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Links between Irrigation, Agriculture, Level of Living and Poverty Scenario in West Bengal

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ABSTRACT

An analysis of irrigation, agriculture, level of living and poverty linkages in eighteen districts of West Bengal was carried out. District-wise scenario of irrigation, agriculture, livelihood and poverty revealed with the help of different indices developed for the study. The values of Groundwater Development Index and Composite Irrigation Index were found low to very low for eight districts. Six districts showed high agricultural development while seven and five districts showed medium and low Agricultural Development Index values, respectively. Level of living of eleven and six districts was found medium and low, respectively. Poverty Ratio Index values of nine districts showed very high to high poverty level. The links and/or missing links between irrigation resources, agriculture development, poverty and level of living were explored.

Key words: Agricultural development, irrigation, groundwater development, level of living, rural poverty

INTRODUCTION

Development of irrigated agriculture has been a major engine for economic growth and poverty reduction. Irrigation resources have played a major role historically in poverty alleviation by ensuring agricultural development, expanding livelihood opportunities and employment both on and off the farm. But, the growing scarcity and competition for water are putting the poor in irrigated areas at great risk (Barker *et al.*, 2000). Poverty alleviation has always been an important aim of the governments of developing countries when investing in the development of irrigation infrastructure (van Koppen *et al.*, 2002). A significant contribution (about 60%) from irrigated agriculture has always been to overall agricultural production in India (Planning Commission, 2012). Therefore, because of its yield augmenting impact, irrigation development has always been the priority area of India's agricultural development strategy in the successive five year plans (FYPs) with massive financial support in irrigation sector. Consequently, irrigation potential has increased from 22 million hectare during pre-plan period to 123 million hectare at present making India the world leader in the irrigation sector (Central Water Commission, Government of India, 2012). Irrigation has played a crucial role in agricultural growth and development due to its direct (Hasnip *et al.,* 2001; Hussain and Hanjra, 2003) as well indirect (Narayanamoorthy and Bhattarai, 2004; Narayanamoorthy, 2007) positive impact on the rural economy in India. If irrigation has the potential to produce such profound impacts on agrarian dynamism, why such impacts are not visible in eastern India, where it is needed and has the water resources to sustain intensive irrigation (Shah, 2004). Northern region of India showed better performance both in irrigation and agriculture while eastern region was found to be lagging behind inspite of rich water resource base (Srivastava *et al.*, 2014). In this backdrop, present paper analyses irrigation, agriculture, poverty and living scenario in West Bengal, an eastern Indian state.

METHODOLOGY

Different indices were constructed for assessment of district wise scenario of irrigation, agriculture, poverty and level of living, *viz.* Groundwater Development Index (GWDI), Irrigation Coverage Index (ICI), Composite Irrigation Index (CII), Agricultural Development Index (ADI), Level of Living Index (LLI), and Poverty Ration Index (PRI). Brief account of these indexes are given below:

GWDI considered district-wise gross annual draft (ha-m) out of utilisable groundwater resource (ha-m) and calculated as:

$$GWDI_j = \frac{GWD_j - \min GWD_j}{\max GWD_j - \min GWD_j}$$

Where, GWDj = (gross annual draft of jth district / utilisable groundwater resource of jth district)

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ICI was calculated on the basis of gross irrigated area out of gross cultivated area.

$$ICI_j = \frac{IC_j - \min IC_j}{\max IC_j - \min IC_j}$$

Where, IC_j = (gross irrigated area of j^{th} district / gross sown area of jth district)

CII was calculated averaging GWDI and ICI giving equal weight.

ADI included seven indicators *viz.* % of cultivable land to total land area, % of net sown area to total cultivable area, % of gross irrigated area, cropping intensity, yield of paddy (major crop), food grain production and per ha fertilizer consumption. To depict the district-wise agricultural development disparity scenario, composite Agricultural Development Index (ADI) was constructed by 'Deprivation Method' by using seven agricultural development indicators similar to those given in the Report Planning Commission (planningcommission. nic.in/plans/stateplan).

