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Agricultural level of development: a comparative study between project and non-project area of JSW Bengal Steel Ltd. at Sundra Basin of Salboni block, Paschim Medinipur, West Bengal, India

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Abstract

M/S JSW Bengal Steel Ltd. is one of the India's leading steel producer company is going to set up a 10.0 Mtpa (Million ton per annum) and 300 MW Captive Power Plant by 2020 at Sundra Basin of Paschim Medinipur, but the proposed project has been suspended due to lack of raw materials on 1st December 2014. For the said project 17.1 sq km land has been acquired from 22 mouzas in 2009. After land acquisition an extensive deterioration in the agricultural level of development has been observed at the JSW project affected mouzas. Due to losing of productive land and profession of primary activities, people of project sites have been suffering from steep reduction in income and employment. As a consequence, a sharp difference in development between project affected and non-affected areas has been observed at basin scale. The value of composite index of agricultural development varies from 0.28 in 2007 to 0.94 in 2014 that indicates a wide regional disparities present at study area and requires immediate attention for all inclusive development. So there is an immediate need for proper planning on project affected mouzas to make alternative livelihood opportunities with help of local NGOs and Government.

Keywords: Composite index, JSW Bengal Steel Ltd, Agricultural development, Land acquisition

Introduction

Quality of life of the people should be improved through proper development planning (Inglehart 1997; Myrdal 1972; Ohlan 2013). Development project may alter existing physical and social situation of the concerned region and its surroundings that may bring unanticipated adverse impacts (Long et al. 2007; Madon 2000; Szirmai 2015) on society. In order to manage the adverse impact, a development indicator is needed to develop for bringing about uniformity in regional development (Akama and Kieti 2007; Choudhury 1992; Dasgupta 1971; Sarker 1994). Development is a multi-dimensional process (Bhattacharya and Mahalanobis 1967; Dreze and

Sen 1999) which cannot be fully estimated by a single indicator. Moreover, when we use a number of indicators individually, we cannot get any integrated and easily comprehensive picture of reality. So, it necessitates to build up a composite index (CI) of development based upon optimal combination of different developmental indicators in the analysis for assessing the level of development (Demurger 2001; Florek et al. 1951; Narain et al. 2011). Drewnowski (1972) has defined an easily accessible socio-economic indicator which contains information about the degree of satisfaction of human needs.

Several studies have been done to provide various dimensions to concept of development (Choudhury 1995; Das 1999; Parihar and Srivastava 2003) and the studies revealed that there are wide disparities in the level of development among different regions. A deeper

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level analysis on the estimation of level of development has been done in different years on same ground for several states, e.g. Orissa (Narain et al. 1992, 1993), Andhra Pradesh (Narain et al. 1994a, b, 2009), Kerala (Narain et al. 1994a, b, 2005), Utter Pradesh (Narain et al. 1995), Maharashtra (Narain et al. 1996), Karnataka (Narain et al. 1997, 2003), Tamil Nadu (Narain et al. 2000), Madhya Pradesh (Narain et al. 2002), Assam (Narain et al. 2004), West Bengal (Narain et al. 2011; Rai and Bhatia 2004, 2011) and Jammu and Kashmir (Narain et al. 1991). It is observed that entire parts of low developed districts are not backward but there are some parts which are also better development (Raja and Yousaf 2014). In addition on the base of above studies, researchers have been trying to provide various dimensions to the concept of development.

M/S JSW Bengal Steel Ltd. of Jindal group, part of O.P. Jindal is one of the India's leading steel producers with a significant presence in sector like mining, stainless steel, carbon steel, large diameter pipes, non-ferrous metals, power generation and distribution and maritime infrastructure (Jindal Steel and Power Ltd 2014; Sudalaimuthu and RAJ 2009). JSW Steel Ltd. operates a steel

plant at Vijayanagar district, Bellary in Karnataka state. The JSW group also owns and operates southern Iron & Steel Company Ltd. which is only integrated steel plant in Tamil Nadu and also cold rolling, galvanizing and color coating plants at Tarapur and Vasind in Maharashtra.

Now the company is signed a pact with West Bengal Government on 11th January 2007 to set up a 10.0 Mtpa steel plant and 300 MW CPP by 2020 at Sundra basin of Paschim Medinipur district, West Bengal (JSW EIA 2007). The basin is stretching between 22°37'09"N to 22°36'02"N and 87°13'44"E to 87°16'09"E (Fig. 1) is one of the backward regions of this state. Sundra is the tributary of Tamal that ultimately pours to the river Silaboti. As of 2011 census, 32,689 persons have distributed among 109 smallest revenue units (mouzas) with a density of 274/sq km. The maximum concentration of population has been observed at Saiyadpur (1114 person), Godapiasol (1387 person), Jhar Bhanga (1983 person), Kontai (2102 person), Benachapra (1203 person), Dudiabandi (887 person), Bagbasa (903 person), Jamdedya (827 person) mouza, etc. along the road side due to accessibility of high transport facility. The literacy rate is 58%. Scheduled Castes and Tribes constitute 24.1 and 16.3% of the

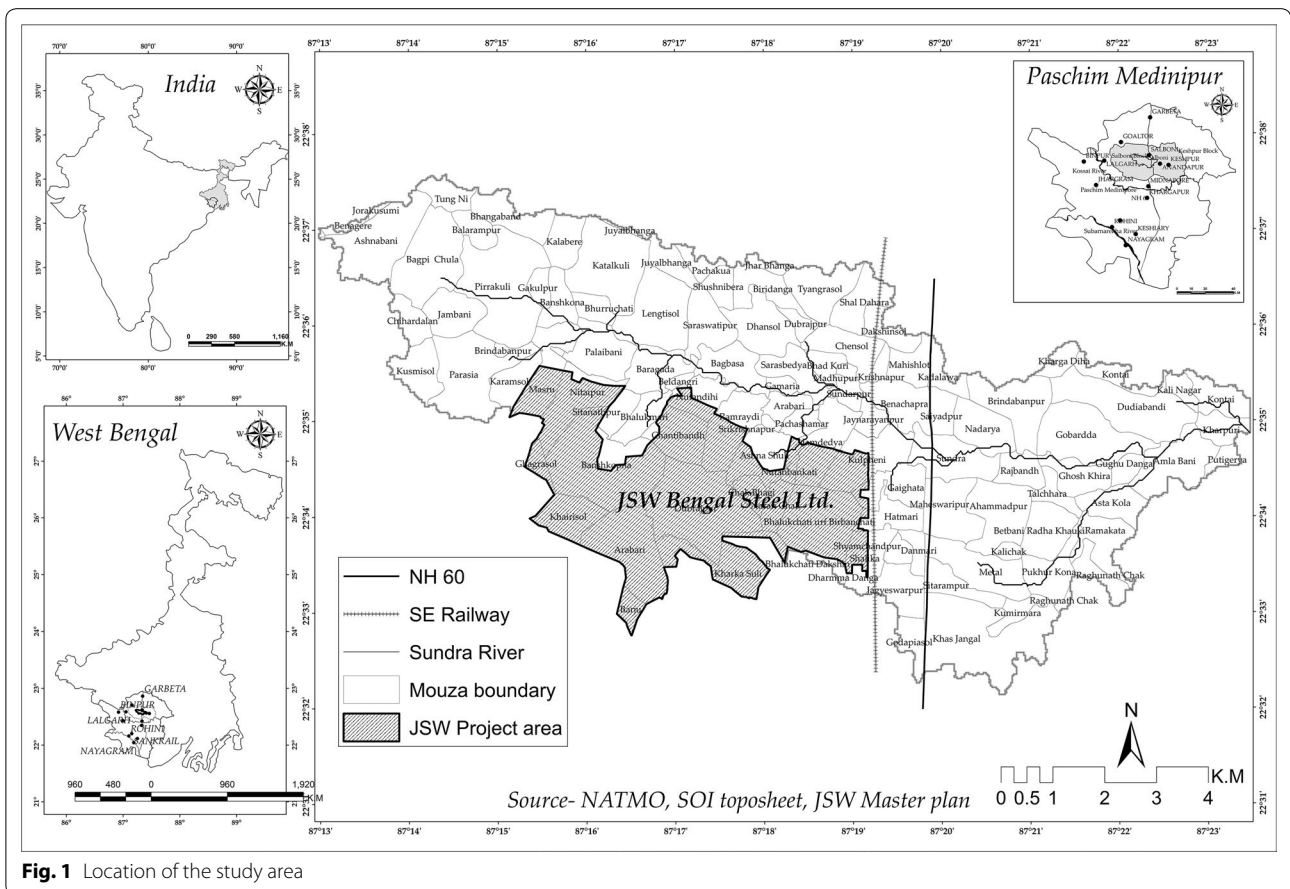


Fig. 1 Location of the study area

population respectively (Census of India 2001, 2011). Agriculture, livestock production and collecting are the main stay of the local economies (District statistical handbook 2006, 2007).

