

Development of tubewell irrigation and its impact on farmer's socio-economic condition of Dakshin Dinajpur district, West Bengal

Manik Halder (✉ manikhalder2018@gmail.com)

Raiganj University

Doli Roy

Independent Researcher, Cooch Behar Panchanan Barma University

Ripom Paul

Raiganj University

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Abstract

Irrigation is a significant indicator to increase agricultural production. It also shapes the socio-economic status of farmers to some extent. Hence, irrigated water has to be used efficiently and judiciously. In this paper, an attempt has been made to show the spatial variation in the level of irrigation development of tube wells. Besides, an effort has been made to show the impact of tube well irrigation on farmers' socio-economic status. To do so a cost-benefit analysis has been done. The present study is based on both primary and secondary sources of data. A positive relation has been found between tube well irrigated area and total irrigated area as changes in tube well irrigated area has influences on the overall irrigation system in the district. Hili block has the highest percentage of area under tube well irrigation. While Tapan block has the lowest percentage of tube well irrigated area. The key occupation of the study area is agriculture. The farmers of the study area are poorly represented in education as the majority of them have an education of upper primary level. A positive impact of tube well irrigation has been seen on farmers' income through cost-benefit analysis.

Introduction

The development of agriculture is varied from place to place with time. Historically, agriculture is the main economy of half of the countries in the world and even it is the backbone of the economy in developing countries like India, Sri Lanka, and Bangladesh. (Khan et al., 2010). India's share of GDP (19.90%, 2020-21) in agriculture has been increased (Kapil, 2021). The development of agriculture depends on irrigation, improved seeds, fertilizer, and the size of agricultural land (Gulati & Sharma, 1995). Among them, irrigation plays a crucial role in the success of agriculture (Diao et al., 2007). Irrigation is an important element to enhance productivity and to change cropping patterns in the farming system and its impact reduces poverty (Elumalai Kannan and Sujata Sundaram, 2011). The demand of irrigation has been increased in agriculture sector to supply food for growing population (Krishnaprabu, 2020). The study area comes under the monsoon climate which is irregular in nature (Qian et al., 2016). As a result, the farmers are choosing irrigation facilities like tank, tube well and don't rely on irregular monsoonal rainfall (Afzal & Hoque, 2018). It means that successful crop production can be effective with irrigation in drought prone areas (Ara et al., 2016; Döll, 2002; Li et al., 2011; Shahid, 2011).

There are many types of irrigation systems such as Canal, Tube well, RLI (river lift irrigation), ODW (open dug well), tank, etc. currently, tube wells are the easiest, suitable, and appropriate method of accessing groundwater resources. Based on depth, tube wells are categorized into various types; STW (shallow tube well), HDTW (high deep tube well), MDTW (middle deep tube well), and LDTW (low deep tube well). The percentage of tube well is the highest among other sources of irrigation facilities in Dakshin Dinajpur district. The net sown area was 188.13 thousand hectares in 2016-17 when the total irrigated area has increased to 59.51 thousand hectares in 2016-17. Several studies have described agriculture production (Singh et al., 2013), agricultural mechanization, utilization of groundwater for irrigation suitability in the alluvial aquifer of Dakshin Dinajpur district (Barua et al., 2021). But none of the studies focuses on the development of tube well irrigation and its impact on farmers' socio-economic condition. Irrigation facility is interconnected with development related issues like social, economic and political at local, national and global levels (Fuso Nerini et al., 2017; Stephan et al., 2018). The cost and returns of major farming systems have been analyzed to measure the impact on the socio-economic condition of farmers (David et al., 2013). Here, emphasis has been paid to collect primary data of the socio-economic aspect of farmers and farming practices that affect the small-scale farmers (Berg Van den, 2013; Gebrehiwot Yihdego, 2015).

