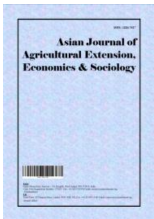

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Factors Influencing the Performance of Cooperative Vis-À-Vis Private Dairy Industries in Andhra Pradesh

K. Vykhaneswari[1*] and G. Sunil Kumar Babu[2]

[1]Agricultural College-Bapatla, Acharya N. G. Ranga Agricultural University, Guntur-522101, India.
[2]National Commission for Scheduled Castes (NCSC), Hyderabad, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author KV designed the study, performed the statistical analysis and wrote the draft of the manuscript. Author GSKB managed the analysis of the study and the literature searches and approved the final manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

A study was carried out to analyze the factors influencing the performance of dairy industries in Andhra Pradesh. Principal component analysis, a multivariate technique was employed to determine the factor influencing dairy industries. The variable of milk procurement with highest loadings of 0.925 under first component was the most influencing factor showing the performance of the industries. The next most dominant factor was milk sold by the industries per year with loadings of 0.912 comes under second component. Likewise, the overall selected variables were represented under four components with high component loadings. Out of the four components considered, milk procurement by the different dairies was the most influencing factor that shows the performance of dairy industry.

Keywords: Dairy industries; principal component analysis; eigen value and milk & milk products.

**Corresponding author: E-mail: vykhaneswarikoyi128@gmail.com;*

1. INTRODUCTION

India is showing an impressive rise in the milk production with a great transformation from deficit to surplus milk producing country over a span of five decades. Dairy sector plays a vital role in providing employment and income generating opportunities to farmers. It becomes a major source of income for an estimated 27.6 million people. Among these, 65 to 70 per cent are small, marginal farmers and land-less labour [1]. About 48 % of the total milk production in India is either consumed at the producer level or sold to non-producers in the rural area. Remaining 52 % of the milk is marketable surplus that is available for sale to urban consumers. Out of the total marketable surplus, an estimation of 40 % of the milk sold is managed by the organized sector which consists of 20 % each by cooperative and private dairies. The rest 60 % is handled by the unorganized sector [2]. According to the report of Dairy India, 2017 [3], it is estimated that the capacity created by private dairies in the last 20 years is more than the capacity set up by the cooperatives in over 30 years. Private dairies were flourishing in a competitive manner mainly with a profit-oriented objective along with cooperatives primarily for farmers welfare. Nevertheless, being a profit-oriented enterprise, private dairies were providing a greater access to large number of farmers. Having an immense importance of dairies in the coming years, there is a need to know about the factors influencing the performance of dairy sectors that makes imperative for socio-economic development.

2. MATERIALS AND METHODS

Andhra Pradesh was purposively selected for the research study which occupied fourth rank in milk production with 15.04 million tonnes next to Uttar Pradesh (30.51 million tonnes), Rajasthan (23.66 million tonnes) and Madhya Pradesh (15.91 million tonnes) [4]. Three districts namely Krishna, Guntur and Kurnool with estimated milk production of 1550.28, 1445.30 and 1120.20 (‘000 metric tonnes), respectively were selected on the basis of highest milk production. A total of six dairy industries with a count of three cooperative and three private dairies were selected. Primary data was collected with the use of well-structured schedules from the dairies during the period of 2017-18. The collected data from the dairies were tabulated and analyzed using SPSS software. To study the factors influencing the performance of both cooperative and private dairy industries, a multivariate technique *i.e.*, principal component analysis was chosen. The main aim of this technique was dimensionality reduction of the data.

Principal component analysis of a set of ‘m’ original variables generate ‘m’ principal components, PC_1, PC_2, …….PC_m, with each principal component being a linear combination of Ss’ scores on the original variable, *i.e.*

$$PC_1 = b_{11}X_1 + b_{12}X_2 + \text{-----} + b_{1m}X_m \quad = Xb_1$$

$$PC_2 = b_{21}X_1 + b_{22}X_2 + \text{-----} + b_{2m}X_m \quad = Xb_2$$

$$PC_m = bm_1X_1 + b_{m2}X_2 + \text{-----} + b_{m\,m}X_m = Xb_m$$

Where,

b_i refer to the coefficients, i = 1 to m
x_i refer to the variables, i = 1 to m

From 6 dairy industries including both cooperative and private, the data regarding 17 variables collected were given below.

