A Logistic Regression Analysis for Problems Faced by the Farmers in Sambalpur

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Abstract

The primary objective of this paper is to recognize the issues facing farmers in the agriculture industry. Food things are the most great to guarantee the quality of life. Logistic regression is a suitable analytical technique for this kind of study, since it can be applied to investigate the variables influencing Sambalpur farmers and identify the causes of the issues they face. According to the results, a subset of the model's variables is determined to have the biggest impact on a farmer's decision to continue using their traditional farming methods. Production-related problems, a manpower shortage, a lack of pesticides and fertiliser, a lack of technical know-how, poor irrigation infrastructure, a lack of marketing resources, and technology and equipment and machinery related to marketing, financial concerns, and a lack of soil fertility problems are some of these variables. The factors including some issues of farmers have encountered with production, marketing, and financing. This study contributes to the encouragement of farmers to enhance productivity and generate more items. It was decided that an intriguing report with pertinent details would be appropriate to investigate the locations. Using a meeting schedule that was specifically created for the purpose, the necessary information was obtained from the farmers. The utmost care was made to provide crucial clarifications in colloquial language so that the respondents may react as accurately and unequivocally as possible.

Keywords: Agriculture, Farmer, Farming Problems, Logistic Regression, Odds Ratio.

Introduction

Indian farming is plague by a number of issues, a few of which are man-made and others of which are characteristic. Still, marketing remains a farmer's first priority. In rural India, agricultural marketing is still in poor condition. Farmers who sell their goods at a low price to local traders and middlemen are their only option if there are no reliable purchasing facilities. The farmers in most small towns sell their crops to the moneylender. Typically, they take out loans. The impoverished farmer is compelled to sell the produce for any price that is permitted to him in order to fulfil his obligations and settle his debt. It was noted correctly in the Rural Credit Survey Report that farmers typically receive poor conditions when they sell their goods at an unsuitable location and time. The marketing and trading of agricultural goods is dominated by individual merchants and middlemen due to the lack of a formalised marketing system. The burden on the customer is increased by paying for the middlemen's services, even while the producer does not gain anything comparable. To spare the agriculturist from the money lenders' clutches and the brokers, the government has controlled markets. These markets by and large present a framework of forceful buying, offer assistance kill misbehaviours, guarantee the utilize of designed weights and measures and advance appropriate apparatus for settlement of debate, subsequently guaranteeing that the makers are not diminished to misuse and get profitable costs. The agricultural area has an important role in Sambalpur, Odisha. In addition, most Sambalpur life in rural area earn a living as a farmer, therefore, the agricultural sector has the main source of income. Numerous writers have highlighted the challenges faced by Punjabi farmers, including limited marketing resources, inadequate storage facilities, lack of locally suitable seeds, and delays in crop planting (1). Some studies have utilized logit regression analysis to explore the factors influencing farmers' choices regarding agricultural inputs and potential funding sources for farming (2). In the paper (3), plot level data from the semi-arid

region of Tigray, Ethiopia, was utilized to investigate the factors affecting farmers' choices in adopting agricultural practices, particularly focusing on conservation tillage, compost, and chemical fertilizers. The study also employed stochastic dominance analysis to evaluate and compare the productivity improvements associated with sustainable farming practices and chemical fertilizers. Also the paper (4) examines the challenges and opportunities related to maize cultivation in the eastern zone of Bihar. A significant marketing constraint identified was the absence of adequate marketing facilities in the region, which poses a major disappointment for maize farmers, affecting 90 percent of them. Additionally, the struggles of farmers in Andhra Pradesh are elaborated upon, detailing production, marketing, and financial constraints they encounter (5). One study (6) found that having a minimum level of education significantly impacts the adoption of modern paddy varieties, thereby affecting farm productivity among those who adopt them, as determined through an endogenous switching regression model. Several authors assessed the application and interpretation of logistic regression across different research fields (7). Several authors have also examined various issues affecting farmers' operations and the reasons behind financial deductions (8, 9). Some authors have concentrated on rural marketing from the perspective of rural consumers (10). Kerala farmers faced major disruptions due to severe flooding from heavy rains on August 15, 2018 (11). Some authors suggest that questionnaire techniques are essential for gathering information in survey research (12). In Tamil Nadu's Salem region, rice farmers need to conduct research to identify the production and marketing factors influencing paddy farming (13). Furthermore, some authors focused on the challenges faced by farmers in the Tirunelveli district as they transitioned their land from agricultural to non-agricultural uses, noting that significant factors such as age and education largely determine land use decisions (14). Investigators have found many occupational problems through studies of farming communities, and some have specified farming as an especially stressful occupation. Studies on farmer problem in farming communities around the world have identified several common risk factors, namely:

production issue, insufficient labour, marketing, finance etc. Objectives of the study are to investigate the challenges encountered by farmers in the Sambalpur district of Odisha. To analyze the relationship between a predictor variable and its corresponding response variable through logistic regression.

Methodology

The study has focused on the variables influencing the problems of farmers in Sambalpur district, Odisha, India. In this study, quantitative methodology is applied. Singarimbun states that questionnaires were used to collect information from respondents for survey research. The number of selected samples are determined by the Slovin formula and resulted in 410 respondents. First, the information gathered from the respondents is reviewed for accuracy and dependability. Factors affecting the plight of farmers are investigated using SPSS 21 software with logit regression analysis. Logit regression is employed to examine the correlation between a predictor variable and its response variable. In essence, the logistic model predicts the logit of Y from X. The logit is the natural logarithm (ln) of odds of Y, and odds are ratios of probabilities (P_i) of Y happening (i.e., the farmer has to face problem) to probabilities $(1 - P_i)$ of Y not happening (i.e., the farmer does not have to face problem). A dependent variable has only two possible values, such as yes or no, making it categorical or binary. On the other hand, covariates are often used to refer to a group of independent factors. The logit regression equation due to (15) is as follows:

$$logit(Y) = Ln\left(\frac{P_i}{1-P_i}\right) = \alpha + \beta_1 X_1 + +\beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \varepsilon$$

[1]

Where, P_i = Probability ($X_1 = x_1, X_2 = x_2, \ldots, X_{10} = x_{10}$) =

$$\frac{e^{\alpha+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\beta_6 X_6+\beta_7 X_7+\beta_8 X_8+\beta_9 X_9+\beta_{10} X_{10}}}{1+e^{\alpha+\beta_1 X_1++\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\beta_6 X_6+\beta_7 X_7+\beta_8 X_8+\beta_9 X_9+\beta_{10} X_{10}}}$$

[2]

α is the Y intercept, β_i is the regression coefficient and ε is the random error term (the base of natural logarithm system). X can be categorical or continuous, but Y is always categorical.

The description of the variables is described in Table 1.

Results
Farmers Characteristics
Farmers in Sambalpur, like those in many other regions of India, are an integral part of the rural economy and culture. Sambalpur farmers primarily cultivate rice, which is the main food crop in the region. Apart from rice, they also grow a variety of crops such as pulses, oilseeds, vegetables, and spices. Sambalpur farmers face various problems, including production related, shortage of labour, lack of fertilizers and pesticides, lack of technology, lack of irrigation facilities, lack of equipment and machinery, marketing related, lack of appropriate marketing facilities, finance related, and soil fertility related. These issues may have an impact on farmers' economic growth, agricultural yields, and social environment. Here, a variety of issues were divided into two main groups: A = Agree and D = Disagree.

Table 1: Description of Variables

Variables	Description	Unit
P_i	Problem face	1 = If the farmer has to face problem.
		0 = If the farmer doesn't have to face problem.
α	Intercept (constant)	
$\beta_1, \beta_2, \beta_3, \dots, \beta_9, \beta_{10}$	Coefficients for independent or predictor variable	
X_1	Production related	A = Agree, D =Disagree
X_2	Shortage of labour	A = Agree, D =Disagree
X_3	Lack of fertilizers and pesticides	A = Agree, D =Disagree
X_4	Lack of Technology	A = Agree, D =Disagree
X_5	Lack of irrigation facilities	A = Agree, D =Disagree
X_6	Lack of equipment and machinery	A = Agree, D =Disagree
X_7	Marketing related	A = Agree, D =Disagree
X_8	Lack of Appropriate marketing facilities	A = Agree, D =Disagree
X_9	Finance related	A = Agree, D =Disagree
X_{10}	Soil fertility related	A = Agree, D =Disagree
ε	Random error is an independent variable that is not included in the analysis that may affect the dependent variable	

Note: A = Agree and D =Disagree.

