Biological Forum – An International Journal 15(11): 48-54(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

A Multifaceted Analysis of IPM Adoption among Vegetable Growers in Central India's Jabalpur Region

Arpit Somtiya[1], Seema Naberia[2], Siddharth Namdeo[3*], Ashish Kumar Nagar[1] and Vedant Gautam[4]
[1]Ph.D. Scholar, Department of Extension Education,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh), India.
[2]Assistant Professor, Department of Extension Education,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh), India.
[3]Ph.D. Scholar, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh), India.
[4]Ph.D. Scholar, Banaras Hindu University, Varanasi, (Uttar Pradesh), India.

(Corresponding author: Siddharth Namdeo)*
(Received: 12 September 2023; Revised: 03 October 2023; Accepted: 17 October 2023; Published: 15 November 2023)
(Published by Research Trend)

ABSTRACT: The adoption of Integrated Pest Management (IPM) among vegetable growers in the Shahpura block of the Jabalpur district, central India, is explored in depth in this study. The complex factors influencing or impeding IPM integration are highlighted under the present study. Notably, education emerges as a powerful catalyst, with educated growers significantly more likely to adopt IPM practices. Experience plays a pivotal role, demonstrating a positive correlation with IPM adoption. Income levels, training received and occupational diversity have an impact on the same. The psychological elements that display strong correlations with IPM adoption include economic motivation, scientific orientation, risk orientation, social engagement, knowledge levels, and attitude. These correlations offer light on the complex forces that underlie sustainable agriculture which adds regional knowledge about the dynamics of IPM adoption and provides policy makers, stakeholders, and agricultural extension agencies with useful advice. Moreover, the IPM programmes have not been widely adopted in developing countries due to lack of proper knowledge and training farmers in efficient IPM practices, the need for more of human labour, and the complexity of IPM practices, all of which impede on the effective implementation of IPM programmes. Therefore, the present study emphasised on the promotion of sustainable agriculture practises in the Shahpura block and advance IPM adoption towards more environmentally conscious and sustainable future through empirical evidence and useful recommendations.

Keywords: Adoption of IPM, Vegetable farmers, Multicollinearity, Regression Analysis, Likert scale.

INTRODUCTION

Agriculture, which is essential for ensuring the world's food security and economic development, faces sustainability and environmental issues as a result of conventional methods (Pingali, 2012; FAO, 2020). In contemporary agriculture, pest management is a serious issue that affects crop yields (Oerke, 2006). Concerns about health and the environment are brought up by the usage of chemical pesticides (Pimentel *et al.*, 2005; Damalas and Eleftherohorinos 2011). The sustainable option is integrated pest management (IPM) (Kogan, 1998; Gurr *et al.*, 2017). (Pedigo *et al.*, 1986; Zehnder *et al.*, 2007) IPM prioritises minimising pesticide use by combining methods like biological control, cultural practises, and chemical intervention as a last resort (Altieri and Nicholls 2003). IPM is praised for its ability to lessen the effects of pesticides throughout the world (Naranjo, 2009; Romeis *et al.*, 2008). The acceptance of IPM, however, differs depending on the circumstance (Gossen *et al.*, 2016; Settle *et al.*, 1996). Adoption is influenced by local and global factors. Adoption of IPM is not exclusively influenced by agronomic considerations; it is also influenced by socioeconomic, psychological, and environmental factors (Feder *et al.*, 2011; Asfaw *et al.*, 2010). To advance sustainable agriculture, guarantee food security, and reduce environmental harm, it is essential to comprehend these determinants (Midega *et al.*, 2018; Pretty *et al.*, 2018).

The Indian Context. India's economy is based on agriculture, which employs a large section of the workforce and contributes significantly to the GDP of the nation (Gulati *et al.*, 2012; GoI, 2021). With its abundant arable land and variety of agroecological zones, India's agriculture sector offers both distinct difficulties and opportunities (Kumar *et al.*, 2012; Parikh, 2019). Notably, the growing demand for fresh product and the possibilities for money generation have made vegetable cultivation more popular (Singh *et al.*, 2019; Mishra and Bhati 2017). However, there are significant pest pressures on vegetable crops in India, and the widespread use of chemical pesticides raises questions about both food safety and environmental contamination (Reddy *et al.*, 2009; Bhaskar *et al.*, 2018).