Study area

The study area Dakshin Dinajpur is situated at 26°35'15" north latitude to 25°10'55" north latitude and 89°00'30" east longitude to 87°48'37" east longitude (Wikipedia, n.d.). After Independence, Dinajpur was divided into East Dinajpur and West Dinajpur. West Dinajpur, part of West Bengal was a single district. But after 1992, again it was divided into Dakshin Dinajpur and Uttar Dinajpur (Saha, 2018). Dakshin Dinajpur is bounded in its north by Uttar Dinajpur and west, Malda on its southern part, and Bangladesh on its east and south. This district includes two sub-division, eight blocks, and 2317 villages. The main rivers of this study area are Punarhaba, Atryee, and Tangon. Every year, these rivers flood on its bank area. Alluvial is deposited near the riverbank area like Balurghat, Hili, Kumarganj, Gangaranpur, Harirampur, Banshiharitha are suitable for paddy cultivation. Rice, jute, potato, wheat, maize, mustard, etc are the main crops of Dakshin Dinajpur district (Barua et al., 2021).

<Figure:1 Location Map of the study area >

Database And Methodology

The present study is based on both primary and secondary data sources. Data were collected from different offices mainly irrigation development office of Dakshin Dinajpur, agriculture development office in Dakshin Dinajpur, district statistical hand book, published and unpublished record of various offices, etc. to discuss the development of tube well irrigation facilities. In order to analyze the influence of tube well irrigation on socio-economic status among marginal, small, and semi-medium farmers in the Dakshin Dinajpur district of West Bengal, an extensive field survey was carried out. A pilot survey was done to know the nature and extent of irrigation systems and the characteristics of farmers. Villages were selected randomly based on pilot survey and the main criteria behind selecting sample villages (8 Villages) is that the villages should have marginal,

small, and semi-medium farmers. Stratified random sampling method was chosen to collect primary data based on farmer's divisions such as marginal, small, and semi-medium farmers. Yamane equation has been used to calculate sample size, mentioned below (Yamane, 1967)-

$$n = \frac{N}{1+N(e)^2}$$

where,

n = the sample size

N = the population size

e = the acceptable sampling error

Out of 268 targeted population, 160 samples were chosen at 95% confidence level and $e = 0.05$ were assumed. Direct observation was used to collect primary data through interview and questionnaire in the local language. The Choropleth map was prepared by using ArcGis 10.5 software. Bivariate analysis has been done between tube well irrigated area and total irrigated area; STW and HDTW through using SPSS software. In order to get the idea about the impact of tube well irrigation on farmer's income, cost-benefit analysis was done by using the following formula-

Regression: $NR = AI - CP$

where,

NR = Net returns per hectares

AI = Annual income per hectare

CP = Cost of production per hectare.

Result And Discussion

Development of Tube well Irrigation

Simply, the development of tube well irrigation means the growth of construction and agricultural area covered by tube wells. Table 1 provides a detailed temporal of net shown area and tube well irrigation pertaining to its various types of irrigation system in the period of 2006-07 to 2016-17. There was an increasing trend of the net cultivated area from the year of 2006-07 up to 2009-10. In 2010-11, this trend became downward due to the effect of drought, and the intensity of traditional tube well practices were also changed in and after this period.

<Table 1>

A continuous rising trend of net sown area was again found in 2011-12. The tube well irrigation system has fluctuated from 2007-10 which was 27.98 hectares. The highest area of Tube well irrigation was 59.51 thousand hectares in 2016-17. While the lowest was 27.98 thousand hectares in 2006-07, 2007-08 and 2008-09.

<Figure:2 Scatter plot shows the relation between tube well irrigated area and total irrigated area in Dakshin Dinajpur district (2006-2017).>

So, it is quite cleared that the figures pertaining tube well irrigation were not distributed in linear manner across the considered time period. The result shows that there has been seen a positive relation between tube well irrigated area and total irrigated area because the changes in tube well irrigated area affected overall irrigation system within the district.

<Figure:3 Scatter plot shows the relation between STW and HDTW in Dakshin Dinajpur district (2006-2017).>

In 2006-07, the tube well irrigated area was 15.00 thousand hectares and the total irrigated area was 35.49 thousand hectares respectively, which is currently raised to 20.93 and 59.51 thousand hectares respectively. But the relation between HDTW and STW is totally opposite to earlier relation. To be more precise, an increase in HDTW in a particular given time results in a decrease in STW, which specifies negative relation.

Present Scenario of Tube Well Irrigation

Tube well irrigation in Dakshin Dinajpur district plays an important role as there is not canal irrigation system. Some of the blocks namely Balurghat, Hili, Kumarganj, Gangaranpur, Harirampur, Banshihari are situated near the river bank of Atryee, Punarbhaba, and Tangon. Hence, there

has been seen alluvial soil that is acidic in nature. Only laterite soil is found in Tapan block. Tube well irrigation has changed the cropping pattern and productivity and productivity in many parts of the country.