Table 2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.614	.631	11

Reliability Test
A statistical technique called a reliability test (Table 2) is employed to evaluate the dependability and consistency of a measuring tool, such a test, questionnaire, or survey. It assesses whether the results are consistent between administrations and how effectively the instrument measures what it is intended to measure. Cronbach's Alpha measures the internal consistency of the collection of items in a scale or questionnaire. Values range from 0 to 1, where higher values indicate greater reliability. The Cronbach's Alpha value is 0.614 and based on the above results, we can decide whether the scale is questionable.

Hotelling's T-Squared Test
A statistical test called Hotelling's T-square (T^2) is used to see if there are any meaningful differences

between the means of two or more groups (Table 3). Since it is a multivariate extension of the t-test, it is capable of handling several dependent variables at once. In this case, the overall problems faced by farmers are taken into account as the dependent variable, and it is divided into two categories: farmers who are having difficulties are denoted as 1, while farmers who are not facing problems are denoted as 0.

Null Hypothesis (H_{00})**:** There is no significant difference between the means of the two groups across all dependent variables. Alternative Hypothesis (H_{01})**:** There is a statistically significant difference between the means of the two groups across at least one dependent variable.

Table 3: Hotelling's T-Squared Test

Hotelling's T-Squared	F	df1	df2	Sig
16890.216	1651.855	10	400	.000

Here, the significant value is $0.000 < 0.05$ means the rejection of null hypothesis. This indicates that there is a statistically significant difference between the means of the two groups across at least one dependent variable.

Factors that Affect Farmers' Farming and Economic Growth

The logistic regression approach is used to analyse the factors that influence farmers' farming. The following independent variables are believed to have an impact on farmers' economic growth: production related, shortage of labour, lack of fertilizers and pesticides, lack of technology, lack of irrigation facilities, lack of equipment and machinery, marketing related, lack of appropriate marketing facilities, finance related and soil fertility related. In the meanwhile, the general issues faced by farmers are divided into two groups for study purposes based on the dependent variable. If the farmer encounters the problem, indicated by the number 1, and if the problem is not encountered by the farmer, indicated by the number 0. Table 4 categorises the general issues, and Table 5 displays the logistic regression's findings.

Table 4: Classification Table

Observed		Predicted		
		Overall Problem Face		Percentage Correct
		No Problem	Problem	
Overall Facing Problem	No Problem	189	42	81.8
	Problem	91	88	49.2
Overall Percentage				67.6

According to the classification table, the model accurately predicted 189 out of 231 farmers who don't have problems and 88 out of 179 farmers who do. The overall accuracy percentage of the predicted model is 67.6%.

Table 5: Logistic Regression Test Results

Variable	Coefficient	p-value	Odds ratio
Production related	-1.000	.357	.368
Shortage of labour	1.251	.050	3.494
Lack of fertilizers and pesticides	-.311	.300	.733
Lack of Technology	1.645	.003	5.182
Lack of irrigation facilities	.437	.392	1.548
Lack of equipment and machinery	.306	.562	1.358
Marketing related	1.132	.000	3.103
Lack of Appropriate marketing facilities	.646	.265	1.909
Finance related	2.797	.000	16.389
Soil fertility related	1.227	.009	3.412
Constant	-2.522	.000	.080
−2 Log likelihood	482.533		

Omnibus Tests of Model Coefficients	79.234
Cox & Snell R Square	.176
Nagelkerke R Square	.236
Hosmer and Lemeshow Test	.180

