Volume 1. No. 1 page 24-36

ECONOMY POLITY ENVIRONMENT

An International Peer-reviewed Journal of Social Studies

Tanks in Rural Purulia and Bankura: Measurement of Efficiency

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Abstract

Tanks have played crucial role as a source of irrigation in different regions of India. Though a number of tank related studies were conducted in Southern and central Indian states eastern parts of the country has hardly been covered for a prolonged period of time. The present paper is a diminutive effort to study the efficiency of tanks in two most tank-dependent districts of West Bengal. In these two districts, twelve tanks were selected for the purpose of study. Relative efficiency of selected tanks has been measured using Data Envelopment Analysis. The study finds out that some tanks are more productive than the others but neither tank size nor frequency of tank rejuvenation are important for efficient working of a tank.

Keywords: *Consumption expenditure, Economic reforms, Consumption pattern*

Received on August11, 2018; Revision received: November 09, 2018, Accepted: December 10, 2018

Introduction

Tanks are important source of water for livelihood sustenance in rural India. Tanks are earthen structures that capture water from various sources and store it to supply to people of its surroundings for various uses. Tanks can be found in early publications like the ‘Agricultural Statistics of India’ published by the Government of India in 1924, where ‘tanks’ refers to a particular type of dammed reservoir, formed by enclosing depressions across the valley of small rivulets and streams to intercept water during rains. In 1961, a committee incorporated ‘jhil’ and ‘talab’ in tank category while recommending for their improvement (Sengupta, 1993). Among the storage structures, popularly referred as tanks are known in various local names in different regions, such as ‘pokhar’, ‘talab’, ‘jhil’, ‘sagar’, ‘beel’ etc. can be seen in the area. Tanks can be both natural and man-made. It can be large or small, linked with other water sources or can be isolated. Varieties can also be seen in terms of ownership such as private tanks, government owned tanks and common property tanks or community tanks. Management of tank is important that needs study in the backdrop of complex social relations and human behaviour with economic sustenance. Main purpose of tank, in its early days of life was to support agriculture by providing irrigation in time of water scarcity. But due to its prolong existence, tanks were more than that of irrigation, which, gradually became a part of rural life. Tanks are easy source of water in various corners of the country, easy inmanagement compared to other large source of irrigation, provides multiple benefits and helps in groundwater recharge. The performance of a tank can be measured through the productivity of agricultural and allied development is relatively new in development literature. It primarily captures the aspect of intergenerational equity. Following sustainable development, it is a well-known fact that economic activity significantly depends upon natural resources. This is true for those economies which have large agricultural sector and majority of the population is engaged in agriculture and allied activities.

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Hence, the performance of village tanks can be judged through their performance efficiency over time.