<Table-2>

Table 2 shows that Hili has the highest tube well irrigated area of 78%. in 2016-17 and this is the highest among all the blocks of South Dinajpur. The block-wise decreasing order of tube well irrigation is as follows Harirampur, Bansihari, Kushimandi, Balurghat, Gangarampur, Kumarganj, Tapan.

<Figure:4 Percentage of Area Under Tube Well Irrigation >

The sharp increase indicates the development of tube well irrigation is dominated by installation of STW, followed by MDTW, LDTW, and other important projects like West Bengal Accelerated Development project of Minor Irrigation, Rural development Infrastructure Fund in All blocks of South Dinajpur district.

Tube well Irrigation and Socio-economic status of Farmers

The development of agriculture relies on irrigation facilities. Availability of irrigation facilities changes the cropping pattern as well as crop production (You et al., 2011). The impact of irrigation transforms the farm characteristics, structure of crop prices, production instability, labor income, and farm income inequality (Peter Timmer, 1988). The farm household has been divided into 3 categories to discuss the socio-economic condition of farmers. These are- According to the census of India, 2011-

1. *Marginal (<1 hectare)*
2. *Small (1 to 2 hectares)*
3. *Semi-medium (>2 hectares)*

Family Size

Man power is necessary for commercial subsistence agriculture (Gurri & Moran, 2002). Prior to modern days, Large family was considered as an asset as more people could engage in the agricultural activities thus raising the family income. But at present, this thinking has been changed in agrarian society. Hence, the size of family indicates both social and economic status. Here, the table-3 shows the family size has been grouped into 3 categories, i.e., less than 4, 4 to 6, and more than 6. The total number of marginal farmers are 80 persons. 9 (11.25%) has family size less than 4, 68 (85%) has 4 to 6 and only 3(3.75%) family has more than 6 persons in their respective family.

<Table-3>

Out of 55 small farmers 8 (14.54%) has family size less than 4, 45 (81.81%) has 4 to 6, and 2 (3.63%) family has more than 6 persons in their family. Again, in case of Semi-medium farmers, out of 25 farmers only 2(8%) has family size less than 4, 22 (88.88%) has 4 to 6 and 2 (4%) family has more than 6 persons in their respective family.

Educational Status

In our society, level of literacy indicates social status of an individual to some extent. According to the census of India 2011, a person who can write and read with understanding in any language, aged seven years or above, is called literate. The literacy rate provides higher socio-economic status in our society and also reduces growth of population. Table-4 shows the educational status of farmers.

<Table-4>

Among Marginal farmers, the highest proportion (45%) has done primary education, followed by upper primary (28.75%), higher secondary (7.5%), secondary (6.25%) and only a few (2.5%) have completed graduation level of education. Similarly, out of 55 in case of small farmer, 15 (27.23%) has completed primary level of education and others have completed Upper Primary (29.09%), Secondary (18.18%), Higher Secondary (9.09%), Graduation (10.91%). Again, the highest proportion (32%) of large farmers have completed Upper primary level of education. In Primary (12%) (%) Secondary (20%) Higher Secondary level (24%) and only Graduation (4%) of Semi-medium farmers have completed. In this table, it has been found that out of 160 samples, 13 persons are illiterate because of high-rate school drop, especially in girls and poverty. In agriculture, education is very important to know about the productivity and other associated aspects of agriculture (Francis et al., 2001).

Occupational Status

Generally occupational status is a common factor to measure socio-economic condition that indicates prestige, privilege, and even power in society (Ganzeboom et al., 1992). Agriculture is the main occupation of selected sampled farmers. In addition to agriculture, they engage in other activities such as business, service, etc.

Table-5 reveals the income-generating occupation pattern. Out of the total 80 Marginal farmers, the main category has been found of cultivation (70%), followed by Cultivation & Fishing (15%), Cultivation & Poultry Farming (8.5%), Cultivation & Business (5%), Cultivation and Service (1.25%). Among small farmers categories, the highest percentage has occupied by Cultivation (60%).