Composite agricultural development index was calculated as:

$$ADI_j = \frac{\sum_{i=1}^{n} I_{ij}}{\sum_{i=1}^{n} i}$$

Where, ADIj is the index of jth district and equal weight to all the indicators

$$I_{ij} = \frac{X_{ij} - \min X_{ij}}{\max X_{ij} - \min X_{ij}}$$

Where, X_{ij} is the actual value of ith indicator for jth district

min X_{ij} and max X_{ij} are the minimum and maximum value of ith indicator

LLI included 14 variables *viz.* per cent of population above poverty line, literacy rate, per capita food grain production, yield of major crop, per cent of gross irrigated area, per cent of village electrification, women work participation rate, per cent of agricultural laborers to total main workers, per cent of cultivators to total main workers, per cent of industrial workers to total main workers, per cent of main workers to total population, percentage of urban population to total population, agricultural productivity per worker, and backward class (Scheduled Class/Scheduled Tribe) population. To ensure the index values for the selected variables move in same direction the index value was calculated as follows:

Index values for the positive variables like literacy rate, agricultural productivity, *etc* were calculated as:

$$P_{ij} = \frac{Y_{ij} - \min Y_{ij}}{\max Y_{ij} - \min Y_{ij}}$$

While index values of the negative variables like backward class population, poverty ratio, etc were calculated as:

$$P_{ij} = \frac{\max Y_{ij} - Y_{ij}}{\max Y_{ij} - \min Y_{ij}}$$

Where, Y_{ij} is the actual value of i^{th} indicator for j^{th} district

min Y_{ij} and max Y_{ij} are the minimum and maximum value of i^{th} indicator

On the basis of the index value of each selected indicator a composite index was derived giving equal weight and there by district-wise LLI value was calculated as:

$$LLI_j = \frac{\sum_{i=1}^{m} P_{ij}}{\sum_{i=1}^{m} i}$$

Where, LLI_j is the index of j^{th} district and equal weight to all the indicators

PRI was calculated on the basis of percentage of families below poverty line (BPL) in the district.

$$PRI = \frac{\max PR_j - PR_j}{\max PR_j - \min PR_j}$$

Where, PR_j = (BPL families of jth district / total rural families of jth district)*100

District-wise data on selected variables were taken from various secondary data sources viz. Economic Survey, Agricultural Statistics of West Bengal, Census, BPL Survey and other published sources. District-wise values of different indices were calculated. Each index ranged from 0.0 to 1.0.

The districts were classified under each index into five categories *viz.* very low (0.0 to 0.2), low (>0.2 to 0.4), medium (>0.4 to 0.6), high (>0.6 to 0.8) and very high (>0.8 to 1.0).

RESULTS AND DISCUSSION

District-wise scenario of irrigation, agriculture, level of living and poverty is presented with the help of different indices derived for 18 districts of West Bengal along with mean and standard deviation value of each index. (Table 1). Each index was categorized into five categories under which the frequency of districts was indicated (Table 2). Categorization of districts in West Bengal on index values is presented in Table 3.

Table 1: Values of different developmental indexes in the districts of West Bengal

District	GWDI	ICI	CII	ADI	LLI	PRI
Bankura	0.242	0.885	0.582	0.482	0.471	0.196
Bardhaman	0.421	0.960	0.711	0.741	0.567	1.000
Birbhum	0.234	0.946	0.610	0.658	0.462	0.119
Coochbihar	0.061	0.028	0.045	0.444	0.314	0.021
Darjeeling	0.003	0.000	0.002	0.224	0.387	0.000
Dinajpur (N)	0.531	0.186	0.362	0.522	0.350	0.270
Dinajpur (S)	0.209	0.152	0.184	0.500	0.403	0.143
Hooghly	0.542	0.583	0.575	0.673	0.554	0.859
Howrah	0.227	0.644	0.449	0.593	0.624	0.706
Jalpaiguri	0.000	0.295	0.154	0.319	0.324	0.523
Malda	0.515	0.198	0.361	0.478	0.436	0.377
Midnapore (E)	0.483	0.216	0.354	0.364	0.423	0.968
Midnapore (W)	0.483	1.000	0.740	0.699	0.520	0.671
Murshidabad	0.867	0.203	0.539	0.641	0.458	0.155
Nadia	1.000	0.261	0.636	0.601	0.484	0.605
Purulia	0.132	0.436	0.293	0.251	0.327	0.138
24 Parganas (N)	0.985	0.151	0.571	0.513	0.470	0.432
24 Parganas (S)	0.985	0.318	0.658	0.344	0.302	0.457
Minimum Value	0.000	0.000	0.002	0.224	0.302	0.000
Maximum Value	1.000	1.000	0.740	0.741	0.624	1.000
Mean	0.440	0.415	0.435	0.503	0.438	0.424
Standard deviation	0.336	0.336	0.227	0.155	0.093	0.321