For the proposed project 17.1 sq km land has been acquired from 22 mouzas in 2009. As a consequence a huge landuse conversion has been observed. The study area has lost 1.3 sq km of crop land, 9.6 sq km of forest land, 2.9 sq km of waste land and 3.3 sq km of fodder farm land. Livelihood of local residents of project site is mainly rely on natural resources like land and forest. But on 1st December 2014, JSW authority has announced to suspend the proposed project (Anandabazar, 2014) due to lack of raw materials. As a consequence the project affected household (HH) are in severe condition in terms of their livelihood, income and accessibility. At Nutandihi, Ashna Shuli, Kharka Suli, Dubrajpur, Barju, Ghagrasol mouza there were 36, 124, 100, 14, 17 and 46 persons of main cultivators before land acquisition but after acquisition this figure is belong to 8, 41, 5, 0, 5 and 7 persons respectively. Maximum percentage of marginal workers has been recorded at Nutandihi (54%), Khairisol (58%), Barju (53%) while it was 0, 19 and 26% respectively before acquisition. At lower catchment Rajbandh, Bagpi Chula, Dudiabandi, Ghosh Khira, Amla Bani, Asta Kola, Putigerya, Kharपुरi mouzas are depending on agricultural activities; but at project site Nutandihi, Nitaipur, Ashna Shuli, Kulpheni, Gaighata, Hatmari, Shalika, Kharka Suli, Arabari, Khairisol major source of income were agriculture (40–60%) and livestock farming (20–30%), now after land acquisition and due to clearance of forest cover this percentage has been observed as 20–25% and only 8–10% respectively.

The main objective of the study is to estimate a CI of development in agricultural sector for comparison in between pre (2007) and post (2014) land acquisition session. The outcome of level of development at mouza level will help to identify where a given mouza stands in relation to others.

Data and method

“Development is a multidimensional process and it cannot be fully estimated by single indicators. Moreover, a number of indicators when analyzed individually do not provide an integrated and easily comprehensive picture of reality” Narain et al. (2011). The major limitation arises from the assumption made about the developmental indicators themselves and their weightage in the aggregate index. To overcome this problem, a CI of development was constructed by Narain et al. (2011) to obtain a statistical method of determining homogenous units in an n-dimensional vectorial space. Hellwig (1967) of the Wroclow School of Economics applied taxonomy

method for ranking and comparing between different countries. The method is very sensitive and valid measure of development levels, because it takes account of the dispersion among component indicators. According to Harbison et al. (1968) “it provides a useful tool for interpolation of statistical data sets up a measure of social and economic maturity and introduces a concept of pattern of development which may prove to be very useful in planning”. Ewusi (1976) has applied the method to find out the disparities in levels of regional development in Ghana. Arief (1982) and Narain et al. (2011) have applied the similar methods in the studies conducted in West Bengal of India respectively. Bhatia and Rai (2004) have applied the method in small area to prepare a project report of planning commission of India. Indicators common to all mouzas of the study area have been included in the analysis for evaluating the level of development. We have gathered information of per capita irrigated and non-irrigated crop land, per capita crop land acquired for proposed project, crop income (in Rs) before and after land acquisition, yield rate of crops (kg/sq meter), consumption of fertilizer in kg/sq meter, production of egg, milk etc. through HH survey (2007–2010 and 2012–2014) and data (mouza wise net sown area, total population, marginal workers, no of main cultivators etc.) of collected from secondary source such as Census of India (2001, 2011) and District statistical handbook (2006, 2007) have been used as input in this method. CI of development for project affected and non-project affected mouzas have been obtained by using the following indicators.

Agricultural development indicators

- Net Sown Area (in sq m).
- No of Marginal Workers.
- Irrigated Area (in sq m).
- Crop Income (in Rs).
- No of Main Cultivators.
- Area not available for cultivation (in sq m).
- Area under cereal crops (in sq m).
- Area under rabi crops (in sq m).
- Cropping intensity (%).
- Yield rate of total crops (kg/sq m).
- Production of total cereal (000 kg).
- Consumption of fertilizer in kg/sq m.
- Production of egg (Hen + Duck) in hundreds.
- Production of milk (cow + goat + buffalo) in kg.

A total of 14 indicators have been applied in this analysis, those are the major interacting indicators for agricultural development. A brief introduction of level of development method (Narain et al. 2011) used in this study has been discussed below.

Measuring the level of development

Let $[X_{ij}]$ be the data matrix showing the variables of i th mouza ($i = 1, 2, \dots, n$) and j th indicator ($j = 1, 2, \dots, k$).

Every mouza is represented by vector in a k -dimensional space. Since the units of measurement of the variables considered are not uniform, combined analysis $[X_{ij}]$ is transformed to the matrix of standardised indicators $[Z_{ij}]$ using following equation (Eq. 1.1)

$$[Z_{ij}] = \frac{X_{ij} - \bar{X}_j}{\sigma_j} \tag{1.1}$$

where, $\bar{X}_j = \frac{\sum_{i=1}^N X_{ij}}{N}$ and $\sigma_j = \left(\sum_{i=1}^N (X_{ij} - \bar{X}_j)^2 \right)^{1/2}$

From $[Z_{ij}]$ the optimal value of each indicator was identified. Let it be denoted by Z_{0j} . The optimal value will be either the maximum value or minimum value of the indicator depending upon the direction of the impact of an indicator on the level of development. For example, increase in literacy rate would positively affect the development, while increasing population density may adversely affected the development. For obtaining the pattern of development C_i of the i th mouza, square of the deviation of the individual value of a variate from the best value was calculated. In other words P_{ij} was calculated using following Eq. 1.2

$$P_{ij} = (Z_{ij} - Z_{0j})^2 \tag{1.2}$$

For each i and j pattern of development is given by

$$C_i = \left[\sum_{j=1}^k P_{ij} / (cv_j) \right]^{1/2} \tag{1.3}$$

where (cv_j) = coefficient of variation of the j th indicator in X_{ij} . CI ‘measure of development’ (D_i) is given by

$$D_i = C_i / C \tag{1.4}$$

where

$$C = \bar{C} + 3\sigma C_i$$

where $\bar{C} = \frac{\sum_{i=1}^N C_i}{N}$ and $\sigma C_i = \left(\sum_{i=1}^N (C_i - \bar{C})^2 \right)^{1/2}$

The smaller D_i will indicate more development and higher value of D_i will indicate low level of development. The value of D_i ranges between 0 and 1.

The level of development

The composite indices of development for different mouzas of Sundra catchment has been estimated on the basis of development in agriculture, infrastructural and overall socio-economic sectors. The mouzas have been ranked on the basis of development indices. The composite

indices of development along with the rank of mouzas have been discussed below.

For relative comparison among different mouzas within the study area regarding the level of development, a simple ranking of mouzas on basis of CI would be sufficient for classificatory purpose. Mouzas are classified in four stages of development as High level, High middle level, Low middle level and Low level. If the mouzas have CI less than or equal to $(\text{Mean} - \text{SD})$ (SD means Standard Deviation) are described as High level development and the mouzas having the CI greater than or equal to $(\text{Mean} + \text{SD})$ are described as Low level development. If the CI lies in between (Mean) and $(\text{Mean} - \text{SD})$ are described as High middle level development and the mouzas having CI in between (Mean) and $(\text{Mean} + \text{SD})$ are described as Low middle level development (Ohlan 2013).

Result and discussion

Keeping in a view on detailed analysis of agricultural development in the study area between prior (2007) and post (2014) land acquisition, with help of following indicators a composite agricultural development index has been made along with their mouza wise ordinal rank. The study area mainly consists of 109 mouzas and within it 22 mouzas has been treated as project affected.

Agricultural development indicators

Percentage of net sown area Relative comparisons among the different mouzas of study area are made between 2007 and 2014 regarding net sown area. Out of 109 mouzas, 18 mouzas are found to have positive changes (15.2%) and project affected 22 mouzas recorded negative changes (-21.1%). Net sown area has been increased by 36.6% at Palaibani mouza, followed by Mahishlot (35.8%), Saiyadpur (26.1%), Dakshinsol (21.9%), Gamaria (20.1%), Brindabanpur (18.6%), Nadarya (18.5%), Ahammadpur (12.9%), Kalichak (10.1%), Asta Kola (9.9%) mouza. The positive changes have been observed in only non-project affected mouzas (Fig. 2).

Project affected mouzas have lost their net sown area due to land acquisition in 2007. Maximum reduction in net sown area has been observed at Dubrajpur (73.6%) followed by Chantibandh (87.1%), Chak Bhagi (56.7%), Ramraydi (51.4%), Ashna Shuli (39.5%) and Nitaipur (38.1%) mouza.