<Table-5>

Secondly, 7.27% of medium farmers involve in fishing with agriculture and only 5.45 % of them are engaged with cultivation and poultry farming. Nearly 20 percent do business along with cultivation. Few small farmers (9.09%) are engaged with both the agriculture and service sector.

Again, in semi-medium farmer, the highest percent (28%) involve in agriculture, followed by Cultivation & Fishing (16%), Cultivation & Poultry Farming (24%) Cultivation & Business (24%), Cultivation and Service (8%). So, it can be said that these farmers are relying on agriculture. Currently, the children of farmers are uninterested to do agriculture because of limited income from agriculture. While Marginal Farmers with families are migrating to the city.

House Status

People can easily guess a farmer's economic situation by looking at house types. Hence, Housing condition is an essential indicator that reflects the farmer's socio-economic condition. Table represented 4 types of houses.

<Table-6>

Kuccha houses have been seen among (30%) of Marginal farmers, (27.27%), small farmers, (24%) of semi-medium farmers. From the table, it is clear that a small portion of farmers lives in tiled houses i.e. (12%) of semi-medium farmers, (21.82%) of small farmers, (13.75%) of marginal farmers, and majority of farmers live in semi pucca house. The highest percentage of pucca houses (36%) has been found by semi-medium farmers, followed by small farmers (20%), small farmers (18.75%). From the table, it is concluded that there is a significant difference in house structure within the study area. The results indicate that a large portion of farmers live in pucca houses and even a few farmers have capability to make pucca houses but they like to stay in semi pucca houses.

Live-stock

Animal husbandry is an important asset of farmers. Most Animals are used for agriculture activities. Table-7 detail description of livestock in Dakshin Dinajpur district has been discussed. In Tapan Block (17.27%) had the maximum percentage of cattle followed by Balurghat (16.30%), Kushmandi (15.99%), Gangarampur (14.90%), Kumarganj (13.54%), Banshihari (8.62%), Harirampur (8.53%), Hili (4.84%). There is a negligible difference in cattle among the blocks. The cattle are important for the farmer because of it meets the needs of milk for children and manure for agriculture. Again, the highest percentage (30.71%) of buffalo has been found in Tapan block and the lowest percentage (0.96%) is found in Kushmandi block. But day by day the number of this animal are decreasing in nature in Dakshin Dinajpur district.

<Table-7>

Sheep takes 1st position in Tapan (33.28%) block after that Kumarganj(24.81%) occupies 2nd position among all blocks. Banshihari, Harirampur, Gangarampur, Balurghat, Hili block accounts for nearly 40% of sheep. Just only 3.10% of sheep have been seen in Kushmandi block. In Kushmandi block, only 3% of sheep have been seen. It is found that in poor irrigated areas, sheep rearing is common practice. The highest percentage of distribution of goats has been seen in Kushmandi block (21.17%), followed by Tapan(21.17%) Balurghat (15.28%), Gangarampur(12.65%), Kumarganj(11.85%), Harirampur (9.47%), Banshihari (7.32%), Hili (5.08%). Aside from these, farmers are engaged with pig farming, poultry farming, and other domestic birds like duck, hen, pigeon. The chicken, eggs, and other animals are very important for farmers' income. So, the results reveal that livestock farming plays an important role as secondary source of income for the farmer.

Cost-Benefit Analysis of major Crops

Cost-benefit analysis is a systematic approach that provides the economic framework and is used to determine cost-effective and beneficial Strategies for achieving benefits (David. et.al.2013). CBA is important or irrigated crops like boro, maize, and other winter season crops. Farmer needs at least 30 days to apply water for producing boro crop. Here CBA has done on maize potato and boro crops analyze the influence of Tube well irrigation on farmer's economy. Table-8 shows the cost-benefit analysis of tube well irrigation system in Dakshin Dinajpur district. Here 3

major non-monsoonal crops have been taken that reflect the economic condition of the farmer. The total cost of Boro rice, maize, and potato are 23200, 18480, and 32040 rupees respectively. The total output of the same crop are 34180, 35510, and 66450 respectively. In this study area, tube well is main source of irrigation. This irrigation dominated area with good soil quality and environment increase productivity for agriculture of any crops and influence the economy of the farmer.

