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An empirical analysis of impact of PACS on socio economic development of the stakeholders by using Data Envelopment Analysis (DEA)

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Abstract: This study has analyzed a number of factors which influence the performance of Primary Agriculture Credit Society (PACS) of West Bengal. In order to determine the impact of PACS on socio economic development of their stakeholder the study has used Data Envelopment analysis (DEA). DEA is a mathematical programming method that provides a single measure of efficiency with the use of multiple inputs and multiple output information and results in a frontier which represents the best practice of decision making units (DMUs). The survey questionnaire was designed to understand the perception of the stakeholders about the performance and socio economic impacts of PACS. Through the DEA, this study has identified the benchmark district that is the best performer in West Bengal. On the basis of DEA analysis it is observed that the performance of PACS of Bardhaman district is best with an average score of 0.9169 among the neutral cross-efficiency scores of 18 districts. Hooghly district is the second best performing district with average score of 0.9076.The inefficient district Purulia secured an average score of only 0.6686.The government should create an environment, for both the PACS and Self Help Group (SHG), to improve their work culture and other activities to increase their performance in near future.

Key Words: ***Data Envelopment Analysis (DEA), Neutral Cross Efficiency analysis, Primary Agriculture Credit Society (PACS), Socio-Economic Development.***

Declaration: We, Biman Maity and Dr. Dipankar Dey, declare that our work is original and it has not been published earlier.

Introduction

Primary Agriculture Credit Society (PACS) plays an important role in shaping the rural socio economic development by providing agricultural credit, distributing agricultural inputs, facilitating the marketing of agricultural produces and reconstruct the financial need of the poor people in rural areas. It provides microcredit to the needy households for their financial needs. It also provides medium term loans for allied activities which include dairy, poultry, animal husbandry etc.

As an academic concept, socio economic impact of PACS has been conceptualized and empirically tested in a variety of subject disciplines. In order to determine the impact of PACS on socio economic development of their stakeholder this study has used Data Envelopment analysis (DEA). DEA is a mathematical programming method that provides a single measure of efficiency with the use of multiple inputs and multiple output information and results in a frontier which represents the best practice of decision making units (DMUs). The survey questionnaire was designed to understand the perception of the stakeholders about the performance and socio economic impact of PACS.

Literature Survey:

According to the study of Dr. A K Khusro (1989), the concept of micro credit delivery through self-help groups is part of business development programme of PACS. In 1995, the State Government permitted the Primary Agricultural Credit Societies of West Bengal to enroll self-help groups as members of PACS. According to the study of Hans Dieter Seibel & Harishkumar R Dave[1] (2002), 'the generated effective operating income and the nominal intermediation margin at PACS level are not sufficient to cover the transaction cost and cost of risk of SHG lending at the PACS level". According to the study by Sa-Dhan[2] (2006) only 7% of microfinance loans in India are given to individuals and the contribution of poor and vulnerable households to the economic development of the country is largely affected by their ability to access credit and create wealth. They suggest that several strategies can be adopted to reduce the costs for the operation of PACS.

Ganley, J.A. and Cubbin, J.S. 1992[3] showed that Data Envelopment Analysis (DEA) was an analytical tool that could assist in the identification of best practices in the use of resources among a group of organisations. Such identification could highlight possible efficiency

[1]**Hans Dieter Seibel &Harishkumar R Dave**, " Bank Transaction Costs in india's self Help Group Banking program" Micro Credit Innovations Department, National Bank for Agriculture and Rural Development, Thompson Press, Mumbai 2002.

[2]**Sa-Dhan** (2006) "Transaction costs in group microcredit in India" Management Decision **ISSN: 0025-1747**

[3]**Ganley, J.A. and Cubbin, J.S. 1992**, *Public Sector Efficiency Measurement:Applications in Data Envelopment Analysis*, North Holland,Amsterdam.

improvements that may help agencies to achieve their potential. According to A Chilingerian, J. A. and Sherman, H. D. 1990[4], the objective of comparative performance measurement is to facilitate a program to improve performance, not to provide a simple grading of service providers. Identifying major gaps in performance can provide the impetus for an organisation to fundamentally rethink how it does things.