Marginal workers Based on the census data it has been observed that marginal workers have increased rapidly by 17% within the study area. It was nearly 23.0% in 2001 and voluminous to 40.4% in 2011. Figure 3 depicts the changing pattern of marginal workers within the study area. At lower catchment Rajbandh, Ahammadpur, Bagpi

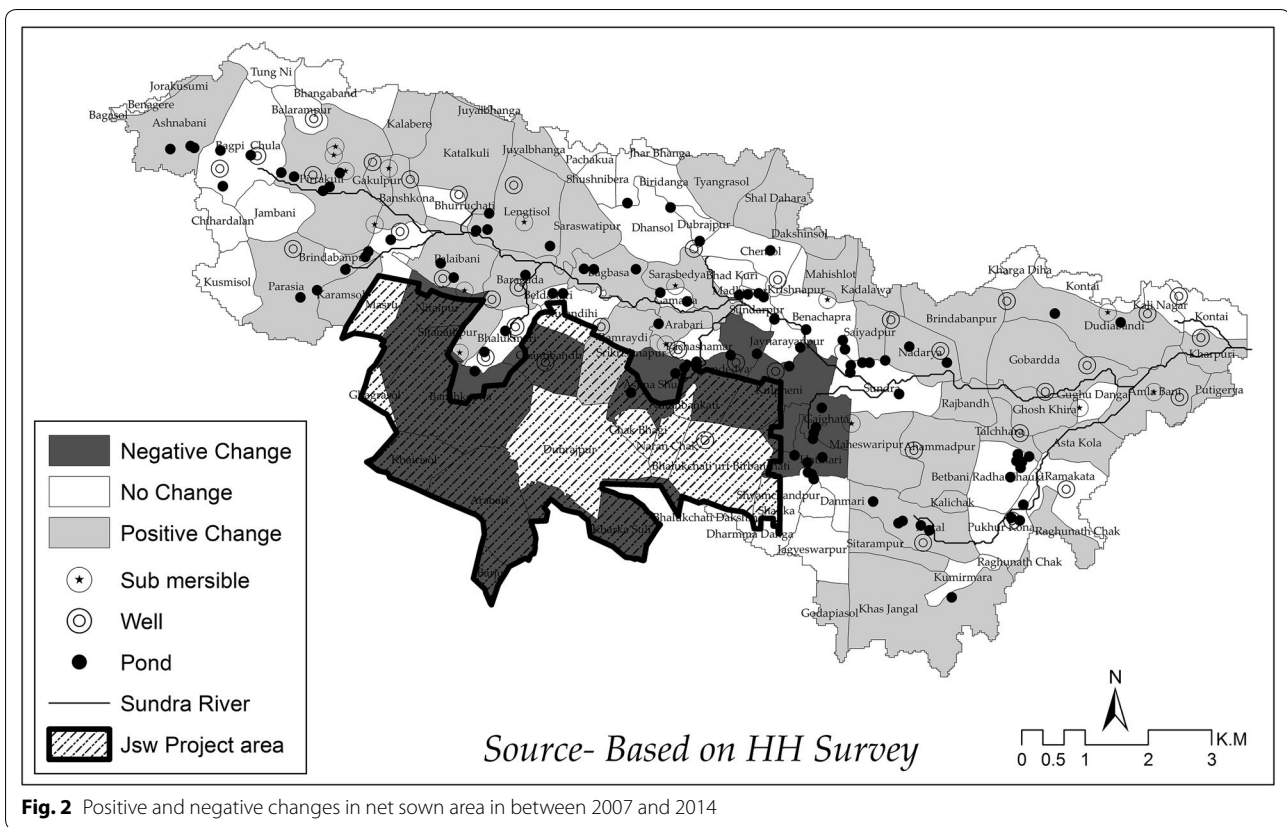


Fig. 2 Positive and negative changes in net sown area in between 2007 and 2014

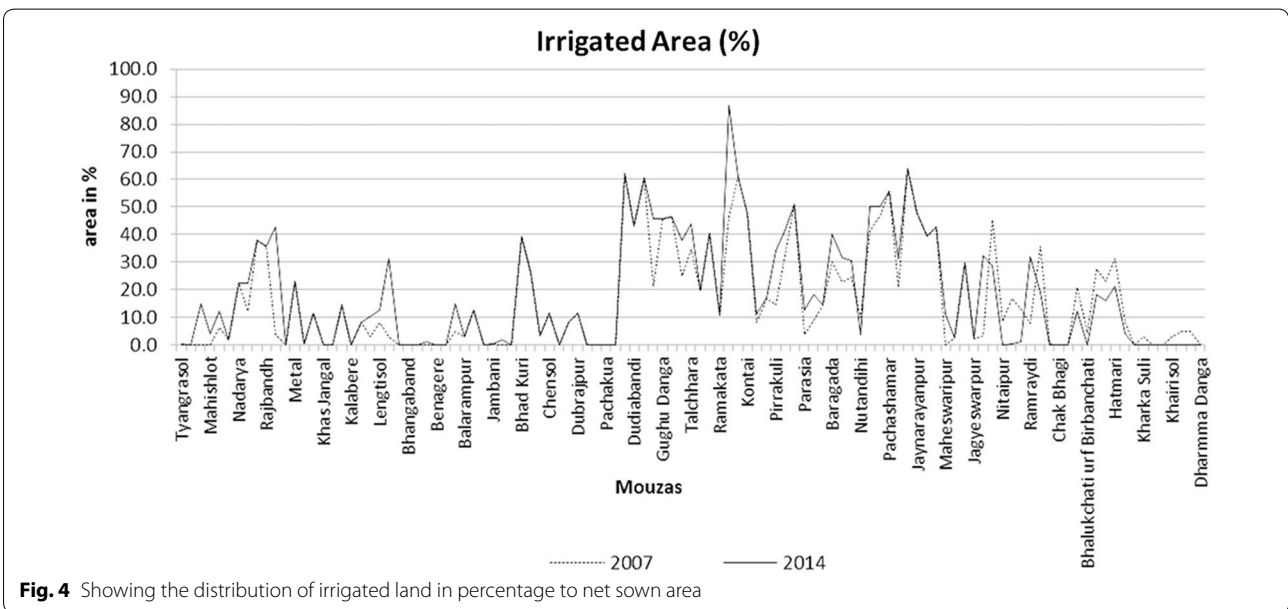
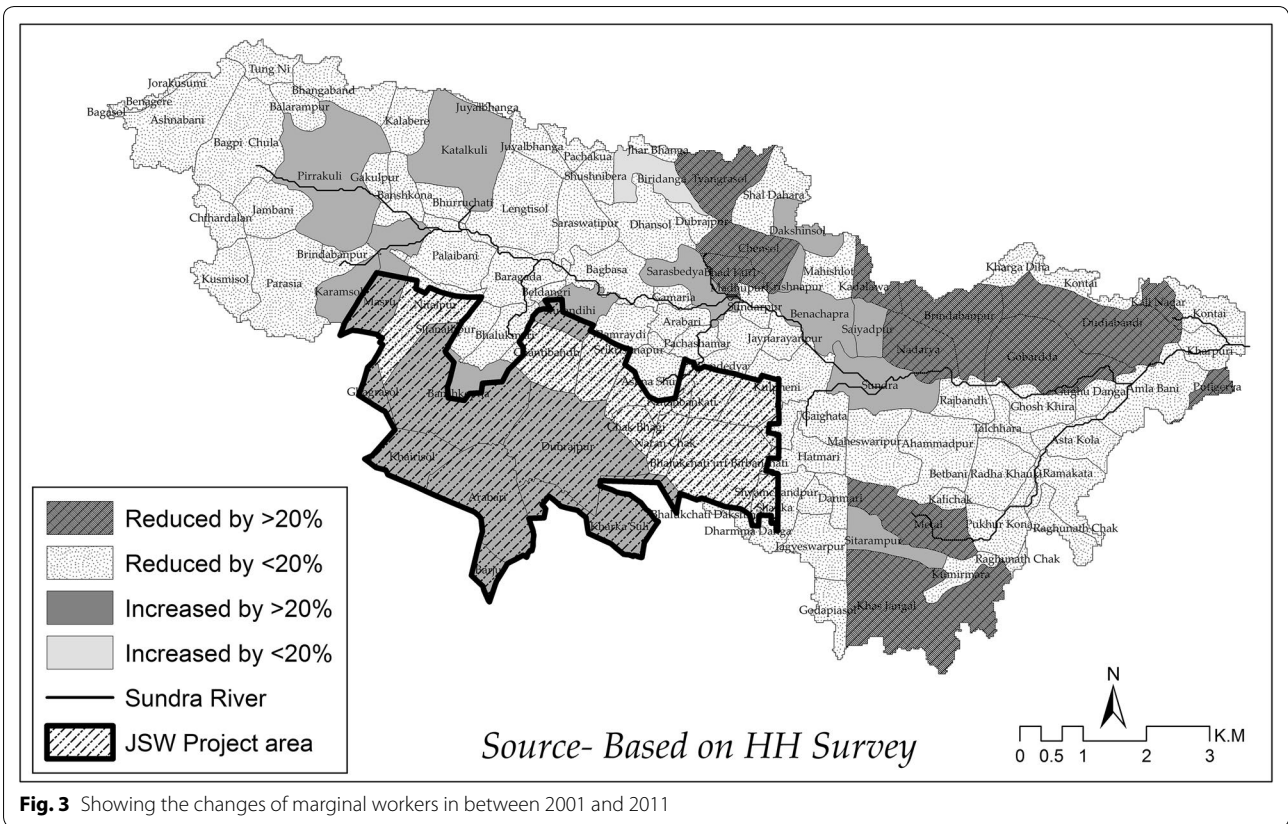
Chula, Dudiabandi, Ghosh Khira, Gobardda, Amla Bani and Asta Kola mouza marginal workers have decreased by more than 20%.