Section 2: Tank Performance and Efficiency: Past Studies

Performance of tanks has been an important indicator that shows how well the tank is serving the rural community. Tank performance has been measured in different ways in various studies. Tank performance has been measured in different manners such as terms of the area irrigated by tanks and crop yield (Palanisami & Easter, 1982), the rice produced and equity in income through productivity ratio (Palanisami & Flinn, 1988), ratio of actual irrigated area by the tank to the registered area that tank can irrigate, i.e. actual command area to registered command area (Balasubramanian & Govindasami, 1991), adjusted tank performance as the tank irrigated area less the area irrigated by wells in the tank command above the threshold limit (Palanisami & Balasubramanian, 1998; Palanisami & Easter, 2000), frequency of tank fill in an year has been used as a proxy of tank performance by Sharma (2003). A completely different approach has been adopted by Dick and Palanisami (2001) where they have constructed a tank performance index using the responses on use share from the respondents. The performance and efficiency is determined by many factors. Importance of them differs over time and across regions, even from tank to tank (Balasubramanian & Govindasamy, 1991). Generally, the factors which play important role in determining tank performance area tank hydrology and run off, variation in rainfall, encroachment and siltation of the tank catchment area, condition of tank bed and bund, condition of outlet channels, mobilization of the resources, social forestry, fish culture, expenditure on operation and maintenance, land and water charges, water distribution and conflicts, development of groundwater management, farmer's participation in tank management, which have broadly been distinguished in three categories such as socio-economic, physical and institutional. Different studies have emphasised on different factors. Palanisami and Easter (1982) pointed to the importance of technical and physical attributes of tanks, decision-making arrangements and the patterns of interaction. Technical factors of tank like length of the bundh, tank size, submerged area, technical relationship of tank components and the utilization of command area received importance in the study conducted by von Oppen and Subba Rao (1987) in Andhra Pradesh and Maharastra. As studied by Balasubramanian and Govindasami (1991), the factors which are important determinants of tank performance are maintenance expenditure, water stored per hectare, presence or absence of Water Users Association, variation in farm size and encroachment in tank foreshore area. Palanisami and Balasubramanian (1998) emphasised on physical and management related attributes like resources mobilization, well density, encroachment and farmer's participation in tank maintenance, whereas, factors like tank hydrology and run off, encroachment and siltation, resources mobilization, social forestry, expenditure on operation and maintenance, charges for land and water, water distribution and conflict obtained importance in the study conducted by Palanisami and Easter (2000). In another study, Sharma (2003) has examined the tank performance and emphasised on the number of tube wells and dug wells in tank command as decisive factors (Sharma, 2003). The review by Dayton-Johnson (2003), captured vast literature including research in sociology, political science, anthropology, engineering and economics to understand the institutions governing the irrigation systems within a community. The review tries to assess measures of irrigation system performance, co-operation and its importance. The author concludes with a demand for more structured qualitative measures of group performance (Dayton-Johnson, 2003). Tanks as a subject of study have never gained importance in the eastern parts of India, probably due to the existence of Ganges and its tributaries in one hand, and, due to its enriched ground water resources on the other. Section three provides a glimpse of the various sources of water in West Bengal.

Section 3: Water Resources in West Bengal

West Bengal has been considered from the colonial period to be situated in the "water-blessed" region. The state captures 2.7 percent of the total landmass of the country and covers about 8 percent of the country population. West Bengal is endowed with 7.5 percent of the country's available fresh water resources. It is rich in agriculture and appears within the top three crop producing states in the country. For a prolonged period of time agricultural sector of the state receive its water from the river

Ganges and its tributaries, directly and indirectly through canals fed by these rivers. But micro-level problems of water availability created a sense of uncertainty in farmers' mind. Increasing food demand and introduction of High Yielding Varieties seeds to meet up the higher requirement created more pressure on groundwater resources in the state.

Table 1: Percentage of Area Irrigated by Different Sourcesin West Bengal

Year	Canal	Tank	Groundwater	Others
1997-98	37.84	13.04	15.98	33.12
1998-99	33.10	11.39	24.17	31.34
1999-00	41.36	10.72	27.77	20.14
2000-01	36.18	11.32	30.92	21.31
2001-02	33.63	9.75	39.90	16.61
2002-03	34.39	9.48	40.32	14.69
2003-04	38.87	10.35	30.55	20.23
2004-05	36.08	9.53	35.95	18.44
2005-06	37.19	7.59	36.49	18.73
2006-07	35.29	7.37	40.05	17.29

Source: District Statistical Handbook Series, Bureau of Applied Economics and Statistics, Government of West Bengal till 2011

The above table shows that except ground water all other sources of irrigation have gradually lost their importance. But in case of both canal and tank irrigation the percentage of decline is not significant. On the other hand, the proportion of land irrigated by the ground water resources has been almost tripled. Most of the small water bodies are concentrated in the districts of Purulia, South 24 Paraganas, Bankura, and partly in the districts of South Dinajpur, Midnapur and Hooghly. Over the years, the number of tanks increased whereas area irrigated by them declined.