Note: Groundwater Development Index (GWDI), Irrigation Coverage Index (ICI), Composite Irrigation Index (CII), Agricultural Development Index (ADI), Level of Living Index (LLI) and Poverty Ratio Index (PRI).

Table 2: Number of districts under each developmental index in West Bengal

Categories	Frequency of the districts					
	GWDI	ICI	CII	ADI	LLI	PRI
Very low (0.0-0.20)	4	6	4	0	0	7
Low (>0.2-0.4)	4	5	4	5	6	2
Medium (>0.4-0.6)	6	2	5	7	11	3
High (>0.6-0.8)	0	1	5	6	1	3
Very high (>0.8-1.0)	4	4	0	0	0	3

Table 3: Categorization of districts in West Bengal on index values

Categories	GWDI	ICI	CII	ADI	LLI	PRI
Very high (>0.8-1.0)	Murshidabad Nadia 24 Parganas (N) 24 Parganas (S)	Bankura Bardhaman Birbhum Midnapore (W)				Bardhaman Hooghly Midnapore (E)
High (>0.6-0.8)		Howrah	Bardhaman Birbhum Midnapore (W) Nadia 24 Parganas (S)	Bardhaman Birbhum Hooghly Midnapore (W) Murshidabad Nadia	Howrah	Howrah Midnapore (W) Nadia
Medium (>0.4-0.6)	Bardhaman Dinajpur (N) Hooghly Malda Midnapore (E) Midnapore (W)	Hooghly Purulia	Bankura Hooghly Howrah Murshidabad 24 Parganas (N)	Bankura Coochbihar Dinajpur (N) Dinajpur (S) Howrah Malda 24 Parganas (N)	Bankura Bardhaman Birbhum Dinajpur (S) Hooghly Malda Midnapore (E) Midnapore (W) Murshidabad Nadia 24 Parganas (N)	Jalpaiguri 24 Parganas (N) 24 Parganas (S)
Low (>0.2-0.4)	Bankura Birbhum Dinajpur (S) Howrah	Jalpaiguri Midnapore (E) Nadia 24 Parganas (S) 24 Parganas (N)	Dinajpur (N) Malda Midnapore (E) Purulia	Darjeeling Jalpaiguri Midnapore (E) Purulia 24 Parganas (S)	Coochbihar Darjeeling Dinajpur (N) Jalpaiguri Purulia 24 Parganas (S)	Dinajpur (N) Malda
Very low (0.0-0.20)	Coochbihar Darjeeling Jalpaiguri Purulia	Coochbihar Darjeeling Dinajpur (N) Dinajpur (S) Malda Murshidabad	Coochbihar Darjeeling Dinajpur (S) Jalpaiguri			Bankura Birbhum Coochbihar Darjeeling Dinajpur (S) Murshidabad Purulia

Irrigation scenario

Groundwater development in West Bengal varied from 1 per cent (Darjeeling and Jalpaiguri dists.) to 57 per cent (Nadia dist.). The GWDI values of eight districts were found low to very low; while four districts' values were high to very high (>0.6). The irrigation utilization or irrigation coverage (ratio of gross irrigated to gross sown area) varied from 12 per cent (Darjeeling) to 91 per cent (Midnapore West dist.) with an average of 46 per cent. Five districts showed high to very high irrigation coverage index value (ICI>0.6). CII value varied from 0.002 (Darjeeling dist.) to 0.740 (Midnapore West dist.). CII values of eight districts were low to very low (< 0.4), while that of five districts each were medium (>0.4 to 0.6) and high (>0.6 to 0.8), respectively.