The marginal workers have increased by on an average of 26.5 and 15.0% respectively at project and non-project site. During that period total population are increased by 12.7% but average net sown area remains same. At upper and middle catchment due to lack of irrigation facility, poor soil quality, inadequate non-farm activity are contributing to increase number of marginal workers quite rapidly. From observation at Dakshinsol, Katalkuli, Krishnapur, Kalichak, Godapiasol, Jorakusumi, Benagere, Chensol, Jhar Bhanga, Pachakua and Kharga Diha mouza marginal workers became almost double from that of last census year. Among the project affected mouzas Khairisol records maximum share (90%) of marginal workers, while before acquisition (2001) the figure was only 15.5%. Other affected mouzas like Nutandihi (84.4%), Arabari (75.3%), Banshkopna (67.7%), Chantibandh (58.1%) and Ashna Shuli (61.2%) also registered a huge percentage of marginal workers. Marginal workers are inversely related to agricultural development.

Percentage of irrigated area The net irrigated area with respect to total crop land within the study area has increased from 16.3% in 2007 to 18.5% in 2014. Mouza

wise distribution of irrigated land has been projected in Fig. 4. It is observed that 32 mouzas experienced improve irrigation facility through bore well. Putigerya mouza is one of them, experiencing increase in net irrigated area by 40% in 2014. Ahammadpur (38.7%), Sitanathpur (29.0%), Saraswatipur (28.2%), Gobardda (24.4%), Pirrakuli (20.1%), Dakshinsol (14.8%), Asta Kola (12.7%), Maheswaripur (11.4%), Sarasbedya (10.5%) mouza experience increase in net irrigated land area. But at the project affected mouzas (Fig. 5) net irrigated land area had been declined after acquisition of irrigated land for proposed project. The statistic reveals that the maximum irrigated land had been acquired from Banshkopna (16.6%) followed by Ashna Shuli (16.4%), Chantibandh (11.9%), Hatmari (9.8%) and Kulpheni (9.1%) mouza. After acquisition of water bodies, as a consequence net irrigated area has been declined in the mouzas outside the project area.

Percentage of crop income Through detailed HH survey it is observed that crop income as a present to total income varies from upper catchment to lower catchment within the study area. Due to good quality of land and better irrigation facility at lower catchment crop income ranges from 57.0 to 80.0% while in upper catchment it varies from 24.0 to 40.0%. Figure 6 depicts the variation



of crop income between pre-acquisition (2007) and post-acquisition (2014) condition.

Major reduction has been observed at project site. After land acquisition average crop income is being

dropped from 74.1% in 2007 to 23.2% in 2014. Major reduction has been observed at Banshkopna, Chantibandh, Kulpheni, Gaighata, Kharka Suli, Ashna Shuli, Arabari and Khairisol mouza.

