricultural technologies.

Keywords: Adoption of Precision Agricultural Technologies, Binary logistic regression, Chilli Growers, Financial support, Willingness

INTRODUCTION

Over the years, the agriculture sector has witnessed remarkable technological progress, ranging from the development of high-yielding and genetically modified crops to advancements like drip irrigation, remote sensing and biotechnology. More recently, innovations such as sensors, drones, GPS soil mapping and robotics have emerged. Precision agriculture (PA), also known as precision farming, represents a modern approach to farming that leverages digital tools to closely monitor and optimize agricultural production processes. Initially, PA involved technologies like variable rate technologies (VRTs), electronic maps, yield monitors, satellites, drones, and ground-based sensors (Liu *et al*., 2021). Over time, cross-industry technologies such as robotics, the Internet of Things (IoT), artificial intelligence (AI), and cloud computing

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have been integrated into agriculture, transforming precision agriculture into smart farming (Mc Fadden *et al*., 2023). These advanced technologies aim to make farming operations not only more efficient but also more predictable.

With precision agriculture technologies like IoT, farmers can access real-time data on soil conditions, plant health, climate and terrain that empowers them to make informed, data-driven decisions. The adoption of smart farming and precision agriculture technologies holds great promise for reducing input costs, boosting yields, minimizing environmental impact and ultimately enhancing the overall efficiency and sustainability of agricultural practices. However, despite these technological advancements, the agricultural sector continues to face challenges such as inefficient resource use, environmental issues like soil pollution, climate change and food safety concerns, all of which impact productivity, efficiency and sustainability. Moreover, despite the agronomic, economic and financial benefits of precision agricultural technologies, their global adoption has remained significantly low due to social, institutional, influential and many other factors.

In the context of chilli farming, these challenges are particularly acute. Chilli cultivation demands intensive agricultural practices and substantial investments due to the crop's vulnerability to pests and weather fluctuations. Guntur district of Andhra Pradesh, being a leading chilli-producing region in India, provides a critical setting for examining these issues. Despite initiatives by several startups in the region to introduce PAT technologies such as IoT, drones and variable rate technologies (VRTs), adoption rates among farmers have remained low with around three million adopters constrained by infrastructure and financial barriers. (CEEW, 2021). Moreover, limited adoption has been observed among small holders in India due to their fragmented land holdings, inadequate skill and higher cost of adoption. (Chaudhary *et al.,* 2025). Against this backdrop, the present study aims to explore the factors influencing chilli growers' willingness to adopt PAT in Guntur, as understanding these factors are essential for enhancing the efficiency, sustainability and profitability of chilli farming.

MATERIAL AND METHODS

Guntur district of Andhra Pradesh is selected purposively for the study due to its distinction as the leading producer of chilli accounting for 15% of the country's total production. Highest chilli growing mandals and villages in district were obtained from mandal and village development offices respectively and among them top three mandals and four villages from each mandals were selected. Chilli growing farmers list was obtained from village agriculture officers and 12 farmers from each village were selected randomly resulting in sample size of 144. To achieve the study's objectives, primary data pertaining to socio-demographic characteristics and other information particulars such as access to agricultural information and technologies, media exposure, storage and finance access, financing sources and institutional participation was collected. Additionally, farmers willingness towards adoption of precision agricultural technologies were collected using a survey method with the help of well-structured schedule. The study specifically focused on three key PATs namely IoT, Drones and variable rate technologies (VRTs), as many startups in the region are working to introduce these innovations. The collected data, which pertains to the year 2024-25, was analysed using percentage analysis and binary logistic regression. The data was collected between June and July months of 2024.