Objective of the study:

This study wants

- To identify several socio economic parameters to assess the impact of PACS on overall socio economic development of their stakeholders in the rural Bengal.
- To test whether the identified parameters have helped to improve the performance of PACS and what policy should be taken by the authority to improve the same.

Methodology of the study:

The study has been done on the basis of primary data collected from the selected PACS in West Bengal with the help of predefined questionnaire. A Random Sample Survey was used for collecting primary information (from members and non-members of PACS), on different development parameters, to understand the impact of PACS on their stakeholders. Structured questionnaires were used to collect the information from the targeted member of selected PACS. The stakeholders of each selected PACS were interviewed on the basis of following criteria.

- A member who is one of the beneficiaries of the PACS and also a part of management of that PACS.
- A member who is only a beneficiary of the PACS.
- A member who was the beneficiary of the PACS but is not a member of PACS at the time of interview.
- A member from SHG /JLG/ Farmer Club/ Association of the PACS.

On the basis of these criteria more than 1074 members (including 358 members of management) and 358 non-members' of PACS (who left the PACS due to some reasons) and 358 SHG /JLG/ Farmer Club/ Association were interviewed to know the importance of PACS in the socio economic development of their stakeholders. The sample size of PACS is 358 those cover 18 districts of West Bengal.

In order to determine the impact of PACS on socio economic development of their stakeholder this study has used Data Envelopment analysis (DEA).

[4]**A , Chilingerian, J. A. and Sherman, H. D. 1990**, 'Managing physician efficiencyand effectiveness in providing hospital services', *Health ServicesManagement Resources*, vol 3, no. 1, pp 3–15.

Variable specification:

The study used six input variables and two social output variables as follows:

Average Financial Support (AFS) provided to the stakeholders of PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the input variable for that specific district (DMU).

Average Financial Awareness Training (AFAT) provided to the stakeholders of PACS in a district. We considered percentage of members who obtained this service from a district PACS and take that percentage value as the input variable for that specific district (DMU).

Average Agricultural Support (AAS) provided to the stakeholders of a PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the input variable for that specific district (DMU).

Average Agricultural Allied Service Support (AAASS) provided to the stakeholders of a PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the input variable for that specific district (DMU).

Average Social Support (ASS) provided to the stakeholders of a PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the input variable for that specific district (DMU).

Average Economic Support (AES) provided to the stakeholders of a PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the input variable for that specific district (DMU).

The two social outcomes considered are:

Average Impact on Members (AIM) who are the stakeholders of PACS in a district. We considered percentage of members who obtained this service from a district PACS and took that percentage value as the output variable for that specific district (DMU).

*Average Impact on Third Sector (AIT) unit SHG/LHG*who are the stakeholders of PACS in a district: We considered percentage of members who obtained this service from a district PACS and took that percentage value as the output variable for that specific district (DMU).

Table 1: Show the average value of all the independent and dependent variable of DEA model different district

Sl No	District	Independent Variables						Dependent Variable	
		AFS	AFAT	AAS	AAASS	ASS	AFS	AIM	AIT
1	Puruliya	56	59	45	52	61	54	74	68

2	Malda	67	69	68	74	58	55	65	81
3	Haora	75	86	75	65	71	65	75	73
4	Hugli	89	75	65	78	85	85	78	86
6	Darjiling	69	72	56	45	52	61	75	78
6	Jalpaiguri	62	58	56	75	52	65	86	75
7	Koch Bihar	84	69	57	65	75	85	56	65
8	Bankura	59	78	57	84	59	65	75	68
9	Birbhum	78	81	75	68	78	88	78	86
10	PurbaMedinipur	68	85	65	58	75	74	84	56
11	PaschimMedinipur	59	86	54	58	75	65	66	58
12	Murshidabad	65	69	65	62	75	74	84	68
13	Nadia	89	74	65	67	84	68	74	67
14	North 24 Parganas	75	75	84	65	62	64	61	65
15	Barddhaman	95	89	76	78	84	89	91	92
16	South 24 Parganas	86	68	87	65	65	66	85	75
17	DakshinDinajpur	78	78	68	65	75	74	77	87
18	Uttar Dinajpur	65	75	75	65	66	68	69	81

