

Grouping of State wise performance of PACS in India: An application of cluster analysis

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Abstract

This paper has analyzed a number of financial parameters to measure the performance of Primary Agriculture Credit Societies (PACS) according to the state wise of India and grouping them into different categories on the basis of their financial performances. The objectives of the paper are to identify the group of PACS to compare their financial performance and also identified the stability of financial performance of PACS in West Bengal. On the basis of the cluster analysis, we can observe that West Bengal belongs to cluster IV in both the year 2008 and 2018. Therefore, we can infer that West Bengal has the stable paid up share capital per PACS, stable working capital per PACS, stable borrowing per PACS and stable profit per PACS, where as improved borrowers per PACS and reserve per PACS over the year 2008 to 2018. Therefore we can infer from this cluster analysis that the performance of cluster members of cluster IV (West Bengal) on the basis of these financial indicators is better than the average national performance of PACS over the year 2008 to 2018.

Keywords: Primary Agriculture Credit Societies (PACS), Socio-Economic Development, Regression Analysis.

Introduction

Primary Agriculture Credit Societies (PACS) play an important role to shape the rural finance and their stakeholders not only form the financial support but also from different non-financial aspect. This paper has analyzed a number of financial parameters to measure the performance of Primary Agriculture Credit Societies (PACS) in state wise of India and grouping them according to their financial performances. A review of literature suggests that “the PACS work towards a positive vision: that of widespread, reasonably equitable social welfare, which is sustainable for the coming generations: a vision that will ensure a safe and clean habitat, with a minimum level of health, education, economic opportunity, social status, political representation and cultural self-expression for all”. The study has been done on the basis of secondary data and on the basis of cluster analysis.

Literature Review: According to *Rabin Mazumder, Chandrasekhar Chakravarty, Amit K. Bhandari, (2014)* , “agricultural

credit is one of the most crucial inputs in all agricultural development programmes. Access of rural credit has still remained scarce in India. Primary Agriculture Credit Societies (PACS) working at grass-root level have direct contact with the rural people and meet their financial requirements”. According to *Koustab Majumdar , Sunanda Saha Chowdhury and Krishnapada Sarkar (2015)*, “financial institutions in the country continue to play a leading role in the microfinance program for nearly two decades. On the basis of primary data, a critical assessment has been done to determine the role of Primary Agricultural Credit Societies (PACS) in promoting the agribusiness of the farmers and that of SHG (Self Help Group) in improving the agriculture production marketing strategies. PACS functioning at grass-root level have direct contact with the rural people and meet the financial requirements of 10.983 core members. PACS also consider some initiatives for providing training to SHG”.

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According to *K. Sudhakara Rao (2016)* “agricultural credit is one of the most crucial inputs in all agricultural development programmes. For a long time, the major source of agricultural credit was private moneylenders. But this source of credit was inadequate, highly expensive

Objective of the study

In order to identify the group of PACS on the basis of their financial performance and also identified the stability of financial performance of PACS in West Bengal.

Hypothesis of the study

The study attempts to probe that the PACS is very active financially in West Bengal compare to the national average.

Methodology of the study

The study has been done on the basis of secondary data collected from various reports of RBI, NSSO, NABARD, NAFSCOB etc. Data processing and analysis have been done on the basis of

$$d(R, P + Q) = \delta_1 d(R, P) + \delta_2 d(R, Q) + \delta_3 d(P, Q) + \delta_4 |d(R, P) - d(R, Q)|$$

The δ_j 's are weighting factors that lead to Ward agglomerative algorithms where two cluster is based on the size of the error sum of squares criterion as described as:

$$\delta_1 = \left(\frac{m_R + m_P}{m_R + m_P + m_Q} \right), \delta_{21} = \left(\frac{m_R + m_Q}{m_R + m_P + m_Q} \right), \delta_3 = -\left(\frac{m_R + m_P}{m_R + m_P + m_Q} \right), \delta_4 = 0$$