Vegetable production plays a crucial role in agriculture by providing food, nutritional and economic security to the people of with higher returns per unit area to the producers (Singh *et al.*, 2018). For Indian vegetable growers to achieve sustainable and secure vegetable output, the implementation of Integrated Pest Management (IPM) strategies becomes essential in this situation (Srinivasan *et al.*, 2013; Basker *et al.*, 2015). Despite the existence of international literature on IPM adoption, context frequently determines the influential elements (Pampolino *et al.*, 2012; Dwiartama *et al.*, 2018). The unique dynamics of IPM adoption within particular locations and farming communities must therefore be understood through localised research in order to make informed decisions (Manunayaka *et al.*, 2019). There are growing concerns of pesticide risks to human health, natural environment and ecosystems (Singh *et al.*, 2020). These effects are increasingly manifested in loss of working efficiency of farm workers resulting in higher cost of production (Manjunath *et al*., 2018). The increased use of pesticides, deteriorating ecosystem health has advocated the need to change traditional and external input use in agriculture towards safe and sustainable production (Gupta *et al.*, 2019). Pest control practices in the vegetable crops have been heavily dominated by the routine use of broad-spectrum insecticides to control pests. Concerns have emerged about the adverse consequences of over use of pesticide. These consequences include short and long term health hazards, contamination and environmental degradation. To minimize the pest losses farmers heavily depend on the chemical pesticides and accessing pest management information from the pesticide dealers due to weak state extension support system. Gaddanakeri *et al.* (2022) highlighted the negative impacts of chemical intensive modules on the coccinellid beetles which keep the sucking pest's population under check. Bio-intensive module, untreated control and also IPM plots maintain significantly higher activity of coccinellids compared to chemical intensive farmers practice module. Similarly, Mourya and Kumar (2021) have concluded that the integrated pest management (IPM) fosters the growth of healthy crops with minimum disruption to agroecosystems and encourages ecofriendly pest management systems. Timprasert *et al*. (2014) investigated the factors determining their adoption or non-adoption of IPM practices. The findings demonstrated that farmers had different uncompromising reasons for determining the use of IPM for their insect pest management. Higher costs of insecticides (91%), adverse effects of insecticides on human health and the environment (80%), and a greater risk of insect pests developing resistance to insecticides (28%) were the primary reasons for the adoption of IPM by vegetable growers in the study area. The reasons for the rejection of IPM practice were unsuitability of IPM for a large farm (52%), implementation difficulties (80%) and a greater belief in synthetic insecticides and their efficacy for target pest control (39%). The Safer insecticide management, Insecticide resistant management and Biorational pest management were screened as emerging trends of ecofriendly approach for sustainable pest management. The Shahpura block in the Jabalpur district, Madhya Pradesh, is recognised for its significant output of vegetable crops, making it an ideal site to investigate variables promoting or impeding IPM techniques, which is especially the subject of this study.

METHODOLOGY

In order to maximise representation of vegetable crop production and cultivation area, the study block was chosen using a purposive approach. Shahpura was chosen as the study's sample location among the district's seven blocks because of its prominence in terms of vegetable crop production and cultivation area. Five villages, Sihoda, Dighoda, Kheri, Belkheda, and Dharampura, in the Shahpura block of the Jabalpur district, were specifically chosen for their high concentration of vegetable growers. A diverse sample of 120 respondents was obtained for the study by using a straightforward random sampling technique to select 24 respondents at random from each of these villages. The study's variables are age, education, work history, family size, social involvement, and training received are socio-personal factors. The following economic factors are included: Landholding, Annual Income, Occupation, and Area Under Vegetable Cult. Extension Contacts and Media Exposure are examples of communication-related variables. The psychological factors economic motivation, scientific orientation, risk orientation, knowledge of IPM, and attitude toward IPM practises are among them. The extent to which IPM practises are used by vegetable growers is the dependent variable. A clear grasp of the study's variables is made possible by this table, which organises and summarises important elements to be examined in the research. The data was collected by using structured interviews and pre-trained questionnaires. These questions were carefully crafted for clarity and compatibility with the study's goals, guaranteeing a logical flow of data. Secondary data were obtained from publications and government agencies as a supplement to the primary data. A carefully planned interview schedule served as the main component of the research tools, making it easier to gather the necessary data. The researcher developed rapport through face-to-face interviews, confirming the accuracy of the data.