***Source*:** Author's calculation on the basis of field survey.

Table 2: Correlation among the all the independent and dependent variable of DEA model

	AFS	**AFAT**	**AAS**	**AAASS**	**ASS**	**AFS**	**AIM**	**AIT**
AFS	1							
AFAT	0.293	1						
AAS	0.545	0.347	1					
AAASS	0.295	0.123	0.252	1				
ASS	0.644	0.557	0.216	0.194	1			
AFS	0.654	0.429	0.251	0.343	0.747	1		
AIM	0.171	0.087	0.142	0.172	0.156	0.249	1	
AIT	0.447	0.861	0.345	0.377	0.126	0.365	0.332	1

***Source*:** Author's calculation on the basis of field survey.

As all the variables in table 2, show low correlation with the other variables and hence we can consider there has no multi-co linearity among the data set and we can apply for DEA.

Data Envelopment Analysis

According to the Charnes, Cooper and Rhodes [5], "DEA is a mathematical programming method that provides a single measure of efficiency with the use of multiple inputs and multiple output information and results in a frontier which represents the best practice of decision making units (DMUs). DEA methodology was first introduced by Charnes, Cooper and Rhodes in 1978 (CCR) [6] and then extended by Banker, Charnes and Cooper in 1984 (BCC). These methodologies are used for estimating technical efficiencies of Decision Making Units (DMU). According to the DEA model, each DMU provides an efficiency score, typically ranging from 0 to 1, where 0 indicates inefficient DMU and score is equal to 1 mean efficient DMU. Therefore by using DEA efficiency frontier we can improve the inefficient DMU by increase in inputs and outputs to reach the efficiency frontier.

The DEA model developed by the Charnes, Cooper and Rhodes in 1978, which assumes constant returns to scale (CRS), is written as:

Objective function

$$\eta_i^{CRS} = \max \eta \quad \text{(i)}$$

Subject to,

Output constraint

$$\sum_{i=1}^{I} \theta_i y_{qi} \geq \eta y_{qi}, (q = 1,2,3,\ldots,Q)$$

Input constraint

$$\sum_{i=1}^{I} \theta_i x_{li} \leq x_{li}, (l = 1,2,3,\ldots,L)$$

$$\theta_i \geq 0, (i = 1,2,3,\ldots,I)$$

Therefore the BCC model developed by the Banker, Cooper and Rhodes in 1984, which assumes variable returns to scale (VRS), is written as:

Objective function

$$\eta_i^{VRS} = \max \eta \quad \text{(ii)}$$

Subject to,

Output constraint

$$\sum_{i=1}^{I} \theta_i y_{qi} \geq \eta y_{qi}, (q = 1,2,3,\ldots,Q)$$

Input constraint

$$\sum_{i=1}^{I} \theta_i x_{li} \leq x_{li}, (l = 1,2,3,\ldots,L)$$

$$\sum_{i=1}^{I} \theta_i = 1, \theta_i \geq 0, (i = 1,2,3,\ldots,I)$$

DEA analysis is carried out at district level data collected from the sample observation in the field study. In order to find out the maximum impact by the PACS to their stakeholders on the available resources they have and also to quantify the performance of PACS each district in West Bengal. In order to make a closer look into the strategies for different DMU, especially those districts are inefficient in terms of performance towards the development of third sector, different weight of each inputs and output are assigned to each district. In comparisons to efficient DMU, on the basis of the weighted priority, inefficient DMU give