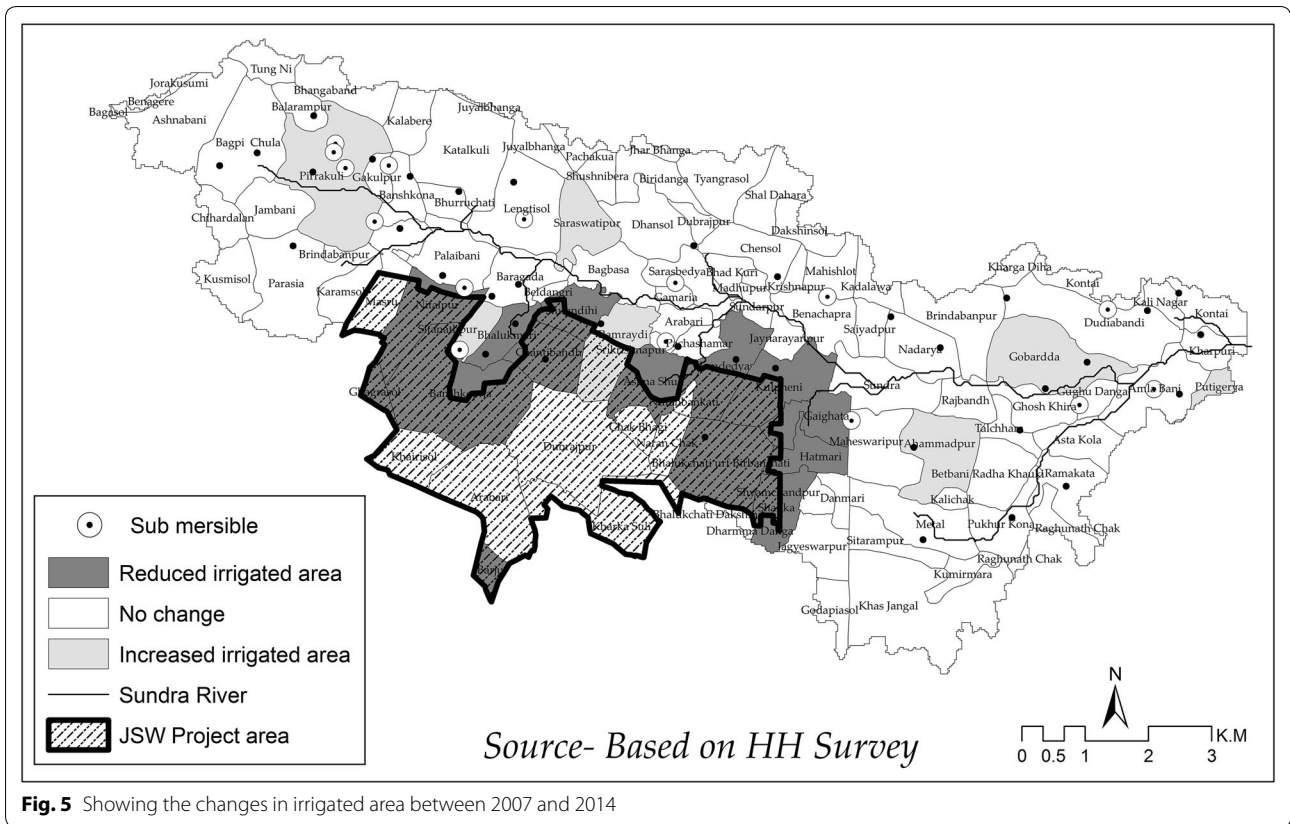


Fig. 5 Showing the changes in irrigated area between 2007 and 2014

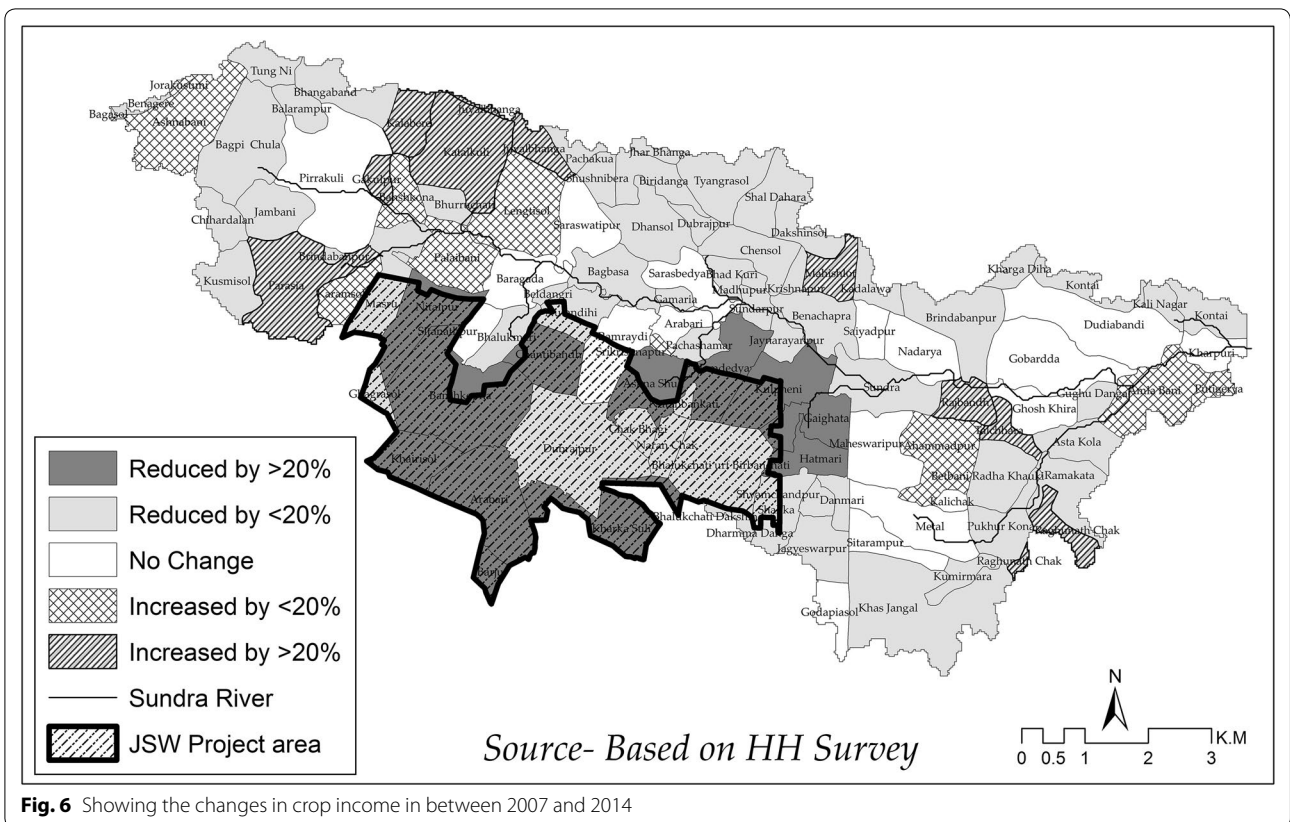


Fig. 6 Showing the changes in crop income in between 2007 and 2014

Percentage of main cultivators Based on the information available from local BDO office and Census of India, it is observed that average percentage of main cultivator is 33.6% at study area and it has been observed as 37.4% in non-project affected mouzas to 18.1% in project affected mouzas in 2014.

But before acquisition (2007), from available data, main agricultural workers were 35.1% in non-project affected mouzas and in project affected 22 mouzas it was 28.2%. In 2014 after improve in irrigation facility in non-project mouzas like Bhangaband, Ahammadpur, Saraswatipur, Gobardda, Putigerya, Mahishlot, Kadalawa, Brindabanpur, Rajbandh, Ahammadpur, Metal, Bhangaband, Chensol, Pachakua, Maheswaripur mouza experienced increase in percentage of cultivators by 20–25% (Fig. 7).

But on the other hand at project site due to land acquisition farm size becomes too small, which is not sufficient to maintain their livelihood. As a consequence, a reverse situation has been obtained here. From Nutandihi, Banskopna, Chantibandh, Kharka Suli, Nitaipur, Ramraydi, Hatmari and Khairisol mouza more than 30% of agricultural workers are now being engaged in non-farm activities.

Agricultural composite index (CI) of development and rank

On the basis of above indicators followed by Narain et al. 2011, a CI of agricultural development along with ordinal rank and level of development has been calculated for 109 mouzas to compare between the situation in pre-acquisition (2007) and that in existing condition (2014). From Table 1 in 2007 before acquisition, Dudiabandi mouza was ranked in first place followed by Amla Bani (2nd), Ghosh Khira (3rd), Kharpuri (4th), Bagpi Chula (5th), Rajbandh (6th), Putigerya (7th), Kharka Suli (8th), Asta Kola (9th) and Saiyadpur (10th) mouza and these mouzas were consisted of an average of 64.5% net sown area, an average 35.1% of irrigated land, an average 42.1% of total population was depending on only agricultural activity.

After 5 years of land acquisition (2014) irrigation facility has been improved only at lower catchment and as a consequence more area has come under irrigation and due to delay of JSW project work local people are trying to invest more attention in this sector. From Table 1 it has been observed that in present condition (2014), mouza Rajbandh is ranked first in agricultural development followed by Putigerya (2nd), Dudiabandi (3rd), Kontai (4th), Gobardda

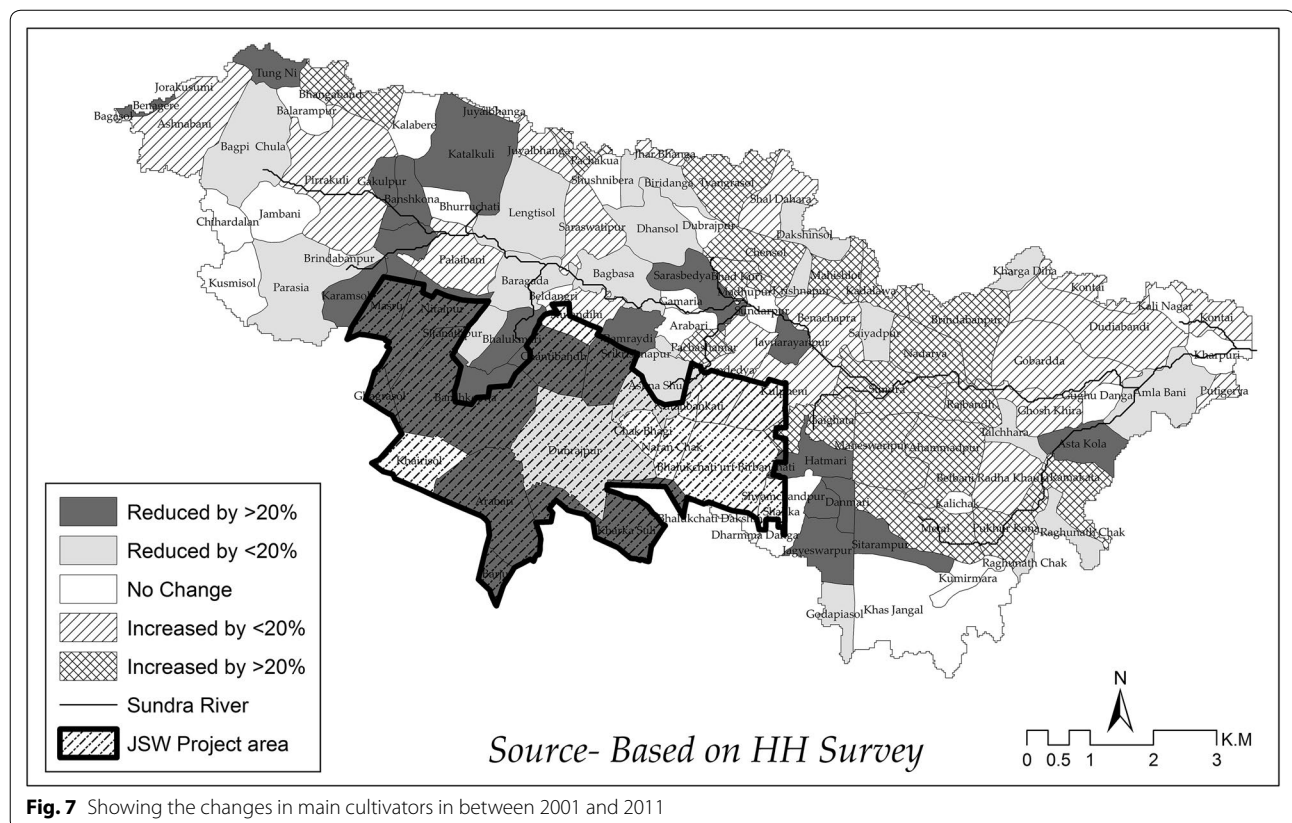


Fig. 7 Showing the changes in main cultivators in between 2001 and 2011

Table 1 Agricultural composite index (CI) of development and Rank of the mouzas in between 2007 and 2014. Source Author's own calculation

SL no.	Mouza	Area of mouza in sq km	2007			2014			Position gained (+) or lost(-) respect to 2007 C.I ranking
			CI	Rank	Level of development	CI	Rank	Level of development	
1	Rajbandh	0.45	0.29	6	High development	0.28	1	High development	(+5)
2	Putigerya	0.98	0.31	7	High development	0.37	2	High development	(+5)
3	Dudiabandi	1.74	0.13	1	High development	0.45	3	High development	(-2)
4	Kontai	3.55	0.39	15	High middle development	0.45	4	High development	(+11)
5	Gobardda	2.29	0.37	12	High development	0.45	5	High development	(+7)
6	Asta Kola	1.15	0.33	9	High development	0.46	6	High development	(+3)
7	Maheswaripur	1.26	0.39	16	High middle development	0.48	7	High development	(+9)
8	Ghosh Khira	0.55	0.28	3	High development	0.48	8	High development	(-5)
9	Ahammadpur	1.38	0.39	19	High middle development	0.5	9	High development	(+10)
10	Amla Bani	1.67	0.26	2	High development	0.55	10	High development	(-8)
11	Kharpuri	0.44	0.28	4	High development	0.55	11	High development	(-7)
12	Bagpi Chula	1.71	0.29	5	High development	0.56	12	High development	(-7)
13	Talchhara	0.38	0.38	13	High middle development	0.56	13	High middle development	No change
14	Madhupur	0.09	0.39	18	High middle development	0.57	14	High middle development	(+4)
15	Baragada	0.85	0.47	39	Low middle development	0.59	15	High middle development	(+24)
16	Sarasbedya	0.74	0.46	32	High middle development	0.59	16	High middle development	(+16)
17	Saiyadpur	0.47	0.34	10	High development	0.59	17	High middle development	(-7)
18	Kadalawa	1.12	0.36	11	High development	0.59	18	High middle development	(-7)
19	Sitanathpur	0.47	0.5	57	Low middle development	0.6	19	High middle development	(+38)
20	Dhansol	1.09	0.48	48	Low middle development	0.6	20	High middle development	(+28)
21	Raghunath Chak	1.01	0.41	20	High middle development	0.6	21	High middle development	(-1)
22	Gakulpur	0.26	0.47	36	Low middle development	0.61	22	High middle development	(+14)
23	Saraswatipur	0.9	0.46	31	High middle development	0.61	23	High middle development	(+8)
24	Mahishlot	0.58	0.6	81	Low development	0.61	24	High middle development	(+57)
25	Nadarya	0.93	0.48	47	Low middle development	0.61	25	High middle development	(+22)
26	Tyangrasol	3.03	0.51	60	Low middle development	0.59	26	High middle development	(+34)
27	Brindabanpur	1.49	0.38	14	High middle development	0.62	27	High middle development	(-13)
28	Dakshinsol	0.72	0.56	74	Low middle development	0.62	28	High middle development	(+46)
29	Lengtisol	1.68	0.47	43	Low middle development	0.62	29	High middle development	(+14)
30	Sundra	1	0.48	46	Low middle development	0.62	30	High middle development	(+16)

