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Multiple regression analysis of factors influencing knowledge and adoption behaviour of grape growers

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ABSTRACT

Grape cultivation is one of the most important and profitable horticultural enterprises in *Karnataka*, particularly in Chikkaballapur district where favourable agro-climatic conditions support commercial grape production. Adoption of recommended grape production technologies plays a crucial role in improving productivity, fruit quality and farmers' income. However, the extent of knowledge and adoption of these technologies varies among grape growers due to differences in socio-economic and communication characteristics. The present study was conducted to analyze the factors influencing knowledge and adoption behaviour of grape growers towards recommended grape production technologies. The study adopted an ex-post facto research design. Multiple Linear Regression analysis was employed to determine the relationship between knowledge and adoption levels with selected independent variables such as Age, Education, Family Size, Experience, Annual Income, Cosmopoliteness, Economic Orientation, Extension Participation, Extension Contact and Marketing Behaviour. The results revealed that the regression model for knowledge was statistically significant with an *R*-squared value of 0.721, indicating that 72.1 per cent of the variation in knowledge level was explained by the selected variables. Marketing behaviour, Education, Extension Contact and Age were found to significantly influence knowledge level, among which Marketing behaviour emerged as the strongest predictor. Similarly, the adoption model was also statistically significant with an *R*-squared value of 0.742, explaining 74.2 per cent variation in adoption behaviour. Family Size, Education and Extension Contact showed significant positive influence on adoption behaviour. The study highlighted that extension contact and educational status play a vital role in improving both knowledge and adoption levels among grape growers. The findings emphasize the need to strengthen extension services, improve farmers' educational exposure and promote effective communication strategies to reduce technological gaps and enhance adoption of recommended grape production technologies for sustainable grape cultivation.

Keywords: Grape cultivation, Knowledge, Adoption, Recommended grape production technologies, Extension contact, Marketing behaviour, Multiple Linear Regression Analysis, Chikkaballapur

Introduction

Grape cultivation is a capital-intensive enterprise requiring high investment in planting materials, irrigation, fertilizers, plant protection chemicals and labour. To achieve higher productivity and quality produce, several improved grape production technologies have been recommended by research institutions and agricultural universities. These technologies include improved varieties, canopy management, pruning practices, fertigation, integrated nutrient management and integrated pest and disease management. Adoption of these recommended technologies plays a vital role in improving productivity, quality and profitability of grape cultivation.

However, grape growers often face several constraints such as pest and disease incidence, shortage of skilled labour, lack of technical guidance, price fluctuations and inadequate marketing facilities. In addition, the adoption of recommended grape production technologies differs among farmers depending upon their educational level, farming experience, extension contact, economic status and access to information sources. As a result, a considerable gap exists between the recommended technologies and the actual practices followed by farmers in the field.

Knowledge is considered a prerequisite for adoption of improved agricultural technologies. Farmers with better knowledge regarding recommended cultivation practices are more likely to adopt scientific technologies effectively. Similarly, adoption behaviour reflects the extent to which farmers practically implement the recommended practices under field conditions. Therefore, assessing the knowledge and adoption behaviour of grape growers is essential for identifying technological gaps and understanding the factors influencing technology dissemination.

Understanding the knowledge and adoption levels of grape growers towards recommended grape production technologies can help identify the existing constraints and areas requiring extension support. Such informa-

tion is essential for strengthening extension services, improving technology transfer and developing suitable policy interventions for sustainable growth and profitability of grape cultivation.

Methodology

Research design

The study adopted an ex-post facto research design to analyze the influence of socio-economic and communication variables on knowledge and adoption levels of respondents. Since the variables had already occurred and could not be manipulated by the researcher, the ex-post facto design was considered appropriate.

Study variables

The dependent variables considered in the study were Knowledge and Adoption. The independent variables included Age, Education, Family Size, Experience, Annual Income, Cosmopolitness, Economic Orientation, Extension Participation, Extension Contact, and Marketing Behaviour.