[5] Charnes A., Cooper W.W., Rhodes E. (1978) Measuring the Efficiency of Decision-making Units, European Journal of Operational Research 2(6): 429-444.

certain degree of priority to create conducive environment to enhance the performance to achieve the efficient frontier. According to the Wang and Chin (2010) [7] proposed a neutral DEA model for the cross-efficiency evaluation and extended to cross weight evaluation where each DMU do not required any difficulties to decide the weight and formulations. The basic idea of the cross efficiency method that alleviates the weak discrimination of the classic DEA model by using two stages: In the first stage, the classic DEA analysis is performed, and the optimal weights of inputs and outputs are calculated for each DMU. In the second stage, a suitable set of weights are allocating to the efficient DMU to find out the cross efficiency of best performing DMU and find out average scoring for their ranking.

Therefore by applying this neutral cross efficient DEA model we can evaluate the cross efficiencies of efficient DMUs. Therefore to achieve more logic results we applied the neutral cross efficiency just for the efficient DMUs and ranked them and used to prescribe different policy.

Results and Discussions:

This study has used constant returns to scale of DEA. The efficiency score obtained using DEA are listed in table 3. On the basis of DEA analysis, 5 efficient districts, among the 18 district in west Bengal, average scores of which are equal to 1 have been identified. And rests of the district are inefficient with average score less than 1. The average efficiency score of 18 DMU is 86.84%.

Purulia has been identified as 66.86 % efficient which is below the average performance. Therefore, using the current available inputs, Purulia could enhance its performance by 34.14% to achieve the efficient frontier by putting maximum emphasis on average financial services which has been assigned the highest priority in the DEA weighted model.

Therefore, it can be concluded that inefficient DMUs should focus on creating supportive environment for the 'highest priority variable 'as a means to improve the overall performance of PACS of the identified districts.
Neutral cross-efficiencies are computed for 5 identified efficient DMUs by using neutral DEA model (iii). The results are shown in table 4. According to the neutral cross efficiencies in table4, DMU 15 is the most efficient district, whereas DMU 04 is the second most efficient followed by DMU 13 , DMU16, DMU09.

Conclusion:

On the basis of DEA analysis it is observed that the performance of PACS of Bardhaman district is the best with an average score 0.9169.Hooghly district ranks second with average score of 0.9076.The inefficient districts Purulia has average score of 0.6686. It should create an environment for both the PACS and Self Help Group (SHG) to improve their work culture to upgrade their performance in near future.

[7] Wang, Y.M., & Chin, K.S., (2010) A neutral DEA model for cross-efficiency evaluation and extension. Expert systems with applications, 37, 3666-3676.

Bibliography:

Charnes A., Cooper W.W., Rhodes E. (1978) Measuring the Efficiency of Decision-making Units, *European Journal of Operational Research* 2(6): 429-444.

Sexton,T.R.., Silkman, R.H. , & Hogan, A,J., (1988) , Data Envelopment analysis: critique and extension. In Sexton,T.R.., Silkman, R.H. (Ed.) , Measuring efficiency: An assessment of data envelopment analysis. San Francisco, CA: Jossey-Bass.

Wang, Y.M., & Chin, K.S., (2010)A neutral DEA model for cross- efficiency evaluation and extension. Expert systems with applications, 37, 3666-3676.

Banerjee, T, "Economic Impact of SHGs-A Case Study". (2009): *Journal of Rural Development*, Vol. 28, No. 4 pp. 451-461.

Salamon, L. and H. Anheier (1997) "The civil society sector" Society, 34:60-65. Seibel, W. (1990) "Organizational behavior and organizational function: toward a micro-macro theory of the third sector" in H. Anheier and W. Seibel (eds.) The Third Sector, Comparative Studies of Nonprofit Organizations, Walter de Gruyter, New York.

Ganley, J.A. and Cubbin, J.S. 1992, *Public Sector Efficiency Measurement: Applications in Data Envelopment Analysis*, North Holland,Amsterdam.