Table 1 continued

SL no.	Mouza	Area of mouza in sq km	2007			2014			Position gained (+) or lost(−) respect to 2007 C.I ranking
			CI	Rank	Level of development	CI	Rank	Level of development	
31	Ramraydi	1.12	0.47	42	Low middle development	0.63	31	High middle development	(+11)
32	Srikrishnapur	0.18	0.49	53	Low middle development	0.63	32	High middle development	(+21)
33	Nutandihi	0.71	0.46	29	High middle development	0.63	33	High middle development	(−4)
34	Karamsol	0.54	0.47	38	Low middle development	0.64	34	High middle development	(+4)
35	Bagbasa	1.07	0.45	27	High middle development	0.65	35	High middle development	(−8)
36	Palaibani	1.3	0.48	44	Low middle development	0.66	36	High middle development	(+8)
37	Shalika	1.02	0.48	49	Low middle development	0.66	37	High middle development	(+12)
38	Gaighata	0.86	0.47	41	Low middle development	0.66	38	High middle development	(+3)
39	Pirrakuli	2.59	0.47	37	Low middle development	0.67	39	High middle development	(−2)
40	Banshkona	0.7	0.45	22	High middle development	0.67	40	High middle development	(−18)
41	Betbani Radha Khauki	0.91	0.5	58	Low middle development	0.67	41	High middle development	(+17)
42	Shal Dahara	1.56	0.55	71	Low middle development	0.68	42	High middle development	(+29)
43	Ashnabani	2.59	0.51	62	Low middle development	0.68	43	High middle development	(+19)
44	Krishnapur	0.17	0.53	68	Low middle development	0.68	44	High middle development	(+24)
45	Dubrajpur	2.59	NA	NA	NA	0.69	45	High middle development	NA
46	Benachapra	0.91	0.51	61	Low middle development	0.69	46	Low middle development	(+15)
47	Pukhur Kona	0.74	0.57	76	Low development	0.7	47	Low middle development	(+29)
48	<i>Banshkopna</i>	2.87	0.45	24	High middle development	0.72	48	Low middle development	(−24)
49	Kali Nagar	0.28	0.51	65	Low middle development	0.72	49	Low middle development	(+16)
50	<i>Masru</i>	1.03	0.45	26	High middle development	0.73	50	Low middle development	(−24)
51	<i>Chantibandh</i>	0.92	0.45	23	High middle development	0.73	51	Low middle development	(−28)
52	Bhad Kuri	0.34	0.56	75	Low development	0.73	52	Low middle development	(+23)
53	<i>Ashna Shuli</i>	1.06	0.46	30	High middle development	0.74	53	Low middle development	(−23)
54	Arabari	1.94	0.51	64	Low middle development	0.74	54	Low middle development	(+10)
55	Sitampur	0.63	0.57	79	Low development	0.74	55	Low middle development	(+24)
56	<i>Kulpheni</i>	1.35	0.39	17	High middle development	0.76	56	Low middle development	(−39)
57	Kalabere	0.7	NA	NA	NA	0.76	57	Low middle development	NA

Table 1 continued

SL no.	Mouza	Area of mouza in sq km	2007			2014			Position gained (+) or lost(−) respect to 2007 C.I ranking
			CI	Rank	Level of development	CI	Rank	Level of development	
58	Biridanga	0.73	0.49	52	Low middle development	0.76	58	Low middle development	(−6)
59	Jagywarpur	1.12	0.46	33	High middle development	0.77	59	Low middle development	(−26)
60	Ramakata	1.35	0.52	66	Low middle development	0.77	60	Low middle development	(+6)
61	Sundarpur	0.34	NA	NA	NA	0.77	61	Low middle development	NA
62	<i>Nitapur</i>	1.21	0.49	51	Low middle development	0.78	62	Low middle development	(−11)
63	Khas Jangal	7.5	0.45	21	High middle development	0.78	63	Low middle development	(−42)
64	Bhangaband	2.67	0.57	78	Low development	0.78	64	Low middle development	(+14)
65	<i>Barju</i>	0.99	0.47	40	Low middle development	0.78	65	Low middle development	(−25)
66	<i>Hatmari</i>	0.61	0.49	55	Low middle development	0.78	66	Low middle development	(−11)
67	Juyalbhang	2.35	0.5	59	Low middle development	0.79	67	Low middle development	(−8)
68	Tung Ni	1.89	0.62	82	Low development	0.79	68	Low middle development	(+14)
69	Durgadaspur	0.05	0.49	50	Low middle development	0.79	69	Low middle development	(−19)
70	Katakuli	1.97	0.51	63	Low middle development	0.8	70	Low middle development	(−7)
71	Shyamchandpur	0.18	0.58	80	Low development	0.8	71	Low middle development	(+9)
72	Pachashamar	0.33	NA	NA	NA	0.8	72	Low middle development	NA
73	<i>Kharka Suli</i>	1.58	0.31	8	High development	0.81	73	Low middle development	(−65)
74	<i>Jamdedya</i>	1.12	0.49	56	Low middle development	0.8	74	Low middle development	(−18)
75	Metal	1.19	0.55	72	Low middle development	0.81	75	Low middle development	(−3)
76	Parasia	2.01	0.45	25	High middle development	0.82	76	Low middle development	(−51)
77	Jaynarayanpur	0.37	0.47	35	Low middle development	0.82	77	Low development	(−42)
78	Kalichak	0.13	NA	NA	NA	0.83	78	Low development	NA
79	Godapiasol	2.33	0.66	84	Low development	0.84	79	Low development	(+5)
80	<i>Arabari</i>	0.26	0.46	28	High middle development	0.84	80	Low development	(−52)
81	Kharga Diha	1.52	0.46	34	High middle development	0.84	81	Low development	(−47)
82	Bhalukmari	0.49	0.53	69	Low middle development	0.84	82	Low development	(−13)
83	Chensol	0.83	0.52	67	Low middle development	0.86	83	Low development	(−16)
84	Benagere	1.98	0.48	45	Low middle development	0.87	84	Low development	(−39)
85	Ghagrasol	1.26	0.54	70	Low middle development	0.87	85	Low development	(−15)

Table 1 continued

SL no.	Mouza	Area of mouza in sq km	2007			2014			Position gained (+) or lost(−) respect to 2007 C.I ranking
			CI	Rank	Level of development	CI	Rank	Level of development	
86	Danmari	0.25	0.62	83	Low development	0.88	86	Low development	(−3)
87	Jhar Bhanga	2.05	0.71	85	Low development	0.91	87	Low development	(−2)
88	<i>Khairisol</i>	1.0	0.49	54	Low middle development	0.91	88	Low development	(−34)
89	Pachakua	3.18	0.56	73	Low middle development	0.92	89	Low development	(−16)
90	Jorakusumi	1.68	0.57	77	Low development	0.94	90	Low development	(−13)
91	Gamaria	0.26	NA	NA	NA	NA	NA	NA	NA
92	Kumirmara	0.41	NA	NA	NA	NA	NA	NA	NA
93	Bhurruchati	0.35	NA	NA	NA	NA	NA	NA	NA
94	Bagasol	0.39	NA	NA	NA	NA	NA	NA	NA
95	Balarampur	0.37	NA	NA	NA	NA	NA	NA	NA
96	Chihardalan	1.13	NA	NA	NA	NA	NA	NA	NA
97	Jambani	0.82	NA	NA	NA	NA	NA	NA	NA
98	Brindabanpur	0.08	NA	NA	NA	NA	NA	NA	NA
99	Kusmisol	0.8	NA	NA	NA	NA	NA	NA	NA
100	Shushnibera	0.48	NA	NA	NA	NA	NA	NA	NA
101	Gughu Danga	0.24	NA	NA	NA	NA	NA	NA	NA
102	Beldangri	0.08	NA	NA	NA	NA	NA	NA	NA
103	<i>Nutanbankati</i>	1.12	NA	NA	NA	NA	NA	NA	NA
104	Chak Bhagi	0.33	NA	NA	NA	NA	NA	NA	NA
105	<i>Naran Chak</i>	0.4	NA	NA	NA	NA	NA	NA	NA
106	<i>Bhalukchati urf Birbanchati</i>	1.71	NA	NA	NA	NA	NA	NA	NA
107	Bhalukchati Dakshin	0.6	NA	NA	NA	NA	NA	NA	NA
108	<i>Dubrajpur</i>	0.2	NA	NA	NA	NA	NA	NA	NA
109	Dharmma Danga	0.41	NA	NA	NA	NA	NA	NA	NA

(5th), Asta Kola (6th), Maheswaripur (7th), Ghosh Khira (8th), Ahammadpur (9th), Amla Bani (10th) mouza. These mouzas are located at the lower catchment of Sundra basin outside the project affected area. These mouzas highly depend on agricultural activity due to availability of good quality of agricultural land and fertile soil. On an average 69.1% of total area is net sown area. More than 45.8% area has irrigation facility. On an average, 59.6% of total population is engaged in agricultural activity.