Analytical tool

Multiple Linear Regression analysis was employed to determine the relationship between dependent variables and selected independent variables. The significance of the variables was tested using regression

coefficients, *t*-values, *p*-values, *R*-squared values, and *F*-statistics.

Knowledge analysis

Multiple linear regression analysis

The Multiple Linear Regression analysis was conducted to determine the relationship between **Knowledge** (Dependent Variable) and ten independent variables: Age, Education, Family Size, Experience, Annual Income, Cosmopolitness, Economic Orientation, Extension Participation, Extension Contact, and Marketing Behaviour.

Table 1. Goodness of Fit for Regression Model

Metric	Value
<i>R</i> -squared (<i>R</i> ²)	0.721
Adjusted <i>R</i> -squared	0.696
<i>F</i> -statistic	8.474
Prob (<i>F</i> -statistic)	< 0.001

The model is statistically significant ($p < 0.001$), and the *R*-squared value of **0.721** indicates that approximately **72.1%** of the variation in the Knowledge level of the respondents can be explained by the selected independent variables.

Table 2. Importance of Independent Variable

Variable	Coefficient (β)	Std. Error	<i>t</i> -value	<i>p</i> -value	Significance
Intercept	2.292	4.830	0.475	0.636	Non-Significant
Age	0.047	0.021	2.190	0.031	Significant (*)
Education	0.559	0.195	2.859	0.005	Highly Significant (**)
Family Size	0.082	0.066	1.238	0.218	Non-Significant
Experience	0.012	0.035	0.324	0.746	Non-Significant
Annual Income	0.000	0.000	0.315	0.754	Non-Significant
Cosmopolitness	0.060	0.178	0.337	0.737	Non-Significant
Economic Orientation	-0.099	0.120	-0.821	0.413	Non-Significant
Extension Participation	0.141	0.098	1.433	0.155	Non-Significant
Extension Contact	0.222	0.101	2.192	0.030	Significant (*)
Marketing Behaviour	0.570	0.128	4.444	< 0.001	Highly Significant (***)

Key Interpretations

1. **Marketing Behaviour (beta = 0.570, $p < 0.001$):** This is the strongest predictor. A one-unit increase in Marketing Behaviour score is associated with a \$0.570\$ increase in Knowledge, suggesting that respondents more involved in marketing activities possess higher technical knowledge.
2. **Education (beta = 0.559, $p = 0.005$):** Education level is a highly significant predictor. Higher formal education contributes significantly to the knowledge level of the respondents.
3. **Extension Contact (beta = 0.222, $p = 0.030$):** Regular contact with extension agents/agencies significantly improves knowledge, as expected in agricultural and developmental studies.
4. **Age (beta = 0.047, $p = 0.031$):** Age has a positive, though smaller, significant impact, indicating that knowledge tends to increase slightly with maturity/age in this sample.
5. **Non-Significant Factors:** Variables like Annual Income, Experience, and Cosmopolitness did not show a statistically significant linear relationship with Knowledge in this specific model.

Adoption analysis

The Multiple Linear Regression analysis was conducted for **Adoption** (Dependent Variable) against the same ten independent variables.

Table 3. Goodness of Fit for Regression Model

Metric	Value
<i>R</i> -squared (<i>R</i> ²)	0.742
Adjusted <i>R</i> -squared	0.718
<i>F</i> -statistic	6.294
Prob (<i>F</i> -statistic)	0.0175

The model is statistically significant ($p = 0.0175$), though it explains a lower percentage of variance compared to the Knowledge model. The *R*-squared value of **0.742** indicates that **74.2%** of the variation in the Adoption level is explained by these variables.

