An Analysis on the Usage of Farm Machinery - *A Multivariate Approach*

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ABSTRACT

In this paper an attempt was made to study various factors that influence a farmer in the selection of agricultural machines. The study was carried out in Krishna, Guntur and Prakasam districts of Andhra Pradesh state. The researcher has collected primary data from 90 farmers who had bought implements for agriculture purpose in these districts. Factor analysis was used to find out the most influencing factors considered by the farmers while making the selection of farm machinery. It is found that there are five influencing factors that are involved in selection of farm machinery.

Key words: *Descriptive research, Factor analysis, Farm machinery, Farmer behavior.*

In the recent period farmers are more acquainted to use farm machinery for all the farm activities starting from seed bed preparation, sowing, weeding, harvesting, threshing etc., due to unavailability of skilled labour and their high charges. For these purpose various machinery is being used by the farmers. Hence an attempt has made to study the factors which are most relevant and influencing the usage of machinery by the farmers. Farmer behaviour deals with the behaviour that farmer displays in the selection of inputs right from purchasing, using, evaluating and disposing them. In other way, it deals with what they buy, how often they use it when they buy it, why they buy it where they buy and how they evaluate it after purchase. The farmer selects machinery based on various factors that include brand reputation, ideas/opinions of friends, relations, family members and reference group members also have profound impact on the decision of farmers. Hence analyzing the factors that relate specifically in determining the type of machinery is set as the main objective of the study.

Mottaleb *et al.* (2016) analyzed the factors associated with agricultural machinery ownership in Bangladesh and concluded that wealth status and land size holding of the sampled households were significantly and positively related to the ownership of agricultural machinery at the household level.

Sivakumar and Kaliyamoorthy (2014) studies revealed that consumers make purchase decisions in each and every aspect of their life. It was found that subsidy was ranked first and followed by sources consulted, horse power, after sales service, price and brand name respectively were considered for purchase of tractors.

Cankurt and Miran (2010) studied on farmers decision making tractor brand choices. The purpose of study was farmers in choosing of the tractor brand to determine what criteria they are given more priority.

Low price, durability, fuel economy, dealers reliability and brand value are taken into account.

MATERIAL AND METHODS

A primary survey was conducted in Krishna, Prakasam and Guntur districts farmers purposively by taking 30 in each district comprising of 15 wet land and 15 dry land farmers. The questionnaire consists of 13 variables related to selection of farm machinery viz., brand reputation, availability of spare parts, easy repair ability, mechanics reputation, engine, cost of the machine, performance with regards to agricultural operations, appearance of the machine, offers from the dealer, resale value, loan availability, subsidy from the Government and media influence. The study was conducted to identify the factors which were mostly influencing the farmer to purchase farm machinery. For this purpose, factor analysis was used, which can identify the most interrelated variables among the study. With the help of factor analysis, dimension reduction was done. In the factor analysis, principal component method with maximum variance (VARIMAX) method of rotation was used for extraction. The number of factors can be extracted based on eigen values having more than one among the variables.

After extraction of the factors, it is beneficial to know the common features between the farmers while purchasing the farm machinery. Hence cluster analysis is used to group the farmers based on similarities existing in between them. Ward's variance method of clustering is used in the present study.

RESULTS AND DISCUSSION

The questionnaire prepared for the collection of data from the farmers is initially tested for the reliability of the data. Cronbach's alpha was used for testing the reliability. The data, which is having Cronbach's alpha value of 0.58 indicated that it is reliable.

In the present study, there are 13 variables measured on 90 farmers. The Kaiser-Meyer Olkin (KMO) and Bartlett's Test measure of sampling adequacy was used to examine the appropriateness of Factor Analysis. The approximate of Chi-square is 262.43 with 78 degrees of freedom, which is significant at 0.01 Level of significance. The KMO statistic of 0.658 is also large (greater than 0.50). Hence Factor Analysis is considered as an appropriate technique for further analysis of the data.

Table 1: 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	2.49	19.17	19.17	2.49	19.17	19.17	2.40	18.50	18.50
2	1.84	14.19	33.36	1.84	14.19	33.36	1.63	12.53	31.03
3	1.54	11.84	45.21	1.54	11.84	45.21	1.50	11.53	42.55
4	1.31	10.10	55.3	1.31	10.10	55.30	1.50	11.53	54.08
5	1.08	8.30	63.6	1.08	8.30	63.60	1.24	9.52	63.60
6	0.98	7.52	71.12	-	-	-	-	-	-
7	0.91	7.02	78.15	-	-	-	-	-	-
8	0.86	6.58	84.73	-	-	-	-	-	-
9	0.65	5.03	89.76	-	-	-	-	-	-
10	0.43	3.31	93.07	-	-	-	-	-	-
11	0.40	3.04	96.12	-	-	-	-	-	-
12	0.36	2.80	98.92	-	-	-	-	-	-
13	0.14	1.08	100	-	-	-	-	-	-

To study the factors that are influencing a farmer in the purchase of farm machinery, thirteen major components were taken into consideration. In this section, PCA and factor analysis (with VARIMAX rotation) were used to group the components into factors based on the communalities observed.