A straightforward solution to the issue of dichotomous dependent variables is the binary logistic regression included in R and R studio. In this study, an empirical model of vegetable farmers' acceptance of Integrated Pest Management (IPM) was established. Specifically, whether a vegetable farmer adopts IPM was the dependent variable, and vegetable farmer's adoption was given a specific value. In order to investigate the impact of farmer differentiation on vegetable farmers' adoption of IPM, the team plans to utilise binary logistic regression analysis. To investigate the impact of farmer differentiation on the adoption of IPM by vegetable farmers, the study employs binary logistic regression analysis. The binary logistic regression model has the following fundamental structure.

$$Y = \beta 0 + \beta 1 \boldsymbol{X1} + \boldsymbol{\beta 2} X2 + ... + \beta n^* Xn + \varepsilon$$

Where,

— **Y**: The dependent variable you are trying to predict.

— **β0**: The intercept or constant term. It represents the expected value of Y when all independent variables (X1, X2, ..., Xn) are zero.
— **β1, β2, ..., βn**: The coefficients associated with each independent variable (Education, Experience, Family size, etc.). These coefficients represent the change in the expected value of Y for a one-unit change in the corresponding independent variable while holding all other variables constant.
— **X1, X2, ..., Xn**: The independent variables used in the model (Education, Experience, Family size, etc.).
— **ε**: The error term, which represents the random variability or noise in the relationship between the independent variables and the dependent variable.
The R programme version 4.3.1, a flexible and popular statistical computer environment, was used to conduct all statistical tests and analyses, including t-tests, ANOVA, VIF calculations, hypothesis testing, condition indicators, and possibly Chi-Square tests.

RESULT AND DISCUSSION

A. Binary logistic model test analysis
Prior to undertaking model estimate, it is taken into account that there can be internal correlations among the observed variables. Regression analysis was employed to show the complex interactions between the explanatory variables. The Variance Inflation Factor (VIF) and Condition Index (CI) values for each of the explanatory variables in order to determine the degree of multicollinearity. These numbers provide crucial information about the dependability and strength of regression analysis.
The table 1. gives a clear overview of the components that make up regression model and includes a list of each unique explanatory variable being taken into account. The second column's VIF for each variable measures the level of multicollinearity. Greater multicollinearity between variables is indicated by higher VIF values. Concerns concerning the validity of the regression results are frequently raised when the VIF is greater than 5 or 10.
The Condition Indicators (CI) for each variable are listed in the third column, and they provide information about the degree of multicollinearity. Less multicollinearity is implied by smaller CI values, which also point to variables that are largely independent of one another. On the other hand, as variables become more interconnected, larger CI values can indicate more multicollinearity concerns. Typically, CI values exceeding 30 or 100 are seen to be a symptom of serious multicollinearity problems. Several important conclusions are drawn from this analysis. The variable "Experience" is noteworthy since it has a VIF of 2.2929, which denotes some multicollinearity. The multicollinearity issue with other variables is not significantly exacerbated, however, according to its CI of 1.000. However, variables with low VIF values, such as "Risk Orientation" and "Annual Income," show no evidence of multicollinearity issues.
Table 1 provides a thorough analysis of the Multicollinearity among the explanatory factors. In especially for variables with modest VIF values, it emphasises the significance of careful interpretation. When examining these variables' associated coefficients, researchers should take into account the potential collinear effects. In addition, future research projects may profit from examining variable selection methods or gathering additional data to solve these multicollinearity concerns, thereby strengthening the accuracy of regression results.

Table 1: Explanatory variable multicollinearity diagnosis.

Explanatory variable	VIF	Condition Indicators
Age	1.449047	1.193
Education	2.263068	1.006
Experience	2.292883	1.000 (Exact)
Family size	2.022095	1.072
Training received	2.201011	1.041
Landholding	1.524693	1.172
Annual income	1.725542	1.154
Occupation	2.130369	1.065
Area under vegetables	1.476297	1.111
Extension contact	2.07957	1.053
Mass Media exposure	2.06277	1.052
Economic motivation	2.036382	1.05
Scientific orientation	2.22553	1.065
Risk orientation	1.818449	1.086
Social participation	2.145332	1.061
Knowledge level	2.107584	1.058
Attitude	2.010513	1.055