In most of the eastern Indian states, the surface water irrigation system is predominant as groundwater irrigation contributed to about 14 per cent, 21 per cent, 21 per cent, 46 per cent and 55 per cent share of IPC in Odisha, Jharkhand, Chhattisgarh, West Bengal and Bihar, respectively. Therefore, it is evident that relatively better groundwater development in Bihar and West Bengal has lead to better irrigation scenario in comparison to other three states in eastern India (Ghosh *et al.,* 2014). Overall the potential utilization of groundwater irrigation system is relatively less in eastern region as compared to other regions of country due to many constraints like higher energy cost, operational cost, defunct lift points, etc. In Indo-Gangetic Basin (IGB) that also covers many districts of West Bengal, energy cost and availability ranked as the top challenge to the farming (Shah *et al.*, 2006). The diesel price squeeze on small-scale irrigation is heading towards a crisis that is also visible in West Bengal, where electric tubewells are few and the ratio of rice (major crop) to diesel price has turned adverse. In crop-sharing contracts for water sales, tubewell owners claim 1/3rd to half of the total output for pump irrigation alone when they pay for diesel (Shah *et al.*, 2009). Non-functioning of groundwater extraction devices (GEDs) has led to poor utilization of irrigation potential as about a quarter of the total GEDs were found to be nonfunctional as reported in the latest (4^{th}) minor irrigation census (2006-07). Many of the non-functional GEDs, were not working because of mainly less discharge rate and mechanical breakdown. Thus, while several states in northern and southern part of the country witnessed over-exploitation of the groundwater, the eastern part is under-utilizing its groundwater because of poor infrastructure and unfavourable geological conditions (Srivastava *et al.*, 2014).

Agricultural scenario

ADI values of eighteen districts in West Bengal ranged from 0.741 (Bardhaman dists.) to 0.224 (Darjeeling dist.). Six districts showed high (>0.6-0.8) agricultural development while seven and five districts showed medium (>0.4-0.6) and low (>0.2-0.4) ADI values, respectively.

Rai *et al.* (2008) reported that as per the agricultural status index, districts within agro-climatic zones 3 (many districts of West Bengal) were medium status. Agricultural development in districts of West Bengal was found to be comparatively better than other eastern Indian states (Ghosh *et al.,* 2014) with relatively higher productivity of major crop paddy (about 2.5 tonne per ha), food grain production (15700 thousand tonne with productivity about 1.7 tonne per ha), cropping intensity (180%) and fertilizer consumption (145 kg per ha). Potential of irrigation development is not fully reaped in all the districts. The possible reasons hover around the issues of poor quality of irrigation rather coverage (high coverage but unreliable water supply affecting crop growth thus crop production adversely). Unreliable irrigation is also the reason for low level of uses of other complementary inputs which affect the agricultural development scenario. While more than half of the gross sown area was found irrigated in the West Bengal, low level of agricultural development in five districts reiterates the fact that performance of groundwater irrigation influences the gross irrigated area. Thus lack of assured irrigation service has bearing on low food grain productivity, cropping intensity, fertilizer consumption, etc in those districts. Smaller the irrigation systems with well managed infrastructure, relatively equitable water distribution and diversified cropping patterns, the greater impacts of irrigation. Improving the performance of irrigation systems by improving water distribution across locations and enhancing land and water productivity through diversified cropping patterns would help in improving agricultural performance in presently low productivity parts of the systems (Hussain *et al.*, 2004).

Poverty and living scenario

Level of living of eleven and six districts was found as medium (with LLI value >0.4-0.6) and low (with LLI value >0.2-0.4), respectively. PRI values of six districts were in high range (higher the value of index lower is the poverty), while nine districts showed relatively higher poverty level with PRI values <0.4. Poverty was found highest in Darjeeling and Coochbihar districts (46 % families are BPL); however, it is lowest in Bardhaman district, where 26% families are BPL, agricultural development was found maximum.