In our study, we used cluster analysis to club different state into the same cluster on the basis of different financial parameters. Also we have identified the common characteristics by using different statistical measurements for the years 2008 and 2018. Cluster analysis is an exploratory descriptive data analysis. By using cluster analysis we can cluster different state PACS on the basis of different financial indicators of the PACS. The study has compared the average performance of PACS for the years 2008 and 2018. Refer annexure 6.3 and 6.4 for data table of

and exploitative. On the basis of secondary data, he compared the performance of PACS in India and Andhra Pradesh with the help of select indicators like number of PACS, memberships, working capital, loans and advances, overdue, etc”.

descriptive statistics, cluster analysis. Performance of PACS in west Bengal and other state are measured by the following financial parameters on the year 2008 and 2018.

Clustering of the state on the basis of different financial parameters per PACS of a state:-

The agglomerative hierarchical methods (Wards methods) utilize most commonly approaches to determine the distances between the clusters as follows: In order to determine the distance between two objects say, P and Q; we can used the distance function:

average performance of PACS in 2008 and 2018. The lists of indicators are as follows:

- ✓ Paid up share capital per PACS of a state.
- ✓ Working capital per PACS of a state.
- ✓ Overdue per PACS of a state.
- ✓ Profit per PACS of a state.
- ✓ Reserve per PACS of a state.
- ✓ Borrowing per PACS of a state.
- ✓ The number of untrained workers per PACS of a state.
- ✓ Borrowers per PACS of a state.

To test the goodness of fit of hierarchical clustering methods, we used cophentic correlation coefficient which is the Pearson correlation. A value of 0.75 or above is needed to be achieved for the clustering to be considered useful. As the cophentic correlation coefficient is 0.81 in the year 2008 and 0.83 in the year 2018,

we can consider hierarchical clustering methods are used to determine the cluster membership for our data set of 2008 and 2018. Drawing a vertical line from point 10, in the figure 1 and the figure 2, gives us 4 clusters in the year 2008 and 4 clusters in the year 2018.

Figure-1: Dendrogram for performance of overall state level PACS in India in 2008