A dramatic change in mouzas' ordinal rank has been observed among the projected affected mouzas. Most of the project affected mouzas have been retreated from their position, from those of 2007 (Table 1). Before land acquisition (2007) Kharka Suli, Kulpheni, Chantibandh, Banskopna and Masru mouza ranked by 8th, 17th, 23rd, 24th and 26th respectively but after acquisition in 2014 these mouzas are now standing on 73rd, 56th, 51st, 48th and 50th position respectively.

A cursory look at Column of CI of Table 1 in 2014 reveals that the CI of agricultural development varies from 0.28 to 0.94 that indicates a greatest regional disparity existing in agricultural development. From the above discussion it may be concluded that the lower catchment is in relatively advanced stage with comparison of upper catchment. Local people of the project affected mouzas are in severe condition. So a proper planning is needed immediately to reduce these regional disparities in agricultural sector.

Relative share of population under different level of agricultural development

Tables 2 and 3 present the number of mouzas lying in different levels of development on basis of the measure of development (Eq. 1.4) in agricultural sector in existing condition (2014) and that was in 2007, before acquisition.

Table 2 Number of mouzas with percentage of area and population under different level of agricultural development in 2014. Source Author's own calculation

Level of development	Number of mouzas	Name of mouzas	% of total population	% of total area
Agricultural level of development				
High	12	Rajbandh, Ahammadpur, Bagpi Chula, Dudiabandi, Ghosh Khira, Gobardda, Amla Bani, Asta Kola, Putigerya, Kharpuri, Kontai, Maheswaripur	17.46	16.92
High middle	33	Tyangrasol, Shal Dahara, Dakshinsol, Mahishlot, Kadalawa, Brindabanpur, Nadarya, Saiyadpur, Gakulpur, Lengtisol, Saraswatipur, Ashnabani, Madhupur, Krishnapur, Dhansol, Dubrajpur, Talchhara, Betbani Radha Khauki, Raghunath Chak, Banskona, Pirrakuli, Palaibani, Karamsol, Baragada, Bagbasa, Nutandihi, Srikrishnapur, Sarasbedya, Sundra, Sitanathpur, Ramraydi, Gaighata, Shalika	34.46	37.41
Low middle	31	Metal, Sitarampur, Khas Jangal, Kalabere, Katakuli, Juyalbhanga, Bhangaband, Tung Ni, Bhad Kuri, Biridanga, Kali Nagar, Pukhur Kona, Ramakata, Durgadaspur, Parasia, Masru, Pachashamar, Sundarpur, Benachapra, Shyamchandpur, Jagyeswarpur, Nitaipur, Banskopna, Chantibandh, Ashna Shuli, Jamdedya, Kulpheni, Hatmari, Kharka Suli, Arabari, Barju	30.08	39.38
Low	14	Kalichak, Godapiasol, Jorakusumi, Benagere, Chensol, Jhar Bhang, Pachakua, Kharga Diha, Arabari, Jaynarayanpur, Danmari, Bhalukmari, Khairisol, Ghagrasol	17.99	6.29

It has been concluded that in existing condition (2014) (Fig. 8) only 12 mouzas are found to be in high level of development category in agricultural sector that covers 16.9% of total area and 17.4% of total population. Before acquisition (2007) (Fig. 9) 14.6% of total population covering 15.8% area is characterised by high level of development. High middle level development category covers 34.4% of total population in 33 mouzas spread over 37.4% of total area in 2014. But in 2007, there was 26.1% of total population in 22 mouzas. 45 mouzas are found to be in low and low middle development category in 2014 that covers 45.8% of the total area and 48.1% of population, but before acquisition (2007) total 51 mouzas were

observed in this category that covered 52.1% of total area and 59.2% of total population.

No mouza at project site has been observed in high development category after acquisition. At project site four mouzas namely Nutandihi, Ramraydi, Gaighata and Shalika are found to be in high middle level of agricultural development category in 2014 (Table 4). These mouzas cover 19.2% of project affected area and 22.04% of project affected population. Before acquisition in 2007 six project affected mouzas were found in high middle level development category and these mouzas covered by 39.4% of total project affected population and 46.4% of project affected area. In low level

Table 3 Number of mouzas with percentage of area and population under different level of agricultural development in 2007. Source Author's own calculation

Stages of development	Number of mouzas	Name of mouzas	% of total population	% of total area
Agricultural level of development				
High	12	Kadalawa, Saiyadpur, Rajbandh, Bagpi Chula, Dudiabandi, Ghosh Khira, Gobardda, Amla Bani, Asta Kola, Putigerya, Kharpuri, Kharka Suli	14.62	15.80
High middle	22	Brindabanpur, Ahammadpur, Khas Jangal, Saraswatipur, Madhupur, Kharga Diha, Talchhara, Kontai, Raghunath Chak, Banskona, Parasia, Masru, Bagbasa, Nutandihi, Arabari, Sarasbedya, Maheswaripur, Jagyeswarpur, Banskopna, Chantibandh, Ashna Shuli, Kulpheni	26.11	32.07
Low middle	40	Tyangrasol, Shal Dahara, Dakshinsol, Nadarya, Metal, Gakulpur, Katakuli, Lengtisol, Juyalbhanga, Benagere, Ashnabani, Krishnapur, Chensol, Dhansol, Biridanga, Pachakua, Kali Nagar, Betbani Radha Khauki, Ramakata, Pirrakuli, Palaibani, Durgadaspur, Karamsol, Baragada, Srikrishnapur, Jaynarayanpur, Benachapra, Sundra, Sitanathpur, Bhalukmari, Nitaipur, Ramraydi, Jamdedya, Gaighata, Hatmari, Arabari, Khairisol, Barju, Ghagrasol, Shalika	46.74	45.51
Low	11	Mahishlot, Sitarampur, Godapiasol, Bhangaband, Tung Ni, Jorakusumi, Bhad Kuri, Jhar Bhang, Danmari, Shyamchandpur, Pukhur Kona	12.52	6.63