X_1 = Procurement of milk (lit in crore/year)
X_2 = Liquid milk sales (lit in crore/year)
X_3 = Liquid milk price (average price/lit)
X_4 = Number of milk and milk products produced
X_5 = Number of dairy societies
X_6 = Number of chilling centres
X_7 = Number of farmers registered
X_8 = Number of AI centres
X_9 = Number of AI done per year
X_{10} = Total payments to producers (Rs. in crore)
X_{11} = Training facilities (Rs. in crore)
X_{12} = Provision of insurance (Rs. in crore)
X_{13} = Provision of feed and fodder (Rs. in crore)
X_{14} = Volume of milk products sold (‘000 kg/year)
X_{15} = Total returns (Rs. in crore)
X_{16} = Total expenses (Rs. in crore)
X_{17} = Net returns (Rs. in crore)

In SPSS, Kaiser Meyer Olkin (KMO) test was used to estimate the sample adequacy. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy index ranges from 0 to 1 and if the index is equal or higher than 0.50 suggests the sample size is advisable for the study [5]. The strength of the relationship can be measured through Bartlett Test of Sphericity. The test measures the multivariate normality set of distribution. Bartlett’s test of sphericity compares an observed correlation matrix to the identity matrix. The null and the alternative hypothesis of this test was given as.

H_0: The variables were orthogonal i.e., not correlated (or) correlation matrix is an identity matrix.
H_1: The variables were not orthogonal (or) correlation matrix is not an identity matrix.

The significant value less than 0.05 indicates that the data do not produce an identity matrix and thus measures the normality and acceptable for further analysis [6,7].

3. RESULTS AND DISCUSSION

With the help of PCA technique, factors influencing the performance of dairy industries were analyzed and identify the important principal components that have most effect on the performance of dairies. The results of the data analysis were given below.

Table 1. KMO and bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.685
Bartlett's Test of Sphericity	Approx. Chi-Square	896.712
	df	136
	Sig.	0.000

The above Table 1 mentioned about the KMO and Bartlett's test which were the beginning steps to indicate the suitability of the data for structure detection. These two tests provide minimum standards which to be passed for the principal component analysis to be conducted. As the KMO value is 0.685 greater than 0.5 which indicates the sample size is sufficient for running analysis.

Correlation matrix is simply a matrix of values that shows the correlation coefficients between variables and the identity matrix is a matrix in which all of the values along the diagonal were one and all of the other values were zero. The approximate Chi-square value was 896.712 with 136 degrees of freedom and the Bartlett test of sphericity was significant at 5 % level of significance which indicates the null hypothesis of the test was rejected *i.e.,* the variables were not orthogonal or correlation matrix is not an identity matrix and were highly correlated. With the significance of the Bartlett's test, the collected data is likely suitable for the analysis.

Table 2. Communalities

Component	Communalities	
	Initial	Extraction
X_1	1.000	0.613
X_2	1.000	0.632
X_3	1.000	0.531
X_4	1.000	0.734
X_5	1.000	0.520
X_6	1.000	0.729
X_7	1.000	0.750
X_8	1.000	0.538
X_9	1.000	0.514
X_{10}	1.000	0.522
X_{11}	1.000	0.544
X_{12}	1.000	0.590
X_{13}	1.000	0.651
X_{14}	1.000	0.642
X_{15}	1.000	0.696
X_{16}	1.000	0.471
X_{17}	1.000	0.602

Extraction method: Principal Component Analysis

The above Table 2 displays the communality as the proportion of each variable's variance that can be explained by the principal components. It is denoted by h^2 and can be defined as the sum of squared factor loadings. Initial values of the communality represents the variance explained by all the variables was common and is said to be one before extraction with out any reduction in the data set. Extraction values potrays the reproduced variances from the number of components that were retained in the analysis. Variables with high values were well represented in the common space than the variables with low values. The capacity of variable variance was highly shared by the X_7 component (number of farmers) with a value of 0.750. The second highest variance was shared by the variable X_4 (number of milk and milk products produced) of 0.734 followed by X6 (number of chilling centres) with a value of 0.729. The least share was with X_{16} (total expenses) variable of 0.471. Like this, each and every variable contributes its share to the total variance that was disclosed by the extracted components in the analysis.

The above Table 3 represents the total variance explained which includes segments *i.e.,* initial eigen values, extraction sum of loadings and rotation sum of loadings. Each segment is having sub segments of total values, per cent of variance and cumulative percentage. The overall table explains about the total variance explained by the components. With the assistance, a new set of variables were computed and the data can be explicated in the form of new variables.

