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A study on factors influencing the purchase of herbicides by the farmers among the select districts of Tamil Nadu

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Abstract
The aim of the research paper is to identify the factors influencing the purchase of herbicides and to analyze the constraints faced by the farmers among the select districts of Tamil Nadu. Analytical or diagnostic research and exploratory research design were designed to find the factors influencing the purchase of herbicides and to identify the constraints during the purchase of herbicides by the sample farmers among the select districts of Tamil Nadu. A well-structured interview schedule was prepared and primary data were collected using interview schedule from the sample farmers. Random sampling method was used for the collection of data. 200 sample farmers were selected in four districts of Tamil Nadu who were purchased herbicides from the input shops for the last one year. Five point Likert scale technique were used to collect the data collection. The collected data were analysed using Factor analysis and Garette Ranking techniques. Economical factor with an initial Eigen value of 4.321 and % of variance was 30.867 was the most influencing factor followed by the psychological or motivational factors, morphological factors and situational factors respectively. The major constraints faced by the farmers during the purchase of herbicides were lack of awareness or knowledge about herbicide products followed by lack of credit availability in the input shops, lack of market information about improved weed management technologies and so on.

Keywords: Constraints, factor analysis, herbicides, reliability statistics

1. Introduction

India accounts for 2.4 percent of the world's land area and 16.7% of the worldwide population. India is the world's seventh-largest country by land area and the world's second-most populous country. It covers a total area of 329 million hectares, which includes 143 million hectares of cultivable land. As population is rising drastically the demand for the food production is also being increasing. To ensure food safety and security for the welfare of all individuals in the country, we must focus more on agriculture and Agri-input industry to a larger extent for improving production and also on following aspects like the quality, a reasonable price, and easy credit, farm produce procurement, and how extension services are provided. Therefore, the increase in food grain production will have to be attained through increasing the productivity of all the crops from the existing agricultural land by proper integrated management of all inputs which includes pesticides and fertilizers. Pest management and weed management plays a major role in increasing the production and productivity, thereby reducing the wastage of food grain losses during the crop production stages. Weed management refers to the process of controlling or removing the unwanted plants in the field which compete with the crops for nutrients and other biological actions by means of cultural, mechanical or by using chemicals. The most common method of chemical weed control is using herbicides. Herbicides is a phyto-toxic chemical which is used for killing or inhibiting the growth of the targeted plants species. Chemical weed management is quite effective in some circumstances and has a lot of potential if the herbicides are inexpensive, effective, and readily available. Herbicides prevent or eliminate weeds, allowing manual and mechanical weeding to be replaced or reduced. It is a more effective and cost-efficient weed management method than cultivation, hoeing, or hand pulling. The Global Herbicide Market is expected to grow at a CAGR of 6.5% during the forecasting period 2020-2027 (Source: Industry ARC business intelligence report). Herbicide use is prevalent in major agricultural producing countries like Australia, the United States, Brazil, India, and China, where labour is scarce and wages are high. Herbicides have become the most widely used crop protection pesticide in the world, with a volume share of around 48% in the worldwide pesticides industry.

2. Review of Literature

- Parmar Pravin *et al.*, 2020 [1] this study revealed that majority of farmers had a positive opinion of herbicide packaging. Increased cropping area affected herbicide purchasing in a positive way among the characteristics influencing farmer buying habits for herbicide.
- Khumalo *et al.*, 2020 [2] According to the study, farmers are not educated about herbicide use, thus they are unsure whether herbicides are cost-effective, enhance output, or are inclusive. Furthermore, they are unsure of its environmental impact. Farmers' perceptions of herbicide use were influenced by their gender, education level, farming experience, access to agricultural trainings, farm revenue, and group participation.
- Oyakhilomen Oyinbo *et al.*, 2013 [5] this study presented empirical data on the parameters influencing pesticide usage in the management of striga by maize farming families in the study region. Household income and education level were socioeconomic factors influencing herbicide usage by maize farmers, whereas membership in associations and extension contacts were institutional factors influencing herbicide use by maize farmers.
- Jesusa C. Beltran *et al.*, 2011 [6] these findings show significant variations in the major determinants of adoption and usage decisions. Farmers' decisions to use herbicides are heavily influenced by the farmer's age, household size, and irrigation status. When farmers opt to use herbicides, these considerations no longer influence their judgments about how much herbicide to apply.