Apart from canals and wells, West Bengal is also fed by tank and small water bodies lift irrigation system and open dug wells. Even in the past, irrigation water was seen to be provided from ponds and wells. But modern irrigation system has put importance on the canal and groundwater (particularly tube well irrigation has revolutionized) due to its terrainian suitability for canal design. According to the official data all shorts of storage devices are supposed to provide lift irrigation. Over the years on average canal irrigation has played a prominent role in providing water for irrigation in West Bengal. Inundation canal system was an important and extra ordinary system that the state had from long back. Sir William Willcocks, the British irrigation expert was quite impressed by the ancient irrigation system prevailed in West Bengal. In fact it was argued by Dr. Willcock that the system of overflow irrigation was prevailing in the country for about 1000 years, which was neglected from the period of Afghan-Maratha War of the 18th Century and the British conquest of India followed by. The neglect had ultimately ended the overflow irrigation system forever. Apart from canals, tanks and ponds are also quite old structure that provided water for various purposes including irrigation. Both above and below surface irrigation tanks can be found in West Bengal. In upland area or adjacent to it the above-surface gravity tanks, known as "Bandh" can be found. Tanks are not evenly distributed in West Bengal. Large number of tanks can be found in North 24 Paraganas (134377), followed by East Midnapore (119200), Hooghly (18633) (District Statistical Handbook, 2003, Govt. of West Bengal). But as a whole these tanks irrigate a very small proportion of total irrigated area. Due to topographic condition and variability in weather districts of Hooghly, Coochbehar, Malda, Midnapore and North Dinajpur mainly use groundwater for irrigation purpose. On the other hand, Purulia, East Midnapore, parts of Bankura, South Dinajpur and Howrah rely on tanks for irrigation and other purposes. Canals mainly feed the districts of South 24 Paraganas, Hooghly, Jalpaiguri, parts of Bankura, and Birbhum.

Table 2: Change in Number of Tanks and Total Area Irrigated by Tanks in West Bengal

Year	Number of Tanks in West Bengal	Area Irrigated by Tanks
1998-99	257668	370220
1999-00	439340	312630
2000-01	470524	325240
2001-02	473128	296650
2002-03	449659	288630
2003-04	449649	266300
2004-05	440565	266042
2005-06	392808	245093
2006-07	403962	247856

Source: District statistical Handbook Series, Bureau of Applied Economics and Statistics, Government of West Bengaltill 2011

Table 2 shows that there is a gradual increase in overall tank structure prevailing in West Bengal for the consecutive five years time period with two patches. First in the period 1999-2000, the number of small water bodies has increased significantly and in the period 2002-03 the number declined by a significant amount. This may well be reasoned that due to improper care and problem related to the management of water bodies many of them become defunct. Hence the similar movement has been witnessed for area irrigated by the tanks in West Bengal.

Table 3: Tanks in Three Most Tank-fed Districts compared to (in Hectares) West Bengal

Year	Average Area Irrigated by each Tank in three Districts			Average Area Irrigated by each Tank in the State
	Purulia	Bankura	24 Paraganas	West Bengal
1997-98	2.88	2.37	0.23	1.51
1998-99	3.47	2.00	0.21	1.58
1999-00	3.14	1.98	0.21	0.75
2000-01	3.02	1.85	0.24	0.73
2001-02	2.41	1.69	0.24	0.66
2002-03	2.45	1.89	0.26	0.71
2003-04	2.92	1.82	0.27	0.59
2004-05	2.95	2.20	0.47	0.60
2005-06	2.99	2.25	0.21	0.62
2006-07	3.02	2.28	0.25	0.61

Source: Calculated from various District statistical Handbook Series, Bureau of Applied Economics and Statistics, Government of West Bengal

Table 3 shows on average districts of Purulia and Bankura depends more on tanks and therefore, the average irrigated area per tank in these two districts is much higher than the state average. On the other hand, in spite of the prevalence of large number of tanks and ponds in South 24 Paraganas, the average irrigated area by each of them are very low, fact much lower than state average. It is also clear that initially the average area irrigated per tank increases in Purulia in 1998-99 but declined thereafter. The case is not similar for Bankura, where average area irrigated by a tank declines from the initial period. For South 24 Paraganas, the average tank irrigated area maintained more or less same position.