Principal component analysis was carried out with all the components and the results were furnished in Table 1.

The initial components are the numbers of the variables used in the Factor Analysis. However, not all the 13 variables will be retained. In the present research only the 5 factors will be extracted by combining the relevant variables. The first factor will always account for the most variance and hence have the highest Eigen values. The next factor will account for as much of the left over variance as it can and the same will continue till the last factor. In the present research the first 5 factors explain 63.60% of variance.

Scree Plot

The scree plot graph i.e Eigenvalue against the each factor, shows that after factor 5 there is a sharp change in the curvature of the scree plot. This shows that after factor 5 the total variance accounts for smaller and smaller amounts.
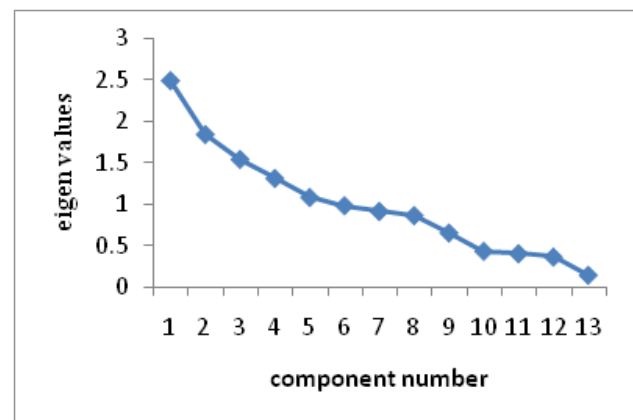

Fig. 1. Scree plot

According to the grouping of the factors, each group of factors was named which represent the grouped factor and represent the respective factors in Table 2.

Table 2: VARIMAX Rotated component analysis factor matrix

S. No	Variables	Component				
		1	2	3	4	5
1	Brand	0.799	-0.083	0.069	0.272	0.194
2	Availability of spare parts	-0.542	-0.021	0.357	-0.002	0.546
3	Easy repair ability	-0.096	-0.167	0.765	-0.033	0.235
4	Mechanics reputation	-0.279	0.457	0.125	0.54	0.023
5	Engine	0.236	-0.074	0.235	0.611	0.153
6	Cost	-0.053	0.129	0.574	0.244	-0.18
7	Look of the machine	0.445	0.196	0.574	-0.113	-0.201
8	Performance with regard to agricultural operations	0.886	0.077	-0.038	-0.153	0.098
9	Offers from dealer	-0.057	0.781	0.011	-0.033	-0.077
10	Resale value	0.127	0.755	-0.017	-0.047	0.175
11	Loan availability	-0.52	0.15	0.038	0.611	0.106
12	Subsidy	0.624	0.318	0.191	-0.523	0.069
13	Media	0.229	0.124	-0.113	0.114	0.829

Extraction method: Principal Component Analysis method

The above matrix gives the correlation of the variables with each of the extracted factors. Usually, each of the variables is highly loaded in one factor and less loaded towards the other factors. To identify the variables, included in each factor, the variable with the value maximum in each row is selected to be part of the respective factor. The values have been highligtened in each of the rows to group the 13 variables into 5 core factors.

Thus, after rotation Factor 1 accounts for 18.50% of the variance; Factor 2 accounts for 12.53% of the variance; Factor 3 and 4 accounts for 11.53% of the variance and Factor 5 accounts for 9.52% of the variance. All the 5 factors together explain for 63.60%

of the variance in factors influencing the farmer in the purchase of farm machinery.

We noted that in the rotated factor solution, variables 1, 8 and 12 load significantly on factor I; variables 9 and 10 loaded significantly on factor II; variables 3, 6, and 7 loaded significantly on factor III; variables 4 and 5 on factor IV; variables 2 and 13 on factor V.

Based on the loadings of the thirteen variables on each factor (factor loading greater than 0.5) and the loadings of the five summarized categories, the model was developed and is presented in Table 3. Different researchers in many instances will no doubt assign different names to the same result because of the differences in their backgrounds and training.