3. Objective of the study

1. To identify factors influencing the purchase of herbicides among the sample farmers.
2. To identify constraints faced by the sample farmers during the purchase of herbicides.

4. Methodology

4.1 Study Area

The study covered four districts in state for assessing the factors influencing the purchase of herbicides and the constraints faced by the sample farmers during the purchase of herbicides in Tiruppur, Salem, Namakkal and Dindigul districts of Tamil Nadu by using the primary data collected from the sample farmers of 200 members.

4.2 Data

The study is based on primary data collected from the study area. The primary data is collected from two blocks of each Select Districts of Tamil Nadu. The data collected were related to the factor influencing the purchase of herbicides and to study the constraints faced by the sample farmers during the purchase of herbicides. From four districts eight blocks were selected based on the production and productivity of the Maize. Among these blocks 200 sample farmers were selected randomly based on the farmers data provided by the district agricultural offices and the herbicide dealers of the selected areas. 25 farmers from each block were selected and the data were collected by using the structured interview schedule.

4.3 Likert Scaling Technique

This technique was widely used for the collecting data from the respondents. The respondents were questioned to indicate whether they were strongly agree, agree, neutral, disagree and strongly disagree to record the factors influencing the purchase of herbicides among the sample farmers and also asked to indicate their responses from very high, high, neutral, low and very low in the form of five point scale. The score of this scale was indicated as below

Table 1: Five point scale used for factors influencing the purchase of herbicides by the farmers

Particulars	Scale
Strongly agree	1
Agree	2
Neutral	3
Disagree	4
Strongly disagree	5

4.4 Factor Analysis

Factor analysis is the method helps to simplifying the wide number of variables into less number of factors. This strategy abstracts the highest standard variance from all parameters and lays them into a common score. We will apply this score as a list of all parameters for further investigation or analysis. It will clarify the interrelationship between the variables. The interrelation of each and every parameter to the hidden factor is concluded by factor loading.

General form of a factor is,

$F=X_1+ X_2+..... X_k$

Factor loadings = Correlation of each variable with the underlying factor

Factor score = Subject's responses x factor loadings

Farmers were questioned to indicate whether they are strongly agree, agree, neutral, disagree or strongly disagree to the statements of farmers influencing factors. In this research, fourteen statements were used to identify the most influencing factors in purchase of herbicides. To analyze the suitability of data for factor analysis, Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity were analyzed with the help of SPSS 16.0 software. Communalities are correlation matrix in factor analysis describe the amount of variance of each factor. If all the communalities are high in extracted components, that will represent the variables very well. Eigen values of greater than are very strong factors were taken for further investigation. Varimax rotation of factor analysis helps to properly redistribute the factor loadings according to statistical conditions. Four components were extracted by using this analysis.

4.5 Garret Ranking

This tool is used to identify the most significant factor which influences the respondent. In this method the farmers are asked to rank all the factors based on constraints which influences them the most. It is calculated by using the formula

Percent position = 100(Rij 0.5)/Nj

Where

Rij = rankgiven for ith variable by j^{th} respondent

Nj = number of factors ranked by j^{th} individual

Garret table is used to convert the percent position into scores. The score assigned by each individual for each factor is summed and total value and scores of mean value are

calculated. The most significant factor will have the highest mean value.

5. Results and Discussion

5.1 Factors influencing the purchase of herbicides among the sample farmers

The tables explained below shows the factors that influence the purchase of herbicides among the sample farmers. Factor analysis was performed using SPSS 16.0 software.