Section 4: Methodology and Selection of the Study Area

The study has mainly been conducted in the state of West Bengal. The objective of study was to examine the relative performance efficiency of village tanks in West Bengal. Hence, the districts namely Purulia and Bankura, depend significantly on tanks for irrigation and fish cultivation has been selected for the purpose of study. Purulia is one of the most poverty-driven districts, not only in West Bengal, but also in India. It has a geographical area of 6259 square kilometers with a population of 2536516 (as per 2001 census). Majority of the population lives in its villages (89.93 percent) whereas only 10.07 percent of people live in urban area. The district has divided in 20 blocks. As per the 2001 census, the number of inhibited villages in the district is 2468. The annual average rainfall is 1220 mm, which takes place in 12 to 15 rainy days. Total cropped area in the district is 331790 hectares (2004-05) with only 19.82 percent of irrigated area to cultivated area. The soil is rich in organic matters and therefore, fertile but the limited water availability is responsible for lower percentage of irrigated area. The average literacy rate (55.60 percent) is relatively high in the district compared to the state average (68.64percent). As per the 2001 census, 44.40 percent of the total population constitutes the total work force. The scarcity of water in the region increases the importance of small tanks and ponds in the daily life of the people. The district is mainly fed by canal and tank water.

Table 4: Area Irrigated by Different Sources in Purulia (Percentage)

Year	Canal Irrigated Area	Tank Irrigated Area	Groundwater Irrigated Area	Other Source Irrigated Area
1997-98	47.87	36.74	10.36	5.02
1998-99	33.45	37.82	13.16	15.55
1999-00	35.90	35.29	6.29	22.51
2000-01	38.89	39.58	1.45	20.06
2001-02	46.28	43.71	2.12	7.88
2002-03	45.72	43.87	1.96	8.44
2003-04	44.09	41.18	6.05	6.96
2004-05	45.35	42.22	6.15	4.85
2005-06	41.99	39.25	4.74	14.01
2006-07	40.53	40.56	4.84	14.07

Source: District statistical Handbook Series, Bureau of Applied Economics and Statistics, Government of West Bengal till 2011

Table 4 shows the different sources of irrigation prevailing in Purulia district. The eight year data reveals that canal irrigated area has marginally declined over this period, whereas groundwater irrigated area and area irrigated by other sources both have declined significantly. But, on the other hand, tank irrigated area has increased over time and also by substantial percentage point. Therefore, it is quite clear that tanks have gained importance in the rural life and is contributing more in agriculture. Bankura comes under the same agro-climatic zone. The total area covered by the district is 6880 square kilometres, with a population of 3192695 (as per 2001 census). Majority of the population of the district lives in the rural area (92.63 percent) and only 7.37 percent of people live in urban area (2001 census). Bankura has 3577 inhibited villages as per 2001 census. The literacy rate in Bankura (63.4 percent) is higher than Purulia (55.60 percent), as per the 2001 census. The weather is hot and semi-humid like Purulia. Annual average rainfall in the district is 1211 mm per year. The total cropped area of the district is 338180 hectares (District statistical Handbook; 2004-05), amongst which 61.68 percent comes under irrigation. On average, 44.7 percent of the total population constitutes total work force. The area under irrigation is significantly higher in Bankura than Purulia may, due to be the presence of underground water.