A , Chilingerian, J. A. and Sherman, H. D. 1990, 'Managing physician efficiency and effectiveness in providing hospital services', *Health Services Management Resources*, vol 3, no. 1, pp 3–15.

Birchall J and Simmons R, "Co-operatives and poverty reduction: Evidence from Sri Lanka and Tanzania", Co-operative College, 2009.

Borzaga, C. & J. Defourny, eds. (2001), "*From Third Sector to Social Enterprise*" The Emergence of Social Enterprise, London and New York, Routledge, 1-18

Sa-Dhan (2006) "Transaction costs in group microcredit in India" Management Decision

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Hans Dieter Seibel &Harishkumar R Dave, " Bank Transaction Costs in india's self Help Group Banking program"Micro Credit Innovations Department, National Bank for Agriculture and Rural Development, Thompson Press, Mumbai 2002.

Table 3: Efficiency scores of different DMU (district) being analyzed by classic DEA and their observed strategy in terms of priority given on the assessment variables by the DEA model.

DMU	District	Efficiency Score	Peers Weight	Priority focus of input weights and output weights							
				Input weights						Output weights	
				AFS	AFAT	AAS	AAASS	ASS	AES	AIM	AIT
1	Puruliya	0.6686		0.61	0.51	0.60	0.59	0.58	0.15	0.01	0.56
2	Malda	0.7487		0.56	0.65	0.35	0.50	0.56	0.78	0.56	0.32
3	Haora	0.9426		0.75	0.86	0.78	0.88	0.65	0.00	0.75	0.88
4	Hugli	1	37.39%								
6	Darjiling	0.8476		0.65	0.85	0.65	0.47	0.81	0.92	0.45	0.62
6	Jalpaiguri	0.8346		0.45	0.32	0.53	0.75	0.84	0.45	0.65	0.85
7	Koch Bihar	0.7869		0.54	0.65	0.56	0.84	0.65	0.75	0.85	0.65
8	Bankura	0.7268		0.65	0.75	0.84	0.75	0.84	0.65	0.75	0.64
9	Birbhum	1	16.12%								
10	PurbaMedinipur	0.8966		0.75	0.85	0.65	0.78	0.84	0.65	0.84	0.75
11	PaschimMedinipur	0.9264		0.85	0.65	0.75	0.84	0.91	0.86	0.78	0.68
12	Murshidabad	0.8746		0.75	0.84	0.68	0.78	0.87	0.68	0.91	0.91
13	Nadia	1	4.44%	0.78	0.68	0.85	0.68	0.69	0.65	0.78	0.68
14	North 24 Parganas	0.7848		0.58	0.68	0.92	0.45	0.65	0.56	0.35	0.28
15	Bardhaman	1	38.27%								
16	South 24 Parganas	1	3.77%								
17	DakshinDinajpur	0.7846		0.84	0.81	0.65	0.75	0.68	0.58	0.68	0.78
18	Uttar Dinajpur	0.8214		0.65	0.85	0.68	0.75	0.69	0.84	0.78	0.59
Average Efficiency		0.8684	100%								

***Source*:** Author's calculation on the basis of observed data

Table 4: Neutral cross-efficiency scores and ranking DMUs:

DMU	District	Targeted DMU					Average Cross efficiency	Rank
		4	9	13	15	16		
		Hugli	Birbhum	Nadia	Barddhaman	South 24 Parganas		
4	Hugli	1	0.8664	0.9866	0.8746	0.8126	0.9076	2
9	Birbhum	0.8669	1		0.8476	0.8646	0.7166	5
13	Nadia	0.8647	0.8678	1	0.8246	0.8426	0.8779	3
15	Bardhaman	0.8468	0.8968	0.9178	1	0.9246	0.9169	1
16	South 24 Parganas	0.8476	0.8126	0.8126	0.7864	1	0.8616	4

***Source*:** Author's calculation on the basis of observed data