<Table-8>

Conclusion

The entire study reveals that tube well irrigation is the key factor behind the improvement of cultivation in Dakshin Dinajpur district as there are no canal irrigation facility. The cost-benefit analysis of tube well irrigation reveals a good economic impact on farmers for boro cultivation. Hence, tube well irrigation system plays an important role to enhance the quality of life of the farmer and reduce rural to urban migration problems. The most important point is that the area under tube well irrigation has decreased. But the overall irrigated area has increased in the district. The study suggests some policy and planning for the development of irrigation systems in the district. These are-

- Proper utilization of irrigated water use should be made in block with highest percentage of irrigated areas namely Kushmandi, Banshihari, Harirampur, and Hili blocks.
- STW, HDTW, MDTW, LTW should be installed in remote locations.
- Electricity near the river bank and diesel-powered pump sets may also help to boost water supply, particularly during Ravi season.
- Institutional arrangements, as well as technology, are very important in irrigation management (Sengupta, 1991).
- Another basic recommendation is to improve skill, knowledge about cultivation through training and education (Chambers & Ghildyal, 1985).
- The implementation of various irrigation schemes should be accompanied by proper monitoring and timely funding from the local government.

Declarations

Ethics approval and consent to participate

The present study used both primary and secondary data. Secondary data is available in public domain. During survey for primary data collection, no identifiable information has been recorded. Therefore, no ethical approval is required for conducting this study.

Consent for publication

Not applicable.

Availability of data and materials

The dataset mainly secondary data are available in different offices such as Irrigation development office of Dakshin Dinajpur, agriculture development office in Dakshin Dinajpur, district statistical hand book <http://wbpspm.gov.in/publications/District%20Statistical%20Handbook>. and primary data had been collected through field survey.

Competing interests

The authors declare no competing interests.

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Tables

Table 1. Spatio-Temporal Changes in Area under tube well Irrigation on Dakshin Dinajpur District (Thousand Hectares)

Year	Total Net Sown area	Tube Well Irrigation					Total Irrigated Area	% of Tube Well Irrigation to Total Irrigation Area
		HDTW	MDTW	LDTW	STW	Total		
2006-07	175.03	8.46	0.55	0.32	5.67	15.00	35.49	42.27
2007-08	184.67	5.38	0.34	0.32	5.71	11.75	27.98	41.99
2008-09	185.59	5.38	0.34	0.32	5.71	11.75	27.98	41.99
2009-10	185.71	5.38	0.34	0.32	5.71	11.75	27.98	41.99
2010-11	183.61	4.94	0.18	1.41	10.33	16.86	46.94	35.92
2011-12	192.78	4.74	0.17	2.25	15.39	22.55	52.56	42.90
2012-13	186.54	4.21	0.18	2.29	15.34	22.02	40.04	55.00
2013-14	186.60	2.81	0.14	1.86	13.95	18.76	52.29	35.88
2014-15	187.38	2.05	0.70	3.00	14.20	19.95	54.44	36.65
2015-16	188.42	1.91	0.16	3.72	14.23	20.02	57.17	35.02
2016-17	188.13	2.41	0.17	4.16	14.19	20.93	59.51	35.17

Source: District Statistical Hand Book, Dakshin Dinajpur (2006-2017)

Note:

HDTW- High-capacity Deep Tube well, **MDTW-** Middle capacity Deep Tube well, **LDTW-** Low-capacity Deep Tube well, **STW-** Shallow Tube well

Table-2: Block Level Area Covered Under Tube well irrigation.

Name of Block	Net Sown Area in Hectares	Tube Well Irrigation in Hectares			% of Tube Well Area to TNSA
		DTW	STW	Total	
Kushmandi	8595	2056	2968	5024	58.45
Banshahari	4495	1161	1524	2685	59.73
Harirampur	3638	675	1608	2283	62.75
Gangarampur	11301	1133	2096	3229	28.57
Kumarganj	10019	541	1736	2277	22.73
Tapan	11677	126	396	522	4.47
Balurghat	8202	1219	2896	4115	50.17
Hili	1658	288	1003	1291	77.86

Source: District Statistical Hand Book, Dakshin Dinajpur (2016-2017)