Table 5 shows that the logistic regression model is suitable for estimating the factors that influence farmers' facing problem, namely farmer production related, shortage of labour, lack of fertilizers and pesticides, lack of Technology, lack of irrigation facilities, lack of equipment and machinery, marketing related, lack of appropriate marketing facilities, finance related and Soil fertility related. This high likelihood ratio of 482.533(>10) indicates that the test model is very From the Table 5, the model is

useful. The value of Nagelkerke R square 0.236 implies that all ten factors can intelligible the influence of farmers' facing problems by 23.6%. The results of the Hosmer and Lemeshow test show that a logistic regression analysis model is feasible, i.e., p-value (=0.180). The fact that there is no discernible discrepancy between the predicted and observed categories suggests that the regression model is appropriate for more investigation.

$$\text{logit}(Y) = -2.522 - X_1 + 1.251X_2 - 0.311X_3 + 1.645X_4 + 0.437X_5 + 0.307X_6 + 1.132X_7 + 0.646X_8 + 2.797X_9 + 1.227X_{10} \qquad [3]$$

The predicted value of overall problem of new farmers will be identified by the logit equation:

Predicted $\text{logit}(Y)$

$$= \frac{1}{1 + e^{-(-2.522 - X_1 + 1.251X_2 - 0.311X_3 + 1.645X_4 + 0.437X_5 + 0.307X_6 + 1.132X_7 + 0.646X_8 + 2.797X_9 + 1.227X_{10})}}$$

[4]

Production Related

The variable (X_1), which is connected to production, has a negative coefficient value of 1.000. According to the test results, farmers who produce more crops may experience fewer overall farming-related problems. The production-related variable's odds ratio value is 0.368, meaning that the likelihood of having production-related issues is 0.368 times greater than the likelihood of having problems compared to those without the overall problem. Here odds ratio value less than 1 indicates a negative association between these variables.

Shortage of Labour

The positive coefficient for the labor shortage variable (X_2) is 1.251. The experimental outcomes demonstrate the way that raising the deficiency of work could increment ranchers dealing with in general issues for cultivating. The odds ratio for the shortage of labor variable is 3.494, which indicates that the odds of having problems with the shortage of labor are 3.494 times higher for people who have problems overall than for people who don't have problems overall. An odds ratio that is greater than one in this case indicates that these variables are positively correlated.

Lack of Fertilizers and Pesticides

The odds ratio value for the lack of fertilizers and pesticides variable (X_3) is 0.733, which shows that

the odds having the lack of fertilizers and pesticides problems is 0.733 times higher those with the overall problems compared to those without the overall problem. An odds ratio value less than 1 indicates a negative association between these variables.

Lack of Technology

The lack of technological problems that Sambalpur farmers experience is crucial for farming. There is a positive association between farmers' general concerns and the lack of technological problems. The variable (X_4), which measures absence of technology, has a positive coefficient value of 1.645. The test results indicate that farmers may have more general farming-related issues if there are less technological issues. The chances ratio value for the absence of technology variable is 5.182, meaning that people who have technology difficulties have probabilities that are 5.182 times greater than those who have overall problems.

Lack of Irrigation Facilities

The lack of irrigation facilities (X_5) has a positive coefficient value of 0.437. The test results show that increasing lack of irrigation facilities could increase farmers facing overall problems for farming. The odds ratio value for lack of irrigation facilities variable is 1.582, implying that the odds having lack of irrigation facilities is 1.582 times higher those with the overall problems compared

to those without the overall problem. Here odds ratio value greater than 1 indicates a positive association between these variables.

Lack of Equipment and Machinery

The variable representing the lack of machinery and equipment (X_6) has a positive coefficient value of 0.306. The research results indicate that farmers may experience more general farming issues because of a growing scarcity of machinery and equipment. The lack of equipment and machinery variable's odds ratio value is 1.358, which suggests that the likelihood of experiencing equipment and machinery issues is 1.358 times greater for those experiencing overall problems than for those experiencing no problems at all. In this case, a positive correlation between these factors is shown by an odds ratio value larger than 1.