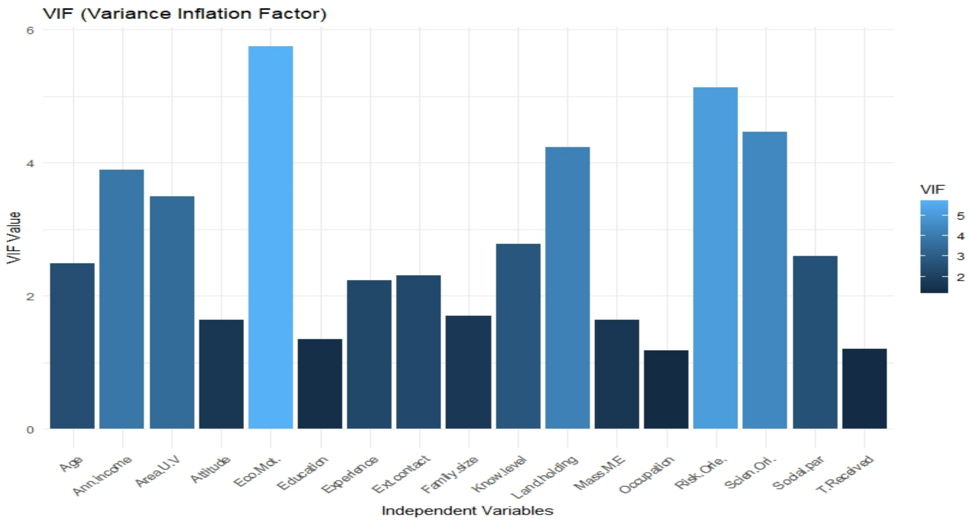


Fig. 1. Variance inflation factor of all considered independent variables.

B. Analysis of the Impact of independent Variables on IPM adoption

Table 2 displays the findings of a multiple linear regression analysis conducted to comprehend the impact of numerous independent factors on IPM adoption, which is a crucial component of the present study. Table 2. gives a thorough breakdown of the regression model, including the estimated coefficients, standard errors, t-values, and related p-values for each independent variable. The main goal of this research is to determine the independent variables' statistical significance in explaining variations in IPM adoption. A number of independent factors show statistically significant associations with IPM adoption, showing their important influence within the framework of the study. A statistically significant positive link between "Age" and the adoption of IPM methods can be seen (coefficient = 0.10550, p-value = 0.0281*). This suggests that those who are older are more likely to adopt IPM techniques. Notably, a number of additional factors have a big impact on IPM adoption. "Education" has a positive correlation (coefficient = 1.019, p-value = 0.0327*), suggesting that adoption rates are correlated with educational attainment. "Experience" (coefficient = 0.2113, p-value = 0.043*) indicates that more experience influences the adoption of IPM in a good way. In order to increase IPM adoption, "Training Received" (coefficient = 0.3715, p-value = 0.030*) emphasises the significance of specific training. Higher salaries play a role in supporting IPM practises, as shown by the statistic "Annual Income" (coefficient = 0.0000179, p-value = 0.0312*). "Occupation" (coefficient = 0.3211, p-value = 0.0282*) denotes preferences connected to a particular line of work. The importance of outreach efforts is indicated by the term "Extension Contact" (coefficient = 0.17627, p-value = 0.0379*). The importance of outreach efforts is indicated by the term "Extension Contact" (coefficient = 0.17627, p-value = 0.0379*). Other variables, confirmed by their respective p-values, such as "Mass M.E," "Economic Motivation," "Scientific Orientation," "Risk Orientation," "Social Participation," "Knowledge Level," and "Attitude" also play important roles. Collectively, these findings shed light on the complex factors impacting IPM adoption in the population under study. On the other hand, there is no statistically significant correlation between "Land Holding," "Area Under Vegetables," or "Family Size" and IPM adoption in this study. This suggests that in the context of this investigation, characteristics including family size, agricultural practises linked to vegetable cultivation, and land holding size do not significantly influence the adoption of IPM. In conclusion, this study's multiple linear regression analysis revealed the importance of a few independent variables, shedding light on the elements that influence IPM adoption. These results provide practical guidance for activities and plans meant to increase the uptake of IPM outcomes among the community under study. Another study conducted by Kamal *et al.* (2018) concluded that educational qualification, time spent in the vegetable field, knowledge about IPM practices, training exposure and attitude towards IPM increase the adoption behaviour of IPM practices of the farmer.