5.1.1 Reliability Statistics

Reliability statistics had performed to analyse the data collected during primary survey is valid or not was given in table 2.

Table 2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.787	.794	14

As per reliability statistics which was given above table 2, the Cronbach's alpha was .787 and the Cronbach's Alpha Based on Standardized Items was .794 for 14 statements. Hence the data is valid for further analysis.

5.1.2 KMO and Bartlett's Test: Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity were used to determine the suitability of data for factor analysis, and the results are shown in table 3.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.684
Bartlett's Test of Sphericity	Approx. Chi-Square	1590.703
	df	91
	Sig.	.000

Kaiser-Meyer-Olkin Measure of Sampling Adequacy measured the variance proportion of variables caused by the primary factors which indicate that data was suitable for analysis. Bartlett's Test of Sphericity test the hypothesis that the correlation matrix was the identity matrix such that variables are related and also suitable for factor analysis. KMO and Bartlett's Test measures the suitability of data for factor analysis. The value was greater than 0.500 (i.e: 0.684) of KMO test and significant value of Barlett's test indicate that the result from the factor analysis is useful for the further investigation.

5.1.3 Total Variance Explained

The below table describes about the variance for initial solutions, extracted components and rotated components.

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.321	30.867	30.867	4.321	30.867	30.867	2.721	19.438	19.438
2	2.088	14.911	45.779	2.088	14.911	45.779	2.698	19.270	38.709
3	1.861	13.295	59.074	1.861	13.295	59.074	2.390	17.072	55.780
4	1.287	9.193	68.267	1.287	9.193	68.267	1.748	12.487	68.267
5	.939	6.709	74.976						
6	.823	5.882	80.858						
7	.668	4.773	85.631						
8	.514	3.669	89.301						
9	.419	2.994	92.294						
10	.409	2.924	95.218						
11	.318	2.270	97.488						
12	.200	1.426	98.914						
13	.114	.817	99.731						
14	.038	.269	100.000						

5.1.4 Method of Extraction: Principal component analysis

The variance was showed for initial solutions, extracted components and rotated components in the above table 4. The first set of column includes initial eigen values. The total column explains the initial eigen values by each factor to total amount of variance, per cent of variance refers to the amount of changes in variance and the cumulative per cent of every row declares the added sum of per cent of variance of previous factors also. The second set of column explained extracted components which had 68.267 per cent of variability in original 14 statements with loss of information were only few per cent. The third set of column indicated the information and also maintained the same cumulative per cent as per the same result of second set of column.

Jolliffe, I. T., & Cadima, J. (2016) [3]. Revealed that Principal component analysis (PCA) is a technique used to reduce the dimensionality of such datasets, enhancing interpretability while minimizing information loss. It accomplishes by generating new uncorrelated variables that gradually optimize variance.

5.1.5 Rotated Component Matrix

The rotated component matrix of the factor analysis was presented in below table 5. The statements used for factor analysis were Herbicide application saves time of the farmer, Herbicide reduce cost of production by cutting labour costs, Herbicide application saves money of the farmers, I purchase herbicides based on the price of the brand, I purchase herbicides based on the influence of dealers, Herbicides are easy to use, Herbicide application is very effective in controlling the weeds, I purchase herbicides based on my own experience, I purchase herbicides based on influence of peer group, I purchase herbicides based on the influence or recommendation of sales representatives, I purchase

herbicides based on the type of weed, I purchase herbicides based on the type of crop, I purchase herbicides based on the size of land holding and I purchase herbicides based on the intensity of weed infestation.