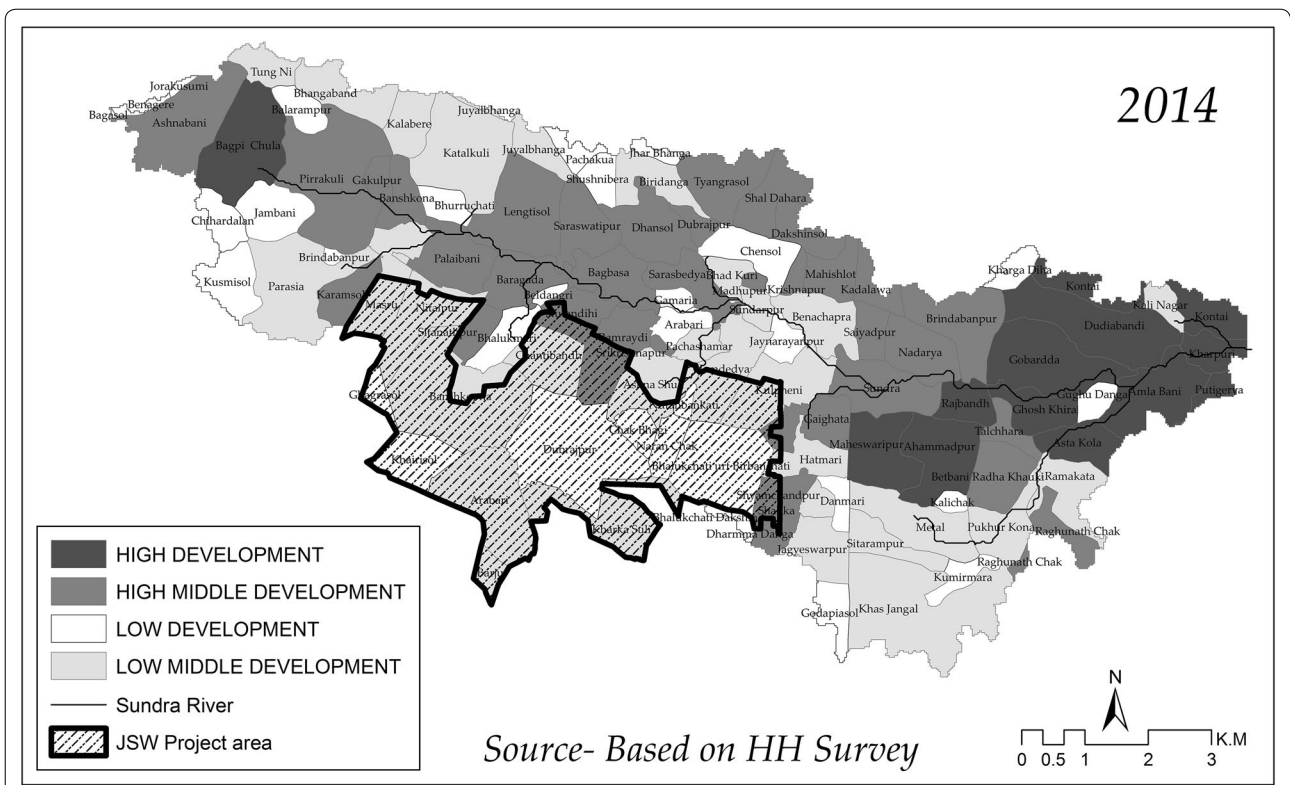


Fig. 8 Level of development in agricultural sector after land acquisition (2014)

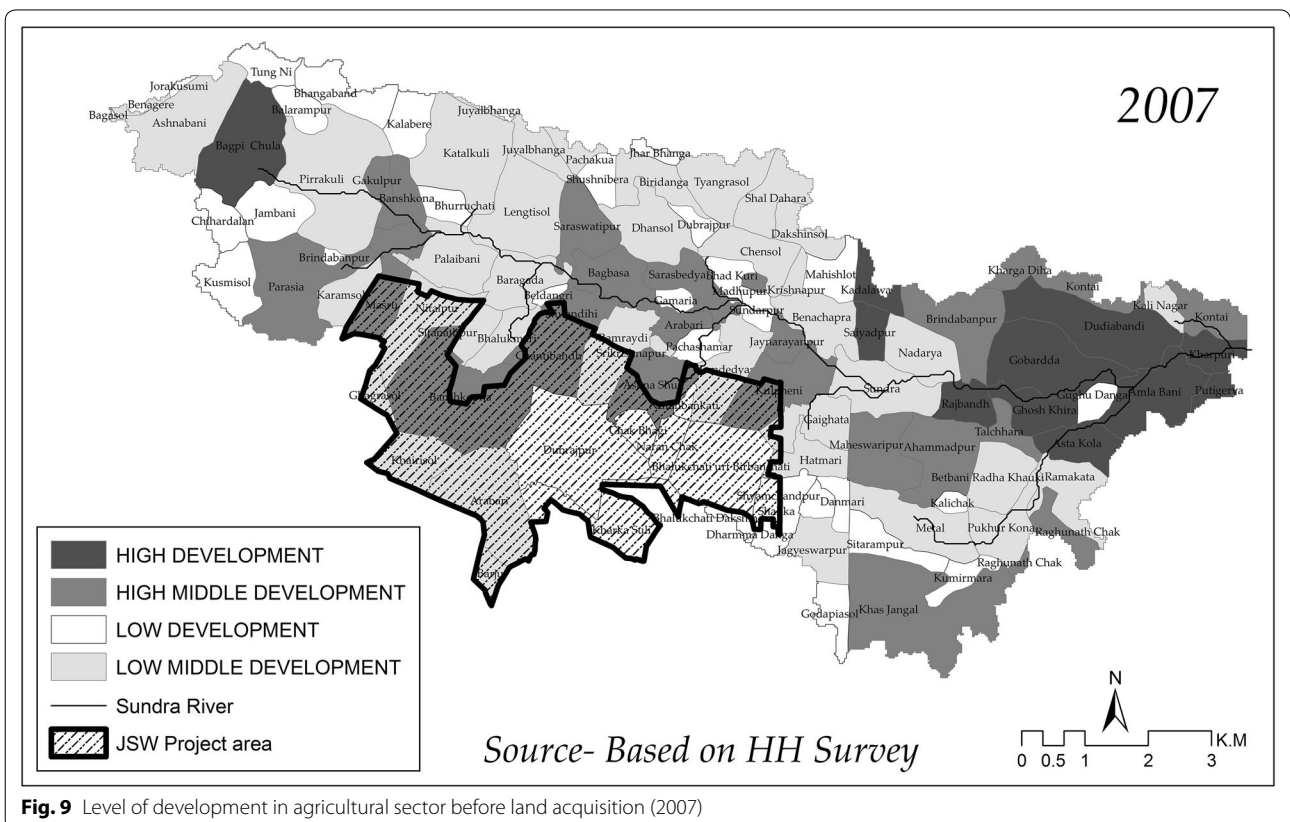


Fig. 9 Level of development in agricultural sector before land acquisition (2007)

Table 4 Number of project affected mouzas with percentage of area and population under different level of agricultural development in 2014 and 2007. Source Author's own calculation

Stages of development	Number of mouzas	Name of mouzas	% of total population	% of total area
After land acquisition (2014)				
High	NIL	NIL	NIL	NIL
High middle	4	Nutandihi, Ramraydi, Gaighata, Shalika	22.04	19.24
Low middle	10	Masru, Nitaipur, Banshkopna, Chantibandh, Ashna Shuli, Jamdedya, Kulpheni, Hatmari, Kharka Suli, Barju	70.64	73.12
Low	3	Arabari, Khairisol, Ghagrasol	7.32	7.64
Before land acquisition (2007)				
High	1	Kharka Suli	0.26	7.38
High middle	6	Masru, Nutandihi, Banshkopna, Chantibandh, Ashna Shuli, Kulpheni	39.45	46.45
Low middle	10	Nitaipur, Ramraydi, Jamdedya, Gaighata, Hatmari, Shalika, Arabari, Khairisol, Barju, Ghagrasol	60.30	46.17
Low	NIL	NIL	NIL	NIL

development category, 7.3% of total project affected population has been distributed in three mouzas namely Arabari, Khairisol and Ghagrasol and that covers by 7.6% of total project affected area in 2014. But in 2007 before acquisition no mouza was in this category. So, agricultural development has been observed outside of project affected mouzas. The major causes of low development in project site are reducing of farm size due to land acquisition and inadequate irrigation facilities that affected the paddy production adversely. Other causes of backwardness include poor quality of land, low area under commercial crop, low crop density, poor doses of fertilizer, etc. Action is required to be taken in these mouzas for improving the level of development in agriculture sector.

Conclusion

Economic planning at the grass root level is necessary for bringing about uniform regional development. The level of development of project affected and non-project affected mouzas is studied with the help of CI based on optimum combination of different development indicators. In order to get a clear picture of regional disparities, the level of development is assessed separately for agricultural sector, infrastructural sector and socio-economic sector using CI of level of development method by Narain et al. (2011). Extensive deterioration in the level of development is observed in the project areas after land acquisition. The maximum reduction in net sown area has been observed due to land acquisition within project area like as Dubrajpur (73.6%), Chantibandh (87.1%), Chak Bhagi (56.7%), Ramraydi (51.4%), Ashna Shuli (39.5%) and Nitaipur (38.1%) mouza. As a consequence farm size becomes small that leads to maximum share of

marginal workers at Khairisol (90%), Nutandihi (84.4%), Arabari (75.3%), Banshkopna (67.7%), Chantibandh (58.1%) and Ashna Shuli (61.2%). Major reduction in crop income has been observed at Banshkopna (78.9%), Ashna Shuli (79.9%), Kharka Suli (77.4%), Gaighata (78.0%) at project site. At project affected mouzas more than 30% of agricultural workers are now being engaged in non-farm activities and try to reduce the livelihood vulnerability. Composite Index of agricultural development varies from 0.28 to 0.94 that indicates a greatest regional disparity existing in agricultural development. After detailed analysis it has been observed that after acquisition (2014) 56.31% of total project area is in low and low middle development category while it was 43.06% before acquisition (2007). It implies that after closure of proposed project work majority of population now exists in low middle and low development category that means socio-economic development has been stopped here. So there is an immediate need for proper planning on project affected mouzas to make alternative livelihood opportunities with help of local NGOs and Government.

Abbreviations

Mtpa: million ton per annum; CI: composite index; NGO: Non-Government Organization; CPP: Captive Power Plant; MW: mega watt; km: kilo meter; sq: square; kg: kilo gram; SD: standard deviation.

Authors' contributions

SPS conceived of the study, carried out field work, analyzed data, drafted the manuscript and coordinate the whole work. RKM gave technical support and supervised the whole work, helped interpret the result and edited the paper. Both authors read and approved the final manuscript.

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The authors declare that they have no competing interests.

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