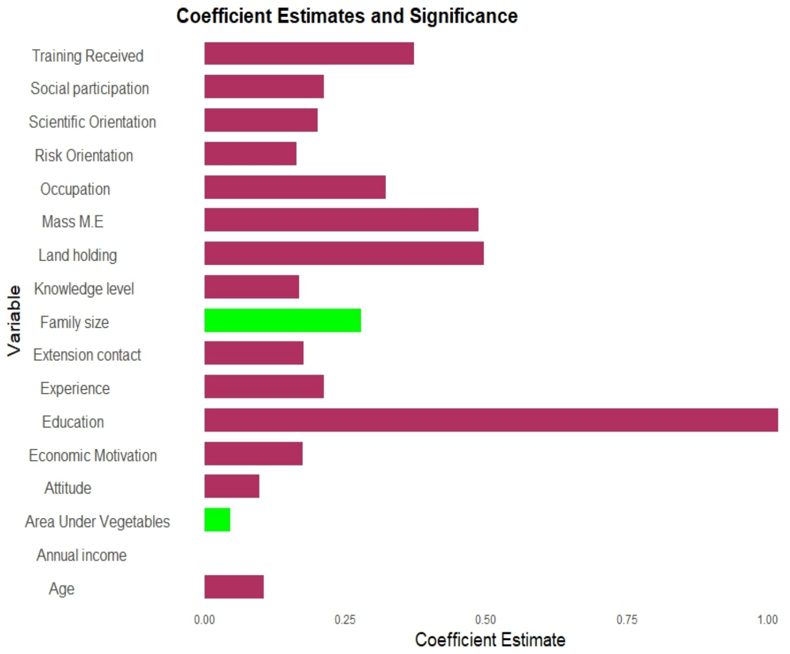
The model only accounts for about 25.08 percent of the variation in IPM adoption, thus it is important to keep in mind that more research into other variables is needed to improve prediction precision.

Model Fit and Explained Variance. Several statistics were used to evaluate the overall model fit. According to the Multiple R-squared value of 0.2508, the model accounts for about 25.08 percent of the variation in IPM adoption. A more conservative estimate of explained variance is provided by the Adjusted R-squared value of 0.1172, which takes the complexity of the model into consideration. With a p-value of 0.02603, the F-statistic confirms the model's statistical significance when testing the model's overall significance.

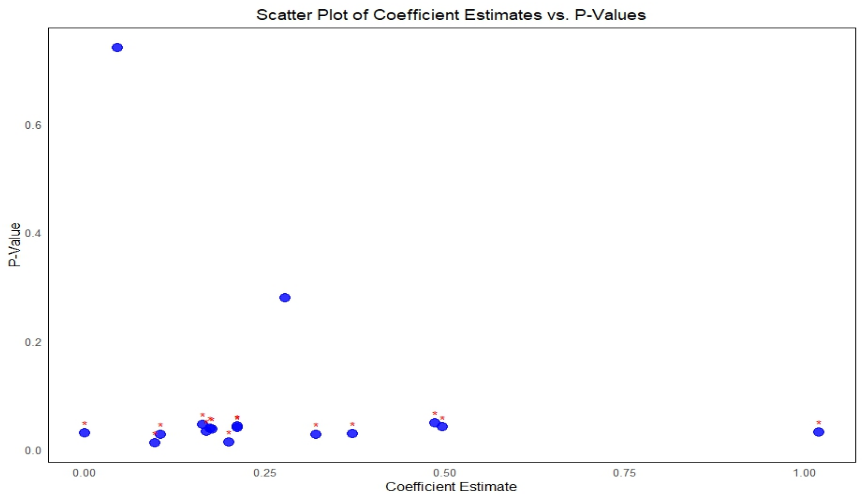
The estimated impact of each individual independent variable on the dependent variable is shown by the coefficients in Table 2. The strength of the evidence against the null hypothesis that a particular coefficient is zero is indicated by the t-values. Statistically significant coefficients are those with higher t-values and corresponding p-values lower than 0.05, indicating a meaningful association with the dependent variable.

Table 2: Regression Results for independent variables of IPM adoption.