Table 5: Rotated Component Matrix

Statements	Component			
	1	2	3	4
Herbicide application saves time of the farmer	.915	X	X	X
Herbicide reduce cost of production by cutting labour costs	.890	X	X	X
Herbicide application saves money of the farmers	.630	X	X	X
I purchase herbicides based on the influence of dealers	X	.839	X	X
Herbicides are easy to use	X	.659	X	X
Herbicide application is very effective in controlling the weeds	X	.656	X	X
I purchase herbicides based on the type of weed	X	X	.959	X
I purchase herbicides based on the type of crop	X	X	.946	X
I purchase herbicides based on the size of land holding	X	X	X	.825
I purchase herbicides based on the intensity of weed infestation	X	X	X	.682
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
Rotation converged in 5 iterations.				

5.1.6 Factor Analysis

The factor statements along with their factor loadings and the appropriate name for the new factor were explained in the table given below.

Table 6: Factor Analysis

Factor names and Variables	Varimax Factor loadings	Initial Eigen Values	% of Variance
Factor 1 (Economical Factors)		4.321	30.867
Herbicide application saves time of the farmer	.915		
Herbicide reduce cost of production by cutting labour costs	.890		
Herbicide application saves money of the farmers	.630		
Factor 2 (Motivational or Psychological factors)		2.088	14.911
I purchase herbicides based on the influence of dealers	.839		
Herbicides are easy to use	.659		
Herbicide application is very effective in controlling the weeds	.656		
Factor 3 (Morphological factors)		1.861	13.295
I purchase herbicides based on the type of weed	.959		
I purchase herbicides based on the type of crop.	.946		
Factor 4 (Situational factors)		1.287	9.193
I purchase herbicides based on the size of land holding.	.825		
I purchase herbicides based on the intensity of weed infestation.	.682		

Factor analysis is used to reduce the factors which mean the similar components were grouped together in the above table 6. Here, nearly 14 statements were reduced to 10 statements by using factor analysis. Eigen values of greater than one were used for further investigation. New names were provided as per the reduced factors. The total variance explained by all the factors was 68.267 percent. The factor loading of less than .600 was omitted for further analysis. Factor loadings described the correlation of each and every variable with their underlying factors.

5.2 Constraints faced by the farmers during the purchase of herbicides

The sample size of 200 respondents were selected and surveyed in eight blocks of the select districts to identify the constraints faced by the farmers during purchase of herbicides. The ranking of these six factors were represented along with garret score in the following table 7. The first and foremost factor which has the most significant value was lack of awareness or knowledge about herbicide products with an average score of 64.76 because many farmers don't aware of the product specifications and how to use it. The second most significant factor is lack of credit availability in input shops creates a burden to the small farmers during the crop cultivation. The third most important factor is lack of market information about improved weed management technologies keeps farmers continuously using the already adopted technologies which leads to increase in the cost of cultivation. Followed by these constraints brand quality and efficiency were not known, the price of the brand is very high in case of using the combined herbicides and the non-availability of different brand herbicides had a significant average score values of 48.595, 37.165 and 35.755 respectively.

Table 7: Constraints faced by the farmers during the purchase of herbicides

Variables	Avg. score	Rank
Lack of knowledge/ awareness about herbicide products	64.76	I
Lack of credit availability in the input shops	62.77	II
Lack of market information about improved weed management technologies	51.14	III
Brand quality and efficiency not known	48.595	IV
Price of the brand is very high	37.165	V
Non availability of different brand herbicides	35.755	VI

6. Conclusion

The study concluded that economical factors was the most influencing factor in purchase of herbicides containing three statements along with factor loadings with an eigen value of

4.321 and % of variance was 30.867 but most of the farmers purchase herbicides based on the morphological characters of the crop and the weed which had the highest factor loadings of .959 and .946 respectively. The study also concluded that the farmers had lack of awareness or knowledge about herbicide products followed by the Lack of credit availability in the input shops, Lack of market information about improved weed management technologies, Brand quality and efficiency not known, Price of the brand is very high and Non availability of different brand herbicides with an garett score of 64.76, 62.77, 51.14, 48.595, 37.165 and 35.755 respectively.

7. Limitations

This study is done only in Select Districts, which may not represent all other districts and States in India.

8. References

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