Table 1. Dependent and Independent Variables

Dependent Variable (Y) Independent variables	Willingness to adopt PAT	Yes :1, No:0
X_1	Age	Categorical variable
X_2	Education	Continuous variable
X_3	Farming Experience	Continuous variable
X_4	Farm Size	Continuous variable
X_5	Family Size	Continuous variable
X_6	Membership in farmer collectives	Yes:1,No: 2
X_7	Agriculture related technological applications usage	Yes:1,No: 2
X_8	Agriculture related information	Categorical variables
X_9	Mass media platforms usage	Categorical variables
X_{10}	Social media platforms usage	Categorical variables
X_{11}	Access to storage facilities	Yes :1, No: 2
X_{12}	Access to finance facilities	Yes: 1, No: 2
X_{13}	Finance source 1	Categorical variables
X_{14}	Attending companies meetings	Yes :1, No: 2
X_{15}	Attending institutional meetings	Yes : 1,No: 2

BINARY LOGISTIC REGRESSION

The functional form of binary regression (logistic) model is briefly described as follows:

$$Ln [Pi 1-Pi] = \beta 0 + \beta 1 X1 + \beta 2 X 2 + \beta 3 X 3 + \beta 4 X 4 + \beta 5 X 5 + \beta 6 X 6 + \beta 7 X 7 + \beta 8 X 8 + \beta 9 X 9 + \beta 10 X 10 + \beta 11 X 11 + \beta 12 X 12 + \beta 13 X 13 + \beta 14 X 14 + \beta 15 X 15.$$

Where,

P_i is the probability that the farmer willingness towards adoption of PAT, that takes value of 1, if adopted and 0 otherwise

RESULTS AND DISCUSSION

Socio-economic and other information particulars of sample respondents

The information related to socioeconomic and other information of sample respondents were collected and analyzed through percentage analysis and the results are represented in Table 1.

Among the total 144 respondents, 52.78 % were in the age group of 45-60 years, followed by 33.33 % in the 30-45 years age category. Half of the respondents (50 .00%) were illiterate, while 28.47 % had primary education. 75.00 % of sample farmers had more than 15 years of farming experience and were small (31.94 %) and medium farmers (26.39 %). Additionally, 48.00 % of the respondents had a family size of 4 to 6 members. For primary agriculture-related information, most of the respondents relied on state departments of agriculture and horticulture (34.00 %) and fellow farmers (26.30 %). For secondary information, they primarily relied on mass media platforms such

Table 2. Socio-economic and other information particulars of sample farmers

(n=144)

S.No	Variable	Frequency	Percent
Socio-economic characteristics			
1	**Age**		
	Less than 30years	12	08.33
	30-45years	48	33.33
	45-60years	**76**	**52.78**
	More than 60years	8	05.56
2	**Education level**		
	Illiterate	**72**	**50.00**
	Primary Education	41	28.47
	Secondary Education	24	16.67
	Graduation and above	7	04.86
3	**Experience**		
	1 to 5years	0	0.00
	6 to 10years	17	11.81
	11to15years	18	12.50
	>15years	**109**	**75.69**
4	**Farm size**		
	<2.5acres (Marginal farmer)	36	25.00
	2.5to5 acres (Small farmers)	**46**	**31.94**
	5to10acres (Medium farmers)	38	26.39
	>10acres (Large farmers)	24	16.67
5	**Family size**		
	1 to 3	3	2.08
	4 to 6	**70**	**48.61**
	7 to 9	52	36.11
	10and above	19	13.20
Other information particulars			
6	**Agriculture information sources**		
	Fellow farmers	38	26.39
	State departments of agriculture/ horticulture	**49**	**34.03**
	Input Dealers	30	20.83
	Buyers	27	18.75