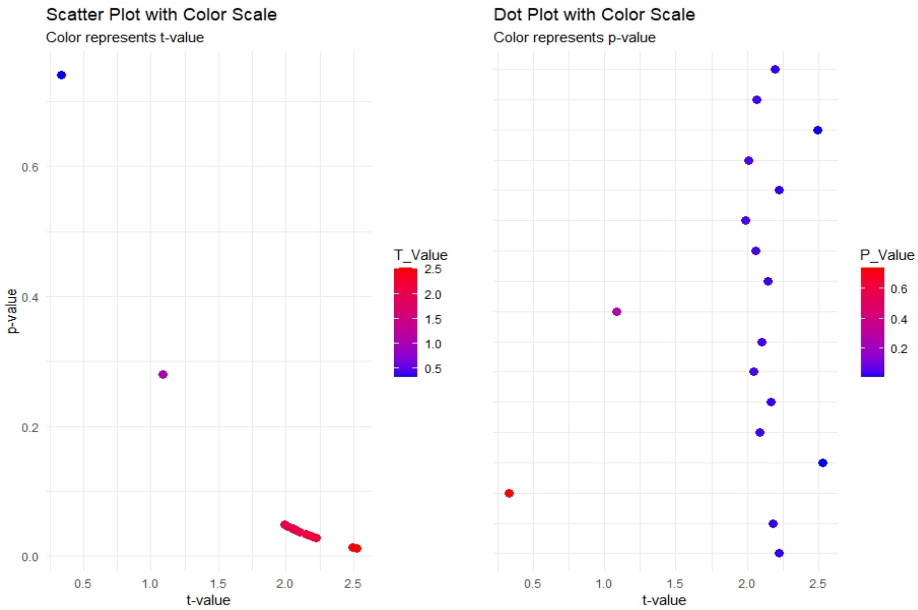
Variable	Coefficient Estimate	Std. Error	t-value	Pr(>|t|)
Age	0.10550	0.04746	2.223	0.0281 *
Education	1.019	0.4714	2.162	0.0327 *
Experience	0.2113	0.1033	2.046	0.043 *
Family size	0.278	0.2562	1.085	0.28
Training Received	0.3715	0.1692	2.196	0.030 *
Land holding	0.4965	0.2411	2.059	0.0417 *
Annual income	0.0000179	0.0000082	2.181	0.0312 *
Occupation	0.3211	0.1445	2.222	0.0282 *
Area Under Vegetables	0.0456	0.1376	0.332	0.741
Extension contact	0.17627	0.08397	2.099	0.0379 *
Mass M.E	0.4863	0.2445	1.989	0.049 *
Economic Motivation	0.17386	0.08332	2.087	0.0391 *
Scientific Orientation	0.20025	0.08029	2.494	0.014 *
Risk Orientation	0.16387	0.08154	2.01	0.0467 *
Social participation	0.2121	0.1028	2.064	0.0412 *
Knowledge level	0.16822	0.07841	2.145	0.034 *
Attitude	0.09735	0.03854	2.526	0.0129 *



A. Coefficient estimates and significance of all 17 independent variables



B. Scattered plot showing relationship between Coefficient and 'T' value.



C. Scattered plot showing relationship between T value and P value of all independent variables.
D. Dot plot showing relationship between T value and P value of all independent variables.

Fig. 2.

For instance, the dependent variable has statistically significant positive relationships with variables like education, experience, training received, land holding, annual income, occupation, economic motivation, scientific orientation, risk orientation, social participation, knowledge level, and attitude, indicating that as these factors increase, the dependent variable is expected to increase as well. Contrarily, Family Size and Area Covered by Vegetables are not statistically significant, indicating that they have little influence on the dependent variable.

The statistical significance of each coefficient estimate is inferred from the table's link between the p-values and t-values. A lower p-value often results from a greater t-value, and vice versa. The asterisks in the Table 2 indicate statistical significance. In this table, variables with greater t-values typically have lower p-values below the traditional threshold of 0.05. On the other hand, variables with lower t-values frequently have higher p-values, which denotes a lack of statistical significance. This association illustrates the degree to which the coefficient is different from zero, with bigger t-values indicating stronger evidence and smaller t-values indicating weaker evidence.

CONCLUSIONS

The results highlight the complex nature of decision-making in agriculture, which is influenced by elements like training, education, experience, income, vocation, extension services, media exposure, and psychological characteristics. By addressing Multicollinearity issues and broadening the focus of future research to incorporate more variables, it will be possible to develop targeted interventions and methods to advance sustainable farming practices in the area. This study adds understanding of IPM adoption and provides policymakers, extension agencies, and agricultural stakeholders with useful takeaways for promoting farming methods that are both economically and environmentally sound.

FUTURE SCOPE

Future studies can be carried to study the factors influencing the farmers towards adoption of integrated pest management practices and challenges faced by the farmers while adoption and implementation of IPM.