Table 5: Area Irrigated by Different Sources in Bankura (Percentage)

Year	Canal Irrigated Area	Tank Irrigated Area	Groundwater Irrigated Area	Other Source Irrigated Area
2000-01	51.74	14.15	27.08	7.02
2001-02	57.89	11.42	25.32	5.36
2002-03	57.73	12.69	23.99	5.58
2003-04	53.78	13.19	26.70	6.31
2004-05	52.67	15.50	24.26	7.56
2005-06	64.44	12.10	18.30	5.15
2006-07	65.12	12.08	17.79	5.00

Source: District statistical Handbook Series, Bureau of Applied Economics and Statistics, Government of West Bengal

Table 5 shows that canals are the most important source of irrigation in Bankura district, followed by groundwater and tanks. Among different groundwater irrigation structures shallow tube wells play important role. Hence, it portrays that on average the district do not have sufficient groundwater back up. Considering the time series data for the available eight years, it can be argued that over time canal irrigation has increased up to 2002-03 but declined thereafter. For groundwater also the area irrigated has declined over time whereas area irrigated by tanks has increased marginally over the years. The increase in net irrigated area over the last eight years shows significant increase in tank irrigation in the district. Hence, it is clear that in the districts of Purulia and Bankura tanks are very important source of water.

In the second stage, again the most tank-irrigated two blocks have been selected from each district. Among the blocks of Purulia, two, namely, Para (with 3362 hectares) and Purulia II (with 1122 hectares) have been selected depending upon the area irrigated by tanks as a whole. Similarly, in Bankura, Gangajalghati with a tank irrigated area of 7000 hectares and Ranibandh with a tank irrigated area of 5600 hectares have been selected for the purpose of study. In the next stage three villages per block has been selected in such a way that each of the selected village have one common tank within the village. From two districts and four Blocks twelve villages have been selected for the purpose of study. The selected villages in Purulia district are Amjora, Majidi, Layadi, Lipania, Phusra and Mahal. On the other hand, selected villages in Bankura district are Balidiha, Pirrabani, Tilasuli, Khejuria, Rajakata and Dhanjhar.

Section 4.1: Method of Analysis

The important objective of the present study is to calculate the efficiency of the tanks on the basis of the measurable quantitative output, i.e. money value of the amount of crop produced in the tank command and the money value of the amount of fish produced in the tank for the current year. Standard tabular representation of data has been used to examine the objective and test the related hypothesis. Performance efficiency can be measured using standard techniques through the application of linear programming. Data Envelopment Analysis (DEA) is a technique that measures the relative efficiency of a set of Decision Making Units (DMU). It is assumed that the DMUs employ identical inputs and produce identical output. DEA technique was first introduced by Farrel (1957) and was popularised by Charnes, Cooper and Rhodes (1978) through their article titled “Measuring the efficiency of decision making units”. The basic idea of measurement of efficiency relies on the total output-total input ratio.

There can be different scenarios of the measurement. First, relative efficiency can be measured for DMUs that use single input and produce single output. Otherwise, a DMU can also use more than one input and can produce single output. Besides, there are DMUs that use multiple inputs and produce more than one output. The estimates of efficiency are relative to the best performing DMU or DMUs. Such best performing DMUs are assigned the value one or 100 percentage point, whereas the values for the others vary between 0 and 100 percent compared to that of the best (Ramanathan, 2003).

Section 5: Analysis of Data

Performance and efficiency of tanks are the two significantly important concepts required to attain sustainable development. Tanks provide several benefits such as water for irrigation, fishery, bathing and washing and also groundwater recharging. Among these benefits irrigation and fish cultivation related performance can be measured in terms of the money value of produced crop output and money value of fish yield. The objective of this paper is to measure the relative efficiency of village tanks on the basis of the above-mentioned outputs.

Table below focuses on the measurable benefits through irrigation and fishery.