S.No	Variable	Frequency	Percent
7	**Mass media platforms**		
	Newspaper	24	16.67
	Radio	0	00.00
	TV	**120**	**83.33**
8	**Social media platforms**		
	YouTube	**69**	**47.92**
	WhatsApp	21	14.58
	Facebook	54	37.50
9	**FPO member**		
	YES	**77**	**53.47**
	NO	67	46.53
10	**Access to tech apps**		
	YES	**101**	**70.14**
	NO	43	29.86
11	**Access to storage facility**		
	YES	**114**	**79.17**
	NO	30	20.83
12	**Access to finance**		
	YES	**94**	**65.28**
	NO	50	34.72
13	**Intention to adopt drone**		
	YES	45	31.20
	NO	**99**	**68.80**
14	**Major Source of Finance**		
	Financial Institutions	42	29.17
	Money Lenders	**61**	**42.36**
	Agribusiness Company	11	07.64
	Family	30	20.83
15	**Participation in Technical Meetings organized by agro based companies**		
	Yes	**98**	**68.06**
	No	46	31.94
16	**Participation in Institutional Meetings organized by state department**		
	Yes	**77**	**53.47**
	No	67	46.53

as television (83.00 %) and YouTube (47.90 %).

Among sample respondents, 54.00 % had FPO membership while 70.00 %, 79.00 %, and 65.00 % of the respondents had access to technological applications, storage facilities and finance, respectively. The source of finance among the respondents was primarily informal sources, with 42.00 % were relying on money lenders. Additionally, 68.00 % had been attending technical meetings organized by agro based companies while 53.00 % were regularly participating in meetings organized by state department of agriculture.

Factors influencing farmers' decisions towards adoption of precision agricultural technologies

The information regarding the farmer willingness towards adoption of PAT was collected using a binary scale response with "Yes" indicating willingness to adopt and "No" indicating unwillingness. As the dependent variable is binary in nature, binary logistic regression was employed to analyze factors

Table 3. Factors influencing farmers' decisions towards adoption of precision agricultural technologies

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step1	Step	94.544	16	<0.001
	Block	94.544	16	<0.001
	Model	94.544	16	<0.001

Model Summary			
Step	-2Loglikelihood	Cox & Snell R Square	Nagelkerke R Square
1	84.329[a]	0.48	0.677

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	3.93	8	0.8

Classification Table[a]					
Observed			Predicted		
			INTEN ADOP		Percentage Correct
			NO	YES	
Step 1	INTENADOP	NO	94	5	94.9
		YES	15	30	66.7
Over all Percentage				86.1	

a. The cut value is 0.500; INTEN: Intention to; ADOP: Adoption

Variables in the Equation

		B	S.E.	Wald	df	Sig.Exp(B)		95%C.I.forEXP(B)	
								Lower	Upper
Step 1[a]	AGEGRP			1.799	3	0.615			
	AGEGRP(1)	24.55	14495.75	0.00	1	0.999	0.000	0.00	.
	AGEGRP(2)	25.18	14495.75	0.00	1	0.999	0.000	0.00	.
	AGEGRP(3)	26.77	14495.75	0.00	1	0.999	0.000	0.00	.
	EDU	0.088	0.076	1.353	1	0.245	1.092	0.942	1.266
	FARMEXP	-0.48	0.082	0.339	1	0.560	0.953	0.812	1.119
	FARMSIZE	0.655	0.154	18.180	1	**0.000**	1.926	1.425	2.603
	FPO MEM	0.166	1.096	0.023	1	0.88	1.180	0.138	10.106
	ATAPPS	0.062	0.764	0.007	1	0.935	1.064	0.238	4.759
	PRIMARY	-0.98	0.317	0.096	1	0.757	0.906	0.487	1.688
	SMPFF	1.421	0.494	8.28	1	**0.004**	0.241	0.092	0.636
	MMP	1.863	0.930	4.01	1	**0.045**	6.445	1.042	39.85
	Access to Storage	-2.725	0.918	8.81	1	**0.003**	0.066	0.011	0.396
	Access to Finance	0.622	0.701	0.788	1	0.375	0.537	0.136	2.120
	F SOURCE	-0.446	0.292	2.32	1	0.125	0.640	0.361	1.135
	Constant	-24.02	14495.75	0.000	1	0.999	0.000		

a. Variable(s)enteredonstep1: AGEGRP, EDU, FARMEXP, FARMSIZE, MEMSHIP, LEADSHIP, AFRE, ARTP, MMP, SMPF.

influencing farmers towards adoption of precision agricultural technologies. The independent variables included socio-economic characteristics (age, education, farming experience, farm size), institutional and resource-related factors (membership in FPOs, access to finance, storage facilities, sources of finance) and information-related factors (use of agricultural apps, agricultural information sources, social media, and mass media). This framework helps in identifying the key determinants significantly influencing the farmers towards adoption of PAT. The results are presented in Table 3.