Acknowledgement. The author thanks to all the members of the advisory committee and staff members of the College of Agriculture, Jabalpur. Also, the author is grateful to the efforts made by the supporting co-authors and seniors and juniors who had given their support and aid during the study.
Conflict of Interest. None.

REFERENCES

Altieri, M. A., and Nicholls, C. I. (2003). Soil fertility management and insect pests: Harmonizing soil and plant health in agroecosystems. *Soil and Tillage Research, 72*(2), 203-211.

Asfaw, S., J. Foltz, and L. DiCaprio (2010). Does adoption of genetically modified crops impact on household food security? The case of Bt cotton in smallholder agriculture in Makhathini Flats, South Africa. *Food Policy, 35*(6), 557-566.

Basker, N., S. Senthil Raja, and M. Suresh Kumar (2015). Factors influencing the adoption of integrated pest management (IPM) in brinjal cultivation in Tamil Nadu, India. *Journal of Agriculture and Environmental Sciences, 4*(1), 75-81.

Bhaskar, R. U., P. R. Dhanya, and K. R. Sridhar (2018). Pesticide residues in commercial horticulture crops: A comparative study of organic and conventional farming systems in India. *Environmental Monitoring and Assessment, 190*(3), 164.

Cornejo, E. Douglas Beach, and Wen-Yuan Huang (1994). Adoption of IPM techniques by vegetable growers in Florida, Michigan and Texas. *Journal of Agricultural and Applied Economics, 26*(1), 158-172.

Damalas, C. A. and Eleftherohorinos, I. G. (2011). Pesticide exposure, safety issues, and risk assessment indicators. *International Journal of Environmental Research and Public Health, 8*(5), 1402-1419.

Dwiartama, A., A. K. Sen, and R. Sarker. (2018). Farmers' adoption and environmental benefits of organic farming: Evidence from a correlogram analysis in West Java, Indonesia. *Ecological Economics, 146*, 330-342.

Feder, G., R. E. Just, and D. Zilberman. (2011). Agricultural extension: The Kenya experience. *The World Bank Research Observer, 26*(2), 183-210.

Food and Agriculture Organization of the United Nations (FAO). (2020). Chickpea: Post-harvest Operations.

Gaddanakeri, S., Pradeep S., Sharanabasappa, S. Deshmukh, S. Sridhara, Shivanna B. K., D. Thippesha and B. Fakrudin (2022). Impact of different IPM Modules of Brinjal *(Solanum melongena* L.) on coccinellid Beetles. *Biological Forum – An International Journal, 14*(4), 985-989.

Gossen, B. D., J. A. Holley, and D. L. McLaren (2016). Factors influencing adoption of sustainable pest management practices by lentil growers. *Agriculture, Ecosystems & Environment, 218*, 93-100.

Government of India (GoI) (2021). Economic Survey 2020-21. Ministry of Finance, Department of Economic Affairs.

Gulati, A., T. Sharma, and N. P. Singh (2012). Agriculture performance and rural poverty: A review of the evidence. *Economic and Political Weekly, 47*(11), 42-49.

Gupta, B. K., Mishra, B. P., Singh, V., Patel, D., and Singh, M. P. (2020). Constraints faced by vegetable growers in adoption of IPM in Bundelkhand Region of Uttar Pradesh. *Indian Journal of Extension Education, 56*(4), 92-97.

Gurr, G. M., S. D. Wratten, and J. M. Tylianakis (2017). Multi-country evidence that crop diversification promotes ecological intensification of agriculture. *Nature Plants, 3*, 17088.

Kogan, M. (1998). Integrated pest management: Historical perspectives and contemporary developments. *Annual Review of Entomology, 43*, 243-270.

Kumar, V., S. Jain, and S. K. Soam (2012). Productivity trends in Indian agriculture: Implications for food security. *Agricultural Economics Research Review, 25*(2), 103-120.

Manjunatha, B. L., Hajong, D., Tewari, P., Singh, B., Shantaraja, C. S., Prashant, H. N., Jat, N. K., Shiran, K., & Parihar, R. P. (2018). Quality seed accessibility index: A case study from a village in western Rajasthan, *Indian Journal of Extension Education, 54*(1), 33-43.

Manunayaka, G., Ganesamoorthi, S. and Goyal, S. (2019). Attitude of vegetable growers towards mitigating the ill-effects of agricultural chemicals. *Indian Journal of Extension Education, 55*(1), 1-6.