Thus the living scenario of most of the districts in West Bengal was at medium level. Rai *et al.* (2008) in their study on livelihood status of different agro-climatic zones in India reported that livelihood status index of agro-climatic zones 7 (Jharkhand, Chhattisgarh and Odisha are in this zone barring coastal districts of Odisha those are in zone 11) and 4 (all districts of Bihar) was categorized as low while agro-climatic zones 3 (many districts of West Bengal) was medium status. Task Force of Planning Commission of India (2003) had identified 150 backward districts for wage employment programme out of which about half of the districts were in eastern Indian states viz. 27, 19, 14, 7 and 6 districts of Odisha, Jharkhand, Chhattisgarh, West Bengal and Bihar, respectively.

Extent of poverty was found maximum in Odisha and minimum in West Bengal having relatively low and high level of irrigation as well as agricultural performance, respectively (Ghosh *et al.,* 2014). In a mega study to explore the links between irrigation and poverty alleviation in six Asian countries (India, Pakistan, Bangladesh, China, Vietnam and Indonesia) covering 26 irrigation systems, it was revealed that irrigation did significantly reduce poverty as measured by household income; however, poverty was still high in irrigation systems, averaging 34 per cent (varied from 6% to 65%) with significant inter- and intra-country differences in poverty incidence in irrigation systems (Hussain, 2007a). The locational differences (upstreamdownstream poverty differences in India about 11%) in poverty were more pronounced in larger irrigation systems (surface irrigation), where locational inequities in water distribution and agricultural productivity differences were also high (Hussain *et al.*, 2004; Hussain, 2007b). Impact of groundwater irrigation on agriculture and poverty reduction is larger (Bhattarai and Narayanmoorthy, 2003; Shah, 2004; Narayanmoorthy, 2007). Mukherji (2007) in an extensive study in West Bengal reaffirmed groundwater irrigation with numerous benefits.

Link between irrigation, agricultural development, poverty and level of living

To draw relationships between irrigation resources, agricultural development, level of living and poverty, at the first step normality of CII, ADI and LLI tested using SPSS 10.0 for Windows program. As the indices' values were found to be normally distributed, correlation and regression analyses were carried out with those values. Links between irrigation, agriculture, livelihood and poverty were understood through a correlation matrix (Table 4) and regression curves (Fig. 1). It was revealed that ADI was significantly related with ICI and CII, while LLI was significantly related with ICI, CII, ADI and PRI. Correlation coefficient value between PRI and CII as well as PRI and LLI was significant; however that of PRI and ADI was not significant. Regression analyses were carried out between irrigation, agriculture and level of living indexes as they were significantly correlated with each other. CII explained about 49 per cent and 33 per cent variation in ADI and LLI, respectively. The analysis also revealed that 58 per cent ($R^2 = 0.576$) variation in living was predicted by the agricultural development in districts of West Bengal. Multiple regression analyses showed that CII and ADI together explained 58% variation in LLI; however regression coefficients of CII and ADI were found significant at 1% and 7% level of significance (Table 6).

A linkage matrix was prepared showing frequency of districts under various combinations of links between irrigation, agriculture, level of living and poverty (Table 5). The CII, ADI, LLI and PRI values of each district were considered to delineate the districts falling under index: high to very high (value>0.6), index: medium (value 0.4-0.6) and index: low to very low (value<0.4) with various combinations of links between the indexes. Number of districts having values of CII, ADI, LLI and PRI more than 0.6 counted under the index: high to very high within various combinations of links; similarly, the values of said indexes falling under 0.4 for the districts were counted under index: low to very low with various combinations of links. The districts with developmental indexes values between 0.4-0.6 for were categorized under the index: medium with various links. Thus, the values of CII and ADI were found more than 0.6 (index: high to very high) for four districts, less than 0.4 (index: low to very low) for four districts and from 0.4 to 0.6 (index: medium) for three districts; therefore, overall the 'Irrigation Agriculture' link was found in 11 districts. However, it was narrowed down to nine and eight districts in the case of 'Irrigation Level of living' and 'Agriculture Level of living' links, respectively. The 'Agriculture Poverty' and 'Irrigation Poverty' links were visible in seven and six districts, respectively. The 'Irrigation Agriculture Level of living Poverty' link was seen only in three districts, which were categorized under medium and low to very low index values. Therefore, better scenario of irrigation and agriculture in four districts could not influence the level of living in those districts showing the missing links.