Table 3: Table showing the Factors influencing a farmer in selection of Farm Machinery

S. no	Variables	Factor loading	Factor title
1	Brand reputation	0.762	Cost effectiveness
	Performance with regard to agricultural operations	0.825	
	Subsidy	0.419	
2	Offers from dealer	0.62	Returns and offers available
	Resale value	0.619	
3	Easy reparability	0.679	Services and worth
	Cost of machine	0.441	
	Look of machine	0.618	
4	Mechanics reputation	0.595	Reputation and credit availability
	Engine	0.513	
	Loan availability	0.679	
5	Availability of spare parts	0.719	Accessibility and publicity
	Media	0.781	

Thus factor analysis has thus identified 5 major factors that influence the farmer in the purchase of farm machinery. They can be categorized as.
♦ Cost effectiveness
♦ Returns and offers available
♦ Services and worth
♦ Reputation and credit availability
♦ Accessibility and publicity
The above factors are discussed here under.

Factor 1- Cost effectiveness
This factor suggests that the farmers prefer a machine with brand reputation which performs well in field conditions and should have higher amounts of subsidy. This factor explains 18.50% of the variability in purchasing the farm machinery. Thus farmer always prefer good branded machinery which performs well. Similarly, this is the core factor which influences a farmer in purchasing farm machinery.

Factor 2- Returns and offers available
This factor suggests that the farmer will always look for resale value because most of the farmers go for selling their machines after the crop season completes. Thus they will go for machines whose resale value and offers from the dealers will be high. This is the second important factor as it constitutes 12.53% of the total variability.

Factor 3- Services and worth
This factor suggests that the farmers were interested to purchase the machinery whose services

are fast and easy. The farmer also looks for the cost of the machines and analyze based on the appearance of that machine. Hence this is the third important factor which constitutes 11.53% of the total variability.

Factor 4- Reputation and Credit availability
This factor suggests that the farmer purchase machinery according to the advice from mechanics or friends regarding the capacity of the machine. Based on their suggestion, the farmer looks for loan or money available for purchasing the machinery. Thus this factor is the fourth important factor that influences a farmer in purchasing the farm machinery constituting about 11.53% of the total variability.

Factor 5- Accessibility and Publicity
This factor suggests that the farmer was purchasing farm machinery after knowing about the spare parts availability through either media or newspaper. Thus this is the last important factor that influences a farmer in purchasing of farm machinery constituting about 9.52% of the total variability.
Thus a total of 5 factors extracted from 13 variables explained about 63.60% of the total factors that influence a farmer in the purchasing of farm machinery.
The cluster analysis was used to identify the factors to purchase the farm machinery by the farmers. Based on the similarities, 90 farmers were grouped into 4 clusters using Ward's variance clustering method. The farmers classified into different clusters as shown in Table 4.

Table 4: Clustering pattern of farmers using Ward's Minimum Variance Clustering Method

Cluster	Farmers	No. of Farmers	Proportion
I	62, 85, 27, 61, 34, 72, 81, 37, 70, 39, 71, 79, 46, 10,7, 11, 12, 69, 75, 30, 80, 83, 29, 77, 89, 90, 87, 88	28	31.10%
II	47, 82, 40, 24, 36, 32, 59, 63, 23, 67,35, 84, 66, 65, 2, 86, 73, 33, 64, 76, 74	21	23.30%
III	31, 44, 42, 43, 38, 45, 78, 41, 68, 26, 18	11	12.20%
IV	53, 57, 50, 51, 17, 55, 52, 58, 21, 22, 48, 49, 6, 60, 20, 25, 3, 4, 5, 28, 9, 8, 13, 16, 14, 15, 1,19,56,54	30	33.30%

The various characteristics of each cluster were as follows.

1) Characteristics of Cluster I:
There are 31.1% of the total farmers in this cluster. The farmers under this cluster are selecting the machinery based on brand reputation, cost of the machine, performance in agricultural operations, loan availability, subsidy and media. The farmers in this

cluster are having similar characteristics with regard to the above mentioned variables.

2) Characteristics of Cluster II
There are about 23% of the farmers existing in this cluster. The farmers under this cluster are selecting the farm machinery based on brand reputation, availability of spare parts, easy repair ability, mechanic reputation, cost of the machine, resale value, loan availability and subsidy.

3) Characteristics of Cluster III

There are about 12.2% of the total farmers existing in this cluster. The farmers under this cluster are having similar characteristics with regard to brand reputation, availability of spare parts, engine, subsidy and media.

4) Characteristics of Cluster IV

There are about 33.3% of the farmers in this cluster. The farmers under this cluster are selecting the farm machinery based on brand reputation, performance with regard to agricultural operations and resale value of the machines.

Hence overall, all the farmers are very much interested to purchase a branded farm machinery irrespective of other variables.

CONCLUSION

It was concluded that multivariate approaches like factor analysis and cluster analysis effectively summarized the source of variation in determining the factors influencing while purchasing the farm machinery. It was identified that 5 factors are influencing a farmer in this process which include cost effectiveness, returns and offers available, reputation and credit availability, accessibility and publicity and finally media influence. The farmers are categorized into 4 clusters such that each cluster is having different characteristic features.

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