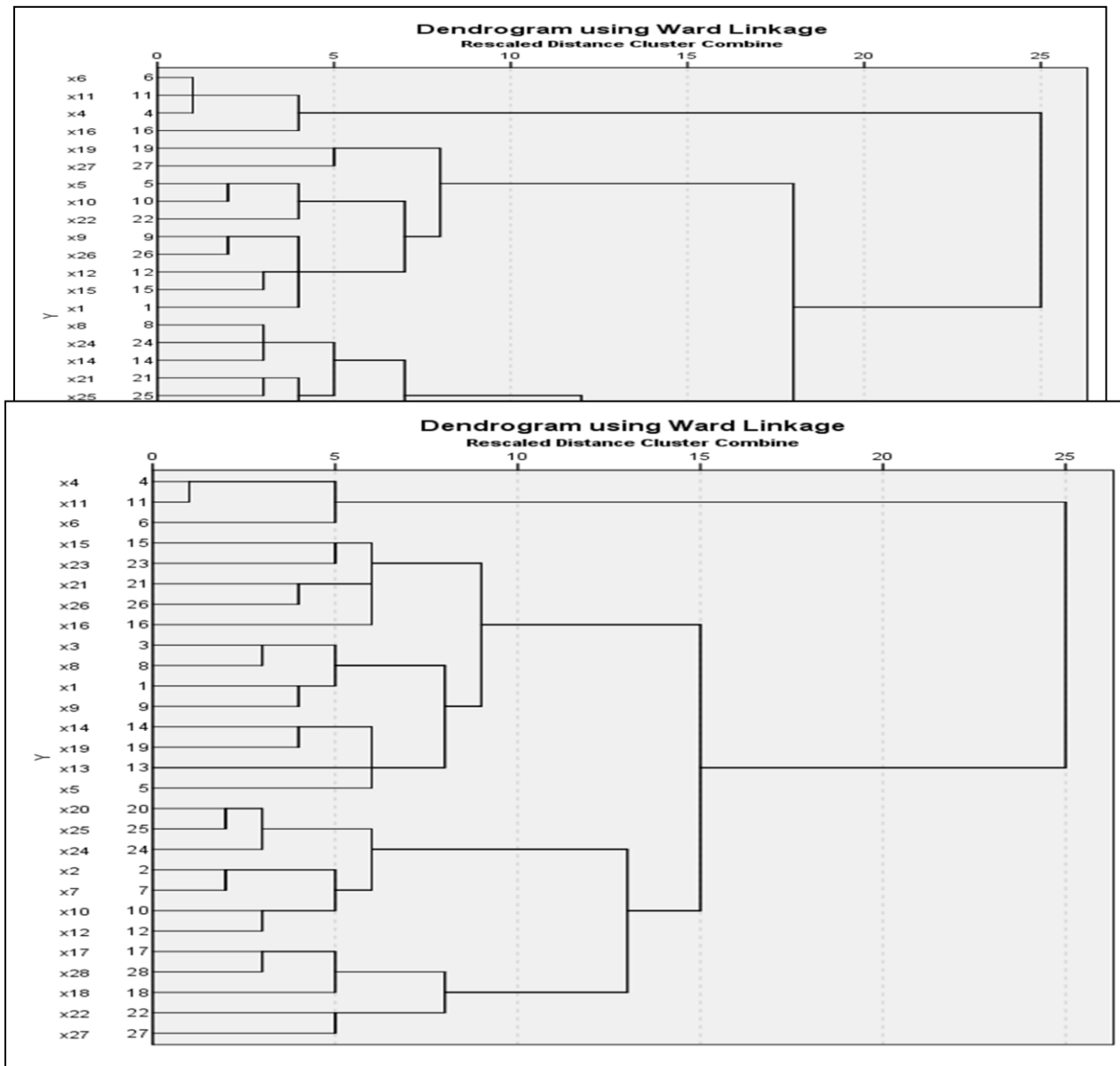


Table 1: Cluster membership of different states of India

Year	Cluster -I	Cluster-II	Cluster -III	Cluster-IV
2008	Kerala, Karnataka, Punjab, Uttar Pradesh.	Andaman and Nicobar, Bihar, Gujarat, Haryana, Himachal Pradesh, Maharashtra, Assam, Tamilnadu, Nagaland, Uttarkhand.	Chhattisgarh, Goa, Madya Pradesh, Sikkim, Tripura, Manipur, Jarkhanda,	Andhra Pradesh, Arunachal Pradesh, Jammu & Kashmir, Meghalaya, Orissa, Rajasthan, West Bengal
2018	Kerala, Karnataka, Punjab.	Uttar Pradesh. Maharashtra, Tripura, Nagaland, Sikkim	Goa, Madya Pradesh, Manipur, Jarkhanda, Rajasthan, Bihar, Arunachal Pradesh, Andaman and Nicobar, Bihar, Gujarat , Jammu & Kashmir, Assam, Andhra Pradesh,	Uttarkhand, Tamilnadu, Meghalaya, Orissa, West Bengal

Source: the author’s calculation.

Table 1 indicates different cluster membership of different states of India on the basis of 2008 and 2018. In the cluster of the year 2008, cluster-I, we included four states - Kerala, Karnataka, Punjab and Uttar Pradesh, whereas in the year 2018, we included only three states -Kerala, Karnataka and Punjab. Hence due to change of dominant characteristics of cluster one, Uttar Pradesh has shifted from cluster I to cluster II. From this cluster analysis we can observe that West Bengal belongs to cluster IV for both the year If the value of test statistics is more than 2 with the critical region at 5% level of significance, we accept the alternative hypothesis that these are the dominant characteristics for a specific cluster.