Many of the districts in eastern Indian states showed both irrigation and agricultural scenario at a low level, which may be attributed to the fact of meager groundwater irrigated area due to low level of groundwater development and dependence on surface irrigation system that mainly providing irrigation during wet season with low level of efficiency where head reach farmers took extensive cultivation of paddy rather than assured productive irrigation in dry season with gap between created and utilized potential (Ghosh *et al.*, 2005; Ghosh *et al.*, 2010; Mishra *et al.*, 2011). Abundant water resources of the eastern region are not accessible to farmers at the right time and place because of poor irrigation infrastructure development making it high potential but poor performing region of the country (Narayanamoorthy 2011). The marginal impact of groundwater irrigation on poverty reduction is larger than that of canal irrigation, which is due to greater control in the application and wide spread use of groundwater irrigation than of canal irrigation (Bhattarai and Narayanmoorthy, 2003; Shah, 2004; Narayanmoorthy, 2007). In this context, lower groundwater exploitation for irrigation in many districts has bearing on the insignificant impact of irrigation development on the agricultural performance, poverty and living scenario.Here, the major challenge is to find ways of bringing down water use cost below the upper threshold beyond which abundantly available water becomes too expensive for the poor to use to maintain livelihoods and food security (Shah, 2009).

As revealed in the present study as well as past studies, the impacts of irrigation vary across settings and the magnitude of the anti-poverty impacts of irrigation depend on a number of factors like structure of land distribution, condition of the irrigation infrastructure and its management (both ground water and surface water), irrigation water management including allocation and distribution procedures, irrigation efficient production technologies, cropping patterns and crop diversification, support measures including information, input and output marketing. There is a need for combination of sustainable irrigation development with the development of appropriate pro-poor institutions and technologies to achieve lasting and sustainable impact on poverty.

Table 4: Correlation matrix of different indicators

	GWDI	ICI	CII	ADI	LLI	PRI
GWDI	1.000					
ICI	-0.107	1.000				
CII	0.656**	0.680**	1.000			
ADI	0.343	0.586**	0.697**	1.000		
LLI	0.172	0.594**	0.579**	0.759**	1.000	
PRI	0.302	0.370	0.503*	0.399	0.569*	1.000

Note: ** significant at 0.01 per cent level and * significant at 0.05 per cent level