Table 3. Total variance explained

Component	Initial eigen values			Extraction sum of squared loadings			Rotation sum of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
X_1	5.826	34.271	34.271	5.826	34.271	34.271	3.986	23.447	23.447
X_2	2.162	12.718	46.988	2.162	12.718	46.988	2.794	16.435	39.882
X_3	1.235	7.265	54.253	1.235	7.265	54.253	1.827	10.747	50.629
X_4	1.056	6.212	60.465	1.056	6.212	60.465	1.672	9.835	60.465
X_5	0.936	5.506	65.971						
X_6	0.825	4.853	70.824						
X_7	0.807	4.747	75.571						
X_8	0.748	4.400	79.971						
X_9	0.681	4.006	83.976						
X_{10}	0.532	3.129	87.106						
X_{11}	0.491	2.888	89.994						
X_{12}	0.378	2.224	92.218						
X_{13}	0.342	2.012	94.229						
X_{14}	0.315	1.853	96.082						
X_{15}	0.283	1.665	97.747						
X_{16}	0.247	1.453	99.200						
X_{17}	0.136	0.800	100.000						

Extraction Method: Principal Component Analysis

The first segment regarding the initial eigen values in which total numerical values portrays about the amount of variance that can be explained by a given principal component. It shows that the first component was having the greater variance of 34.271 per cent with eigen value of 5.826 followed by second component showing variation of 12.718 percent with eigen value of 2.162. Total 100 per cent variance was explained by all the components before extraction.

After extraction, number of components retained can be known with the help of eigen values greater than one was seen in the second segment of extraction sum of squared loadings. Total initial eigen values column before extraction was similar to total extraction sum of squared loadings column after extraction. It was observed that four components were extracted out of 17 with eigen values greater than one was characterized in decreasing magnitude. The total values represent the retained components after extraction and the per cent of variance explains about the amount of variation displayed by each principal component. About 34.271 per cent of variation was explained by the first component followed by second, third and fourth component of 12.718, 7.265 and 6.212, respectively. All these extracted four components represent about 60.465 per cent of the total variance. Cumulative per cent displays the variance of the component added to the previous one after extraction. First component with 34.271 per cent and second component with cumulative of 46.988 per cent followed by third with 54.253 per cent and finally fourth with cumulative of 60.465 per cent of variance.

Rotation sum of squared loadings represents the distribution of variance after the varimax rotation. Varimax rotation tries to maximize the variation of each of the components, so that the total variance accounted for was redistributed over the extracted components. Total values in the panel of rotation sum of squared loadings explain about the total variance after rotation. The percent of variance differed from 34.271 before rotation to 23.447 after rotation by the first component. The consecutive per cent of variance were 16.435, 10.747 and 9.835 accounted by the second, third and fourth components, respectively. The values in the third column of the panel point outs the cumulative variance of each component when added to the preceding component and the total variance accounted for was 60.465 per cent.

Scree plot was a pictorial approach displaying the eigenvalues versus components. With the use of this plot, number of components to be retained can be determined. The point on the graph where the attention to be hold was elbow bent of the curve. The number of factors to be extracted was preferred based on the eigenvalue greater than one. In the pictorial representation, four points from one to four whose eigenvalues were greater than one was considered and these were the components to be retained, whereas from 5th point whose eigenvalues were less than one was not considered. The extracted four components were best to sum up all the variables.

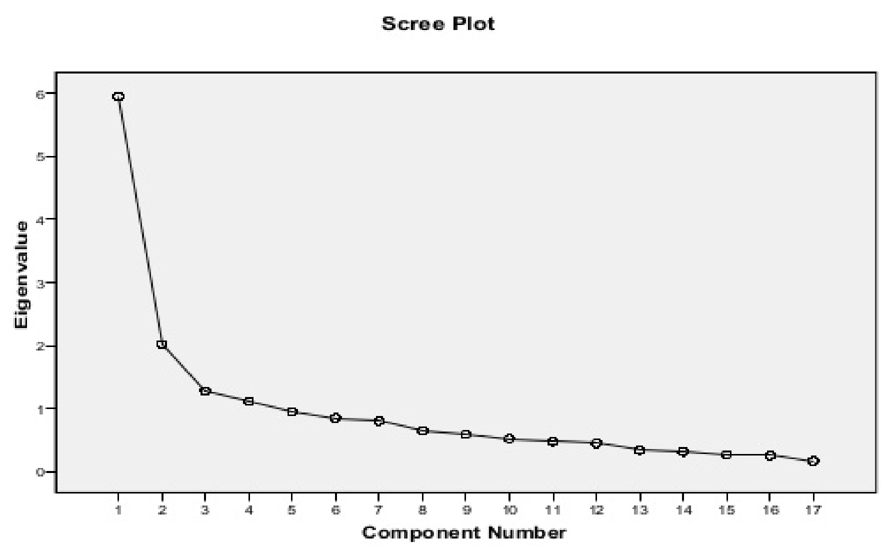

Fig. 1. Scree plot

Table 4. Component matrix [a]