Table 4. Importance of Independent Variable

Variable	Coefficient (β)	Std. Error	t-value	p-value	Significance
Intercept	25.634		4.796	5.345 < 0.001	Highly Significant
Age	0.032		0.021	1.491	0.139 Non-Significant
Education	0.404		0.194	2.082	0.04 Significant (*)
Family Size	0.178		0.066	2.695	0.008 Significant (**)
Experience	-0.056		0.035	-1.602	0.112 Non-Significant
Annual Income	0.000		0.000	0.635	0.526 Non-Significant
Cosmopolitaness	0.088		0.176	0.499	0.619 Non-Significant
Economic Orientation	-0.14		0.119	-1.177	0.242 Non-Significant
Extension Participation	0.023		0.097	0.239	0.812 Non-Significant
Extension Contact	0.225		0.1	2.237	0.027 Significant (*)
Marketing Behaviour	0.199		0.127	1.565	0.121 Non-Significant

Key Interpretations

1. **Family Size ($\beta = 0.178$, $p = 0.008$):** This is the most significant predictor for adoption in this model. Larger families appear to have a significantly higher adoption score, possibly due to more available labor or collective decision-making.
2. **Extension Contact ($\beta = 0.225$, $p = 0.027$):** Similar to the knowledge model, extension contact remains a significant driver for the actual adoption of practices.
3. **Education ($\beta = 0.404$, $p = 0.040$):** Education remains a significant factor, showing that more educated individuals are more likely to adopt the technologies/practices measured.
4. **Non-Significant Factors:** Interestingly, **Marketing Behaviour** and **Age**, which were significant for Knowledge, are not statistically significant for Adoption at the 5% level, suggesting that while they help in knowing about a practice, they don't necessarily drive the final decision to adopt it as strongly as family size and education do.

Conclusion

The regression analysis revealed that Marketing behaviour, Education, Extension Contact and Age significantly influenced the knowledge level of respondents. Among these, Marketing behaviour emerged as the strongest predictor of knowledge.

In the case of adoption, Family Size, Education and Extension Contact significantly influenced the adoption behaviour of respondents. Extension Contact and Education consistently showed positive influence on both knowledge and adoption levels, highlighting the importance of extension services and educational status in agricultural development.

The findings emphasize the need to strengthen extension contact, improve educational opportunities, and encourage effective marketing participation to enhance knowledge and adoption of improved agricultural practices among farmers.

Policy implications

Policy implications

The findings of the study revealed that Education, Extension Contact and Marketing behaviour significantly influenced the knowledge level of grape growers, while Family Size, Education and Extension Contact significantly influenced adoption behaviour. Therefore, strengthening extension and educational interventions is essential for improving the adoption of recommended grape production technologies.

Regular training programmes, field demonstrations, farmer field schools and exposure visits should be organized by the Department of Horticulture, Universities and extension agencies to improve farmers' knowledge regarding scientific grape cultivation practices. Strengthening extension contact through frequent interaction between

farmers and extension personnel can help in timely dissemination of technical information and reduce the technological gap between recommended and adopted practices.

The significant role of education indicates the need to develop simple, practical and locally understandable extension materials such as videos, leaflets and mobile-based advisories to improve accessibility of information among farmers with different educational backgrounds. Promotion of digital extension services and ICT-based advisories can further enhance awareness and adoption of improved technologies.

Since marketing behaviour significantly influenced knowledge level, efforts should be made to strengthen market intelligence services, farmer producer organizations (FPOs) and cooperative marketing systems. Providing timely market information, price forecasts and value addition opportunities can motivate farmers to actively participate in marketing activities and improve their technical knowledge.

The study also emphasizes the importance of institutional support in the form of credit facilities, subsidies for irrigation and plant protection measures, crop insurance and post-harvest infrastructure. Such support can encourage farmers to adopt scientific grape production technologies more effectively.

Overall, policy interventions focusing on extension strengthening, farmer education, market support and technology dissemination are essential for improving knowledge and adoption behaviour of grape growers and ensuring sustainable and profitable grape cultivation in the study area.

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