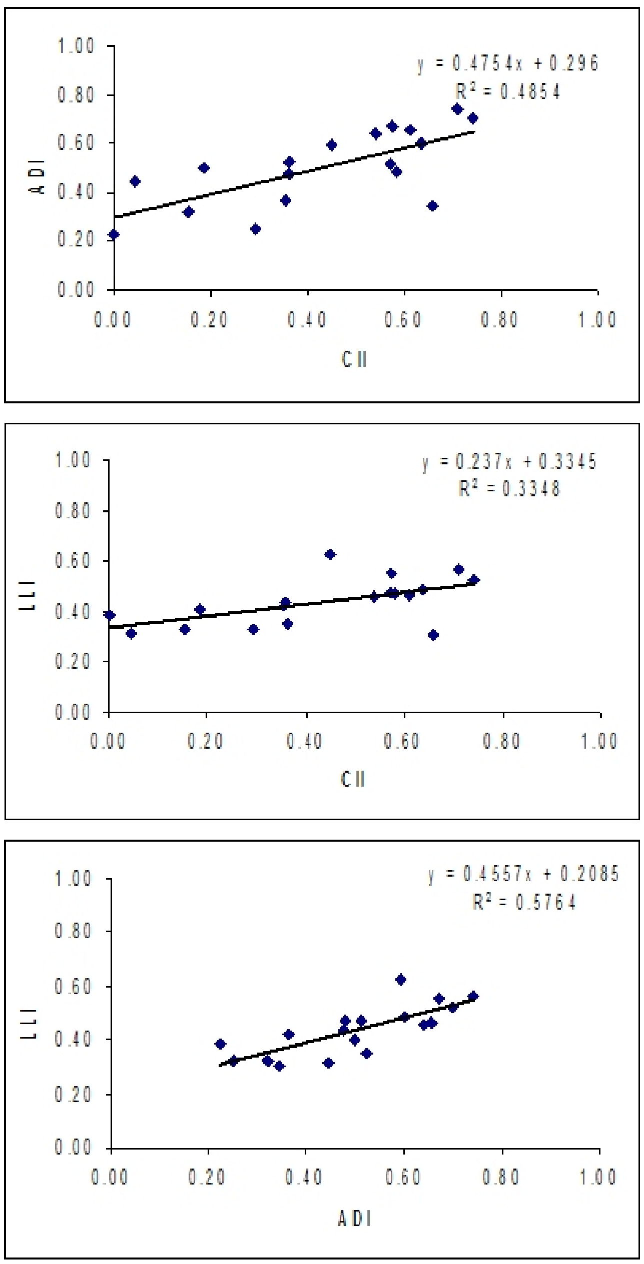

Fig. 1. Linear regression between irrigation, agriculture and level of living indexes

Table 5: Linkage matrix showing number of districts under various combinations of links between irrigation, agriculture, level of living and poverty

Types of Links	Districts (No.)			
	Index: High to very high	Index: Medium	Index: Low to very low	Total
Irrigation - Agriculture	4	3	4	11
Agriculture – Level of living	0	4	4	8
Irrigation – Level of living	0	4	5	9
Irrigation - Poverty	3	1	2	6
Agriculture - Poverty	4	1	2	7
Level of living - Poverty	1	1	4	6
Irrigation – Agriculture – Level of living	0	1	3	4
Irrigation – Agriculture – Poverty	3	1	2	6
Irrigation – Level of living - Poverty	0	1	4	5
Agriculture – Level of living – Poverty	0	1	2	3
Irrigation – Agriculture – Level of living – Poverty	0	1	2	3

Table 6: Multiple Regression between CII, ADI and LLI in West Bengal

Regression Statistics	
Multiple R	0.762
R Square	0.581
Adjusted R Square	0.525
Standard Error	0.064
Observations	18.000

ANOVA

	df	SS	MS	F	Significance F
Regression	2.000	0.086	0.043	10.407	0.001
Residual	15.000	0.062	0.004		
Total	17.000	0.148			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.212	0.053	3.980	0.001	0.098	0.325
X Variable 1 (CII)	0.040	0.095	0.414	0.684	-0.164	0.243
X Variable 2 (ADI)	0.415	0.140	2.970	0.010	0.117	0.713

CONCLUSIONS

District-wise scenario of irrigation, agriculture, living and poverty was revealed with the help of different indices developed for the study. The differential influences of irrigation on agriculture as well as that of both irrigation and agriculture on living and poverty scenario were witnessed on many districts of West Bengal. Lower groundwater exploitation for irrigation has attributed to the lower impact of irrigation development on the poverty and livelihood scenario. Irrigation Agriculture link is found in many of the districts; however, it is narrowed down in case of Agriculture Livelihood and Irrigation Livelihood link. Irrigation Poverty and Agriculture Poverty link is visible in few districts. Irrigation-Agriculture-Livelihood-Poverty link is seen only in three districts of West Bengal. The links have been found more in case of poorer condition of different sectors; while betterment in one sector has not linked to betterment of other sectors in many of the districts. Thus, the study has unveiled the links and/or missing links between irrigation resources, agricultural development, level of living and poverty which would help formulating future policies and planning for eastern India in general and West Bengal in particular for better agricultural growth and visible impact on agrarian economy and livelihood.

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