Table 6 shows the tank productivity which is measured in terms of the value of cultivation per acre of irrigated area. This also indicates efficiency of tanks. In the table, column 2 presents the actual area of crop production for each tank, i.e. actual cultivated area whereas column 3 represents the money value of agricultural production for each of the tanks and the final column represents the value of production (per acre of tank water) for each tank. Table 8 reveals that per acre of tank water produces more or less similar amount of crop. The small difference is may be due to variation in crop composition in different villages. Tank in Lipania has the highest productivity in terms of per acre of tank water (Rs. 31630), followed by Balidiha (Rs. 31515), Amjora (Rs. 30470) and Tilasuli (Rs. 30330). Majhidi and Lyadi have the productivity of Rs. 19925 and Rs. 19762, which are the lowest among the sample tanks. On average, the productivity of per acre tank water is Rs. 27275.

Table 6: Village-wise Total Cultivated Area with Value of Crop Produced (Per Acre of Tank)

Village Tank Name	Cultivated Area (acres)	Total Value of Yearly Production (Rs.)	Value of Production per acre of Tank (Rs.)
Amjora	12.97	101465	30470
Majhidi	0.49	99625	19925
Layadi	1.98	85570	19762
Lipania	9.24	240388	31630
Mahal	825	9001300	25718
Phusra	5.94	123648	26880
Balidiha	82.5	63030	31515
Pirrabani	132	175875	26645
Tilasuli	26.4	121320	30330
Khejuria	16.5	47434	26763
Dhanjhar	29.7	44832	29646
Rajakata	66	80289	28020

Source: Author's Survey Data, 2009

But it is not only the absolute efficiency that always matter. The relative efficiency of tanks has been measured with the help of DEA technique. Here output-oriented DEA has been used to calculate the relative efficiency of the tanks. The standard DEA model has been run twice, first with two outputs, namely the actual command area irrigated by tanks and the amount of fish production per annum. In the second phase, another output has been added with that namely the number of uses provided by the tank to villagers. In both the models, same set of inputs have been used which are volume of water in the tank that can be used for irrigation, fish cultivation and other non-measurable but important household activities. Similarly, in case of outputs, actual command area irrigated by each of the tanks has been considered as output. The other output has been taken as the amount of fish produced in each of the tanks.

Using the data in table 7 the CRS output-oriented results have been generated (Table 6.6) for two outputs and two inputs. It is to be noted that only those have been used as inputs and outputs which are clearly measurable. Similarly, table 7 provides the input matrix with three-output and two input case, whereas, table 8 shows the result for the three-output efficiency results.

Table 7: Data for CRS DEA (with two outputs and two inputs)

DMU	Crop Yield per annum (Rs.) (Y_1)	Fish Yield per annum (Rs.) (Y_2)	Volume of Water (cubic meters) (X_1)	Investment for Fish Cultivation and Yearly Maintenance (Rs.) (X_2)
Amjora	184150	5000	70237.6	18000
Majhidi	6900	15000	94039.9	15000
Layadi	27000	4000	79666.3	7000
Lipania	152563	100000	127038.8	90000
Mahal	3552500	0	11538521	40000
Phusra	83538	20000	43461.7	17000
Balidiha	1186250	0	74951.1	12000
Pirrabani	1759688	100000	276135.5	40000
Tilasuli	325000	35000	150395.3	10000
Khejuria	229937	10000	69675.9	10000
Dhanjhar	216000	0	70266.6	2000
Rajakata	887250	100000	11983	15000

Source: Calculated from Author's Survey Data, 2009

Table 8 shows the relative efficiency of tanks. Here, both CRS and VRS has been applied to measure the relative efficiency as none of the tanks are operating at their optimal level considering both crop yield and fish yield. The DEA model shows that tanks of Mahal, Balidiha, Dhanjhar, Rajakata are performing best among the sample tanks followed by the Amjora village tank (CRS value 0.926), on the other hand, tanks of Layadi (0.086), Majhidi (0.150), Phusra (0.176) and Khejuria (0.258) are the worst performing tanks. The variation in tank efficiency depends on factors such as tank size and frequency of tank rejuvenation as proxy of tank condition. The table below shows the factors mentioned above for the sample tanks.