Marketing Related

The problems with marketing that Sambalpur farmers deal with are crucial to farming. There is a positive correlation between farmers' general problems and issues pertaining to marketing. The positive coefficient value of 1.132 is found for the marketing-related variable **(**X_7**)**. The test findings indicate that a rise in marketing-related issues may result in a greater number of general farming-related issues for farmers. The marketing-related variable's odds ratio value is 3.103, which suggests that the odds of having marketing-related issues are 3.103 times higher than the odds of having overall difficulties in comparison to those who do not.

Lack of Appropriate Marketing Facilities

The variable representing the lack of appropriate marketing facilities (X_8) has a positive coefficient value of 0.646. According to the test results, farmers may experience more general farming difficulties if there are less suitable marketing options available. The lack of acceptable marketing facilities variable has an odds ratio value of 1.909, meaning that individuals with problems related to the lack of proper marketing facilities have a chance that are 1.909 times higher than those without problems related to the overall problem. In this case, a positive correlation between these factors is indicated by an odds ratio value larger than 1.

Finance Related

The odds ratio value for the finance-related variable (X_9) is 16.389, meaning that the probability of having finance-related issues is 16.389 times greater than the probability of having overall difficulties as opposed to those who do not. In this case, a positive correlation between these factors is indicated by an odds ratio value larger than 1.

Soil Fertility Related

The associated variable (X_{10}) to soil fertility has a positive coefficient value of 1.227. The test results indicate that raising soil fertility may cause more general farming issues for farmers. The labor shortage variable's chances ratio value is 3.412, meaning that those with soil fertility-related issues are 3.412 times more likely to have overall problems than people without them. In this case, a positive correlation between these factors is indicated by an odds ratio value larger than 1.

Discussion

By studying the challenges faced by farmers and employing logistic regression, we can uncover valuable insights that may inform policy decisions or interventions to support agricultural development in Sambalpur. The stakeholders can gain valuable insights into the challenges faced by farmers, enabling them to design effective strategies and policies to support agricultural sustainability and improve livelihoods. If there are remarkable changes with reference to the required value divulgence components then a managed market system will help smooth and strengthen agriculture. The promotion of horticulture can be enhanced by taking the input of political parties and associations in various fields, as producers, intermediaries, experts, and presidents. This is advantageous. We must exhibit the essential techniques in agricultural marketing, where inventive and innovative ways to ship the product to farmers are available. Sambalpur's farming community's issues may also be resolved by implementing appropriate training and educational initiatives in addition to knowledge and skill development. Sambalpur farmers may be eligible for insurance plans and subsidies from their governments. By comprehending and resolving these problems, we can work towards creating a more sustainable and equitable agriculture sector, improving the livelihoods of farmers.

Conclusion

Logistic regression can identify which factors, such as access to resources, climate conditions, or market prices, significantly affect the likelihood of farmers facing specific challenges like crop failure or financial difficulties. By analyzing the relationship between predictor variables—such as access to training or credit—and a binary outcome, like the adoption of sustainable practices, researchers can pinpoint the key drivers that promote or impede the uptake of beneficial farming methods. Additionally, logistic regression can predict the likelihood of particular outcomes based on various predictor variables. In conclusion, the problems that farmers face- such as shortage of labour, lack of technology, lack of irrigation facilities, lack of equipment and machinery, marketing related, lack of appropriate marketing facilities, finance related and issues with soil fertility—have an impact on their capacity to produce food in a sustainable manner and enhance their standard of living. These elements have a significant impact on the farmers' economic development. In the interim, issues with production and the availability of pesticides and fertilisers have little bearing on the general issues with farmers' agricultural systems. There is no doubt that any promotion makes sense to include benefits, while sales promotion is based on specific characteristics, standards and reasoning methods, such as offering fair and reasonable costs to hardworking farmers.

Abbreviation

Nil.

Acknowledgement

The author thanks to the Chief Editor for his constructive feedback and reviewers for their valuable suggestions for improving this research paper.

Author Contributions

Dr. Nirupama Sahoo was involved in the conceptualization, methodology, data analysis, and writing of this research paper.

Conflict of Interest

The author declares that she has no conflicts of interest to report regarding the present study.

Ethics Approval

Not applicable.

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