	Components			
	1	2	3	4
X_5	0.710	0.192	0.071	0.258
X_6	-0.742	0.093	0.251	-0.101
X_7	0.613	-0.128	0.290	-0.235
X_1	0.802	-0.298	-0.018	0.041
X_4	0.591	0.194	0.127	0.324
X_2	0.658	0.208	0.491	0.106
X_3	-0.726	0.353	0.313	-0.011
X_{14}	-0.613	0.334	-0.110	0.182
X_8	0.629	0.191	-0.286	0.003
X_9	0.598	0.306	0.231	0.131
X_{11}	-0.516	0.081	0.326	0.406
X_{12}	-0.295	0.465	0.064	0.532
X_{13}	0.689	0.368	0.192	0.063
X_{10}	0.473	-0.168	-0.469	-0.412
X_{15}	0.265	-0.781	-0.124	0.005
X_{16}	0.252	0.480	0.319	0.101
X_{17}	0.359	0.581	0.295	0.352

Extraction Method. Principal Component Analysis.
a. 4 components extracted

Component matrix Table 4 contain component loadings which show the correlation between the variables and components before rotation. Component loadings values with absolute value of less than 0.3 will be suppressed. Most of the variables *i.e.,* 14 in number were highly loaded on the first component followed by second and fourth components. A very few was loaded on the third component. The highest correlation of 0.802 was observed between the procurement of milk (X_1) and the first component, followed by number of chilling centres (X_6 = -0.742) and so on. The variable X_{16} and the first component were drawn with least correlation of 0.252. In the second component, highest correlation was with X_{15} (gross returns) variable with absolute value of 0.781. The variable X_2 (liquid milk sales) and variable X_{12} (insurance) were recognized with highest correlation of 0.491 & 0.532 in the third and fourth components, respectively. The highest loadings with a greater number of variables were noticed in the first component. In order to reduce the variables with high loadings, varimax rotation method was followed which helps to make the interpretation easier.

The above table 5 represents the rotated component matrix with varimax rotation method. The main aim of this rotation was to reduce the variables with high loadings in one component and also to understand how the data correlated with the principal components. The loadings with absolute value of more than 0.3 was considered in the matrix. The variables X_5, X_6, X_7, X_1 and X_4 comes under first component having the strongest correlation by excluding all other variables with less correlation. The maximum correlation prevailed with first component was X_1 (procurement of milk) of 0.925 followed by X_7 (number of farmers) of 0.847 and X_5 of 0.820 (dairy cooperative societies). Under second component, the variable with highest correlation value of 0.912 was spotted with variable X_2 (liquid milk sales) followed by X_{14} of 0.896 (volume of milk products sold) and X_3 of 0.759 (liquid milk sale price).

Five variables were showing correlation with third component and they are X_8 (number of AI centres), X_9 (number of AI done), X_{11} (training facilities), X_{12} (insurance) and X_{13} (feed and fodder) with absolute values of 0.421, 0.514, 0.716, 0.608 and 0.621, respectively. Among these variables, the highest correlation for third component was associated with X_{11}. Finally, X_{17} (net returns), X_{15} (total returns), X_{10} (payment to producers) and X_{16} (total expenses) were the variables which shows correlation from highest to lowest with the fourth component having the values of 0.657, 0.639, 0.525 and 0.498, respectively.

Table 5. Rotated component matrix [a]

	Components			
	1	**2**	**3**	**4**
X_5	0.820	0.064	0.210	0.080
X_6	0.792	0.182	0.016	0.092
X_7	0.847	0.256	0.070	0.209
X_1	0.925	-0.118	0.156	0.171
X_4	-0.787	0.205	0.023	0.272
X_2	0.269	0.912	0.127	0.204
X_3	0.051	0.759	0.099	-0.011
X_{14}	0.163	0.896	0.065	0.025
X_8	-0.227	0.263	-0.421	0.215
X_9	0.157	0.298	0.514	0.078
X_{11}	0.183	0.075	-0.716	0.167
X_{12}	0.241	0.174	0.608	0.026
X_{13}	0.182	0.231	0.621	0.153
X_{10}	-0.094	0.279	0.033	0.525
X_{15}	0.235	-0.191	0.012	0.639
X_{16}	0.195	0.232	0.107	0.498
X_{17}	0.291	0.096	0.020	0.657

Extraction Method. Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations

4. CONCLUSION

The overall analysis showed the performance of different dairy industries with respect to their variables. All the variables were branched under four components with related aspects of their performance. The first component reveals the capacity or strength of the dairy industries that includes procurement of milk, number of farmers registered, number of dairy cooperative societies, number of chilling centres and number of milk and milk products produced. Marketing aspects includes sale of milk and milk products and the average price given to the farmer were the variables which comes under second component. Third component describes about the services provided by the industries such as number of AI centres, number of AI done, amount used for training facilities, insurance and the provision of feed and fodder. The last component includes the payments to producer farmers', total returns, total expenses and net returns which depicts the financial aspects of the dairy industries. As the overall performance of dairy industries chiefly hinged on procurement of milk, liquid milk sales and volume of milk products sold, industries should intensify their collection centres with latest apparatus and increase the ample varieties of quality milk and milk products that made available to consumers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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