Table 8: CRS Output-Oriented DEA Results (With two outputs and two inputs)

DMU	CRS TE	VRS TE	SCALE	
Amjora	0.926	0.963	0.775	Drs
Majhidi	0.150	0.150	1.000	-
Layadi	0.086	0.104	0.824	Irs
Lipania	0.167	0.371	0.167	Drs
Mahal	1.000	1.000	1.000	-
Phusra	0.176	0.200	0.882	Drs
Balidiha	1.000	1.000	1.000	-
Pirrabani	0.529	1.000	0.529	Drs
Tilasuli	0.530	0.569	0.932	Irs
Khejuria	0.258	0.262	0.985	Drs
Dhanjhar	1.000	1.000	1.000	-
Rajakata	1.000	1.000	1.000	-
Mean	0.502	0.621	0.841	

Source: Calculation based on Author's Survey data, 2010

Table 9 portrays the productivity of sample tanks for per acre of water spread area for both crop and fish yield taking together. The last column of the table shows the frequency of rejuvenation for each sample tank within a span of twenty years. The productivity column shows significant variation among the sample tanks with Balidiha, providing highest productivity followed by Rajakata, Pirrabani, Khejuria, Dhanjhar, Tilasuli and Amjora. On the other hand, Majhidi, Mahal and Layadi have comparatively lower productivity. Following the last column, it can be argued that except the Amjora tank, other tanks have not been rejuvenated properly leading to improper tank condition. The table also points to the fact that role behind tank productivity.

Table 9: Tank Size, Tank Condition and Total Output of the Sample Tanks

Village Tank	Crop and Fish Yield per annum (Rs.)	Tank Size (acre)	Tank Productivity (per acre of tank spread area)	Frequency of Tank Rejuvenation in Last Twenty Years
Amjora	189150	3.33	56801.80	2
Majhidi	21900	5.00	4380	0
Layadi	31000	4.33	7159.35	1
Lipania	252563	7.6	33231.97	0
Mahal	3552500	500	7105	0
Phusra	103538	4.6	22508.26	0
Balidiha	1186250	3.00	395416.66	1
Pirrabani	1859688	6.6	281770.91	1
Tilasuli	360000	4.00	90000	1
Khejuria	239937	1.6	149960.62	1
Dhanjhar	216000	1.6	135000	0
Rajakata	987250	3.00	329083.33	1

Source: Calculation based on Author's Survey data, 2010

Section 6: Conclusion

The studies on tank irrigation in Eastern India are very less in number. The results of the study on tank in West Bengal bear important policy implications. Table 6.1 shows that productivity of village tanks is very close to each other and do not vary on the basis of their physical or institutional condition. This may be due to the type of crop cultivation taking place. The role of physical and institutional factors that affect tank performance has been captured through the application of similarity measure, where tanks have clustered into two groups on the basis of their similarity. Data

Envelopment Analysis has been used to measure relative efficiencies of tanks where two outputs such as fish output and yearly crop output and two inputs like volume of water and cost of tank maintenance have been taken to measure the efficiency. The result shows that tanks of Mahal, Balidiha, Dhanjhar, Rajakata and are Amjora are performing well whereas Layadi, Majhidi, Phusra and Khejuria tanks are relatively inefficient. The reason may be that the first set of tanks has been better managed compared to the second set of tanks obtained in the DEA CRS model which has later been confirmed by the per acre tank productivity, except Mahal Tank. The reason may be that the big Mahal tank was excavated particularly for irrigation purpose and fish cultivation is not allowed in it.

Efficiency and performance of tanks can be increased by directly involving all tank users. A village-level tank management committee may be constituted to take care of tank for water appropriation and provisioning. Yearly tank maintenance activity should involve the tank users. Moreover, the amount of money collected from leasing out the tanks for fish cultivation should be used for yearly tank repair activities.

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