2008 and 2018. In order to determine the dominant characteristics of each cluster on the basis of their cluster membership, we consider the descriptive analysis (mean, standard deviation, V-test) and identify the dominant characteristics of each cluster. According to Cohen J, V test statistics is

$$\text{defined as } vt = \frac{\bar{x}_g - \bar{x}}{\sqrt{\frac{n - n_g}{n - 1} \times \frac{\sigma^2}{n_g}}}$$

According to the study of Weatherall, M., Shirtcliffe, P., Travers, J. & Beasley, R. dominant characteristics of cluster members can be determined by Vt test statistics as:

Table 2 dominant characteristics indicators

V test value	Criterion
$ vt < 2$	Not dominant characteristics (NDC)
$2 < vt < 4$	Dominant characteristics (DC)
$4 < vt < 6$	Moderate dominant characteristics (MDC)
$ vt > 6$	Strong dominant characteristics (SDC)

Sources; Weatherall, M., Shirtcliffe, P., Travers, J. & Beasley R (2004), "Use of cluster analysis to define COPD phenotypes", *The European respiratory journal*. 36, 472–474,

Table-3: Descriptive analysis of cluster members for the year 2008:

Cluster	Descriptive statistics	Paid up share capital per PACS	Working capital per PACS	Over due per PACS	Reserve per PACS	Borrower per PACS	Untrained worker per PACS	Borrowing per PACS	Profit per PACS
Cluster-I	Mean	60.7	695.7	3.55	26.65	5.14	1.81	83.5	152.5
	Standard deviation	52.8	62.5	3.3	19.71	3.37	1.15	55.9	270.1
	Vt test value	3.2	6.7	1.5	2.1	3.4	1.2	6.2	5.4
	Nature of variable	DC	SDC	NDC	DC	DC	NDC	SDC	MDC
Cluster-II	Mean	25.42	165.9	61.22	4.15	1.68	6.85	48.52	25.64
	Standard deviation	26.78	55.6	13.5	3.58	0.98	2.35	6.5	4.5
	Vt test value	1.2	4.2	4.5	1.5	2.92	2.1	4.5	2.1
	Nature of variable	NDC	MDC	MDC	NDC	DC	DC	MDC	DC
Cluster-III	Mean	23.97	365.2	39.61	5.05	2.35	4.51	62.35	65.24
	Standard deviation	10.28	85.1	14.25	2.5	2.1	3.37	5.6	5.62
	Vt test value	1.8	3.2	3.1	1.86	2.1	2.5	2.3	2.3
	Nature of variable	NDC	DC	DC	NDC	DC	DC	DC	DC
Cluster-IV	Mean	48.57	265.25	17.5	11.25	8.53	3.52	76.54	135.45
	Standard deviation	30.52	65.4	8.65	2.5	2.51	1.51	2.5	2.65
	Vt test value	3.1	4.2	2.1	2.1	4.5	2.1	4.5	6.5
	Nature of variable	DC	MDC	DC	DC	MDC	DC	MDC	SDC
Over all mean		39.66	373.02	30.47	11.78	4.45	4.17	72.51	94.71

Source: The author's calculation. (Please refer table 6.13 for NDC, DC, MDC and SDC)

Table-4: Descriptive analysis of cluster members for the year 2018:

Cluster	Descriptive statistics	Paid up share capital per PACS	Working capital per PACS	Overdue per PACS	Reserve per PACS	Borrower per PACS	Untrained worker per PACS	Borrowing per PACS	Profit per PACS
Cluster-I	Mean	452	856	6.5	36.58	7.8	1.28	95.85	156.54
	Standard deviation	52	89	1.5	5.6	1.2	0.65	5.6	12.2
	Vt test value	4.5	2.1	1.8	5.4	2.1	1.3	4.5	6.5
	Nature of variable	MDC	DC	NDC	MDC	DC	NDC	MDC	SDC
Cluster-II	Mean	265	548	51.22	12.56	5.8	2.5	45.85	84.56
	Standard deviation	65	74	13.5	3.6	2.1	0.56	8.9	7.8
	Vt test value	2.3	2.1	2.1	1.5	2.3	2.1	2.4	2.1
	Nature of variable	DC	DC	DC	NDC	DC	DC	DC	DC
Cluster-III	Mean	251	352	34.52	16.5	3.5	2.12	58.69	68.45
	Standard deviation	35	69	6.5	5.6	2.6	1.1	15.6	12.12
	Vt test value	2.1	3.1	2.4	1.4	1.8	2.3	2.1	3.1
	Nature of variable	DC	DC	DC	NDC	NDC	DC	DC	DC
Cluster-IV	Mean	451	415	15.24	18.65	6.5	1.57	78.85	114.12
	Standard deviation	48	89	5.6	3.56	2.4	0.89	18.52	21.1
	Vt test value	2.5	4.1	1.89	4.51	6.5	1.56	4.1	6.1
	Nature of variable	DC	MDC	NDC	MDC	SDC	NDC	MDC	SDC
Overall mean		354.75	542.75	26.87	21.07	5.9	1.86	69.81	105.92

Source: The author's calculation. (Please refer table 2 for NDC, DC, MDC and SDC)

Table-5: Dominant Characteristics of Cluster Members 2008 and 2018:

Variable	Cluster-I			Cluster-II			Cluster-III			Cluster-IV		
	2008	2018	Remark	2008	2018	Remark	2008	2018	Remark	2008	2018	Remark
Paid up share capital per PACS	DC	MD C	improved	ND C	DC	improved	ND C	DC	improved	DC	DC	Stable
Working capital per PACS	SD C	DC	deteriorated	MD C	DC	deteriorated	DC	DC	Stable	MD C	MD C	Stable
Overdue per PACS	ND C	NDC	stable	MD C	DC	deteriorated	DC	DC	Stable	DC	ND C	Deteriorated
Reserve per PACS	DC	MD C	improved	ND C	ND C	Stable	ND C	ND C	Stable	DC	MD C	Improved
Borrower per PACS	DC	DC	stable	DC	DC	Stable	DC	ND C	deteriorated	MD C	SDC	Improved
Untrained worker per PACS	ND C	NDC	stable	DC	DC	Stable	DC	DC	Stable	DC	ND C	Deteriorated
Borrowing per PACS	SD C	MD C	deteriorated	MD C	DC	deteriorated	DC	DC	Stable	MD C	MD C	Stable
Profit per PACS	MD C	SDC	improved	DC	DC	Stable	DC	DC	Stable	SDC	SDC	Stable

Source: The author's calculation. (Please refer table 2 for NDC,DC, MDC and SDC)

Therefore from the above table 3, 4 and 5 we can interpret the cluster analysis as: Cluster I is associated with states where the dominant characteristics of the PACS are like stable borrowers per PACS, borrowing per PACS, where as deteriorated working capital per PACS and also improved paid up share capital per PACS, reserve per PACS and profit per PACS over the year 2008 to 2018.

Cluster II is associated with states where the dominant characteristics of the PACS are stable borrowing per PACS, working capital per PACS, borrowers per PACS and untrained workers per PACS, where as deteriorated overdue per PACS over the year 2008 to 2018.

Cluster III is associated with states where the dominant characteristics of the PACS are stable working capital per PACS,

untrained workers per PACS, overdue per PACS, borrowers per PACS over the year 2008 to 2018.

Cluster IV is associated with states where the dominant characteristics of the PACS are stable paid up share capital per PACS, stable working capital per PACS, stable borrowing per PACS and stable profit per PACS, whereas improved borrowers per PACS and improved reserve per PACS over the year 2008 to 2018. It also observed that overdue per PACS and untrained worker per PACS deteriorated over the period of time which is not dominant characteristics of cluster members.