Md. Mostofa Kamal, K.M. Nazmus Saleheen, Mst. Sadia Islam, Mohammad Bashir Ahmed (2018). Adoption of integrated pest management practices by vegetable growers at Sadar upzila under Jhenaidah district. *Journal of Bangladesh Agricultural University, 16*(3), 366-371.

Midega, C. A. O., Z. Khan, and J. A. Pickett. (2018). Climate-adapted push-pull system effectively controls fall armyworm: Evidence from semi-field and on-farm studies. *Ecological Applications, 28*(3), 708-719.

Mishra, A. K. and G. K. Bhati (2017). Extent of diversification in Indian agriculture: An analysis at state level. *Agricultural Economics Research Review, 30*(2), 269-277.

Monika Wason, R.N. Padaria, Baldeo Singh, and Anjani Kumar (2009). Farmers perception and propensity for adoption of integrated pest management practices in vegetable cultivation. *Indian Journal of Extension Education, 45*(3), 21-25.

Morya, G. P., and Kumar, R. (2021). Trends of Ecofriendly Approach for Sustainable Pest Management. *International Journal of Theoretical & Applied Sciences, 13*(2), 32-35.

Naranjo, S. E. (2009). Conservation and evaluation of natural enemies in IPM systems for *Bemisia tabaci*. *Crop Protection, 28*(10), 891-897.

Oerke, E. C. (2006). Crop losses to pests. *Journal of Agricultural Science, 144*(1), 31-43.

Pampolino, M. F., L. Witt, and A. Dobermann (2012). Constraints to the wide-scale adoption of organic fertilizer in developing countries: Evidence from experimental and modeling studies in the Philippines. *Nutrient Cycling in Agroecosystems, 93*(2), 155-169.

Parikh, J. (2019). Agriculture and climate change: Challenges and opportunities in India. *Economic and Political Weekly, 54*(3), 19-21.

Pedigo, L. P., M. E. Rice, and R. D. Saunders (1986). Economic injury levels in theory and practice. *Annual Review of Entomology, 31*, 341-368.

Pimentel, D., R. Zuniga, and D. Morrison (2005). Environmental and economic costs of the application of pesticides primarily in the United States. *Environment, Development and Sustainability, 7*(3), 229-252.

Pingali, P. (2012). Green Revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences of the United States of America, 109*(31), 12302-12308.

Pretty, J., A. S. Ball, and T. Lang (2018). Global assessment of agricultural system redesign for sustainable intensification. *Nature Sustainability, 1*(8), 441-446.

Reddy, P. P., A. N. V. Satyanarayana, and C. V. S. R. Prasad (2009). Assessment of pesticide residues in different vegetables. *Research Journal of Agricultural Sciences, 1*(3), 246-248.

Romeis, J., A. M. Shelton, and G. G. Kennedy (2008). Assessment of risk of insect-resistant transgenic crops to nontarget arthropods. *Nature Biotechnology, 26*(2), 203-208.

Settle, W. H., M. J. D. Jones, and R. K. Schulthess (1996). Managing tropical rice pests through conservation of generalist natural enemies and alternative prey. *Ecology, 77*(6), 1975-1988.

Singh, A., Singh, A. K., Singh, S. K., Singh, S., Sahay, R., Tiwari, D. K. and Maurya, R. C. (2019). Food and nutritional security through nutritional gardening in Unnao district. *Indian Journal of Extension Education, 55*(3), 60–64.

Srinivasan, R., G. S. R. Murthy, and S. R. Hegde (2013). Insecticide use in vegetable crops in India: Regional patterns and implications for human and environmental health. *Environmental Development, 6*, 39-52.

Timprasert, S., Datta, A., & Ranamukhaarachchi, S. L. (2014). Factors determining adoption of integrated pest management by vegetable growers in Nakhon Ratchasima Province, Thailand. *Crop protection, 62*, 32-39.

Zehnder, G., D. B. Deb, and A. A. Headrick (2007). Quantitative monitoring of soybean aphid (Hemiptera: Aphididae) abundance and population growth. *Journal of Economic Entomology, 100*(4), 1258-1267.

How to cite this article: Arpit Somtiya, Seema Naberia, Siddharth Namdeo, Ashish Kumar Nagar and Vedant Gautam (2023). A Multifaceted Analysis of IPM Adoption Among Vegetable Growers in Central India's Jabalpur Region. *Biological Forum – An International Journal, 15*(11): 48-54.