The results of logit model from the Table 3. indicated that, the model showed good fit and is statistically significant, as the probability is less than 0.05 with chi square value of 94.54. The Nagelkerke R Square value of the model was 0.677 indicating that the model explains 67.70% of variance while classification table indicated that the model correctly classified 86% of the cases.

Among the explanatory variables, farm size (p <0.05; Odds ratio (OR)–1.92), social media usgae (p= 0.004; Odds ratio (OR) – 0.241), mass media exposure (p = 0.045; Odds ratio (OR) – 6.445) and access to storage (p=0.003; Odds ratio(OR)-0.066) were found as statistically significant variables influencing farmers willingness towards adoption of precision agricultural technologies. This infers that, higher the land holdings, higher the usage of social media and higher mass media exposure for sourcing agricultural related information, higher the access to storage, higher will be the probability of adoption of precision agricultural technologies. Platforms such as You Tube and television played a strong role in shaping farmers awareness and beliefs towards these technologies. The findings are consistent with the results of (Diaz *et al*., 2021) and (Le Hoang Nguyen *et al*., 2020) who also established positive relationship for education and farm size with adoption of technology related applications by the farmers.

The variables namely farming experience, and those farmers having access to storage facilities are associated with a decreased likelihood of farmers willingness towards adoption of PAT. As many farmers in the sample had lower education levels, it did not showed significant relationship. However, in studies conducted by (Chaung *et al*.,2020 and Jenkins *et al.,* 2011) the results highlighted that increased education levels increases the likelihood of adoption of technologies. This suggests that farmers with higher farming experience and having access to storage facilities are less inclined to adopt new technologies. This could be because farmers with greater farming experience may be reluctant to deviate from their routine farm operations, feeling comfortable with their established practices. Similarly, farmers with access to storage facilities may feel a sense of flexibility and security in their farming operations, making them less motivated to explore or invest in new technologies. Thus, the findings suggest that efforts to increase adoption should initially target farmers with larger land holdings. Additionally, providing more information through widely viewed platforms such as television and YouTube can help raise awareness. Moreover, offering financial support for these investments can further boost the rate of adoption.

CONCLUSION

The study conducted among a sample of 144 chilli growers in Guntur district of Andhra Pradesh revealed that farmers with large land holdings, active users of social and mass media platforms were more inclined to adopt PAT. Among these platforms, You tube and Television identified as key channels for disseminating agricultural information and technological knowledge. Conversely, farmers with greater farming experience and had access to storage facilities were less likely to adopt, possibly due to their reluctance to deviate from current agricultural practices and the financial security offered through usage of storage facilities. Thus, the findings suggest that to enhance the adoption of PAT among farmers, agri startups and other agro based companies should prioritize engaging large farmers, while strategically leveraging social and mass media platforms. Furthermore, facilitating initial financial support systems through institutions and involving agri departments at state and central level in capacity building initiatives will be crucial for driving the adoption.

To increase the adoption of precision agricultural technology (PAT) among chili growers, focus should be on larger landholders by offering tailored programs and financial incentives. Usage of platforms like YouTube and TV to share practical, localized content,

and improve access to affordable credit and subsidies is recommended. Providing hands-on training and sharing success stories may help experienced farmers to overcome hesitations, while building strong farmer networks for peer support. Advocate for policies and partnerships that simplify and encourage PAT adoption, creating a more favourable environment for farmers.

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