From this cluster analysis (table 5), we can observe that West Bengal belongs to cluster IV in both the year 2008 and 2018. Therefore, we can inferred that West

Bengal has the stable paid up share capital per PACS, stable working capital per PACS, stable borrowing per PACS and stable profit per PACS, whereas improved borrowers per PACS and reserve per PACS over the year 2008 to 2018.

Therefore we can infer from this cluster analysis that the performance of cluster members of cluster IV (eg West Bengal) on the basis of these financial indicators is better than the average national performance of PACS over the year 2008 to 2018.

Table 6: A comparative analysis of the performance of West Bengal PACS between 2008 and 2018 with respect to State to National ratio:

Sl no	Parameters	2008			2018			Improved/ Deteriorated
		West Bengal	India	State to nation ratio	West Bengal	India	State to nation ratio	
1	Borrower per PACS	8.17	4.45	1.837	11.48	5.9	1.95	Improved
2	Paid up share capital per PACS	22.4	39.66	0.564	226.3	354.75	0.64	Improved
3	Reserve per PACS	35	11.78	2.97	77.73	21.07	3.69	Improved
4	Overdue per PACS	9.75	30.47	0.32	6.54	26.87	0.24	Deteriorated
5	Profit per PACS	45.5	94.71	0.48	83.78	105.92	0.79	Improved
6	Working Capital per PACS	231	373.02	0.62	400.5	542.75	0.74	Improved
7	Borrowing per PACS	34.1	72.51	0.47	36.23	69.81	0.52	Improved
8	The number of untrained workers per PACS	10.6	4.17	2.54	4.576	1.86	2.46	Deteriorated

Source: Performance of Primary Agricultural Cooperative Societies for various years, and the authors' calculation; www.nafscob.org/ Accessed on 01/August/2019

Table 6 indicates a comparative analysis of the performance of PACS in West Bengal between 2008 and 2018 with respect to state to nation ratio. It is observed that the ratio of the financial indicators, such as members per PACS, paid up share capital per PACS, reserve per PACS, profit per PACS, working capital per PACS and

borrowing per PACS are improved in West Bengal with respect to state to nation ratio. These are all positive impact variables for the overall performance of a PACS. It is also observed that the ratio of the financial indicators, such as overdue per PACS and the number of untrained workers per PACS deteriorated in West

Bengal with respect to state to nation ratio. These are negative impact variables for overall performance of a PACS. Hence we infer that the performance of PACS in West Bengal is better than the average

Conclusion

Cluster analysis shows that cluster IV is associated with states where the dominant characteristics of the PACS are like stable per PACS over the year 2008 to 2018. It also observed that overdue per PACS and the number of untrained workers per PACS deteriorated over the period of time which is not dominant characteristics of cluster members. In case of West Bengal, it shows that overdue per PACS, the number of untrained workers per PACS are deteriorated with respect to state to nation ratio where as the members per PACS, paid up share capital per PACS, reserve per PACS, profit per PACS and working capital per PACS, borrowing per PACS are improved in West Bengal with respect to state to nation ratio.

As all positive impact variables for the overall performance of a PACS improved over the study period. It is also observed that the ratio of the financial indicators, such as overdue per PACS and the number of untrained workers per PACS deteriorated in West Bengal with respect to state to nation ratio. These are negative impact variables for overall performance of a PACS. Hence we infer that the performance of PACS in West Bengal is better than the average national performance of PACS. Therefore PACS are financially efficient in West Bengal to compare with the average national performance of PACS.

Hence we accept our hypothesis that ***“the PACS are financially efficient in West Bengal compared to the average national performance of PACS”***.

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national performance of PACS. Therefore PACS are financially efficient in West Bengal compared to the average national performance of PACS.

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