Table-3: Family size of the farmers

Particulars	Type of Farmers						Total
	Marginal		Small		Semi-medium		
	No	%	No	%	No	%	
<4	9	11.25	8	14.54	2	8	19
4 to 6	68	85	45	81.81	22	88	135
>6	3	3.75	2	3.63	1	4	6
Total	80	100	55	100	25	100	160

Source: Field Survey

Table-4: Level of Educational Status of Farmers

Particulars	Type of Farmers						Total
	Marginal		Small		Sem-medium		
	No	%	No	%	No	%	
Illiterate	8	10	3	5.45	2	8	13
Primary	36	45	15	27.27	3	12	54
Upper Primary	23	28.75	16	29.09	8	32	47
Secondary	5	6.25	10	18.18	5	20	20
Higher Secondary	6	7.5	5	9.09	6	24	17
Graduation	2	2.5	6	10.91	1	4	9
Total	80	100	55	100	25	100	160

Source: Field Survey

Table-5: Occupational Status of Farmers

Particulars	Type of Farmers						Total
	Marginal		Small		Sem-medium		
	No	%	No	%	No	%	
Cultivation	56	70.00	33	60.00	7	28.00	96
Cultivation & Fishing	12	15.00	4	7.27	4	16.00	20
Cultivation & Poultry Farming	7	8.75	3	5.45	6	24.00	16
Cultivation & Business	4	5.00	10	18.18	6	24.00	20
Cultivation and Service	1	1.25	5	9.09	2	8.00	8
Total	80	100	55	100	25	100	160

Source: Field Survey

Table-6: House Status of Farmers

Particulars	Type of Farmers						Total
	Marginal		Small		Sem-medium		
	No	%	No	%	No	%	
Kuccha	24	30	15	27.27	6	24	45
Semi Puccha	30	37.5	17	30.91	7	28	54
Pucca	15	18.75	11	20.00	9	36	35
Tiled	11	13.75	12	21.82	3	12	26
Total	80	100	55	100	25	100	160

Source: Field Survey

Table-7: Distribution of livestock

Name of the block	Live-stock											
	Cattle		Buffaloes		Sheep		Goats		Poultry Birds		Others (Pigs)	
	No	%	No	%	No	%	No	%	No	%	No	%
Kushmandi	83608	15.99	72	0.96	251	3.10	98693	21.17	214207	18.27	2487	7.30
Banshihari	45102	8.62	192	2.55	647	7.98	34107	7.32	79243	6.76	4122	12.09
Harirampur	44613	8.53	794	10.55	703	8.67	44122	9.47	138681	11.83	6012	17.64
Gangarampur	77924	14.90	1052	13.98	1182	14.58	58984	12.65	186712	15.92	4356	12.78
Kumarganj	70827	13.54	1694	22.51	2012	24.81	55216	11.85	136824	11.67	4792	14.06
Tapan	90342	17.27	2311	30.71	2698	33.28	80120	17.19	196012	16.71	6114	17.93
Balurghat	85268	16.30	1312	17.44	304	3.75	71219	15.28	153872	13.12	5392	15.82
Hili	25316	4.84	98	1.30	311	3.84	23681	5.08	67216	5.73	816	2.39
Total	523000	100.000	7525	100.00	8108	100.00	466142	100.00	1172767	100.00	34091	100.00

Source: Dy. Director, Animal Resources and Development Parishad Office, Dakshin Dinajpur, 2016-17.

Table-8: Cost-Benefit Analysis of Major Non-Monsoonal Crops in Dakshin Dinajpur District

Type of Irrigation	Crops	LC	PC	SC	FR		Pesticides		IC	MC	TC	HC	TE	TI	P
					OR	IN	Inse	Her							
Tube well Irrigation	Boro	3350	1300	1900	2200	2600	700	520	5000	870	1680	3650	23200	34180	11150
	Maize	3100	1100	2150	2920	2900	780	420	1000	1010	1600	1850	18480	35510	18170
	Potato	5600	1250	3750	4200	4200	1300	130	820	980	4750	6400	32040	66450	36340

Source: Field Survey

Note:

LC- Labour Cost PC-Ploughing Cost SC- Seed Cost
OR- Organic Cost IN- Inorganic Inse- Insecticides
Herb- Herbicides IC- Irrigation Cost MC- Maintenance Cost
TC- Transport Cost HC- Harvesting Cost TE- Total Expenditure
TI- Total Income P- Profit

Figures

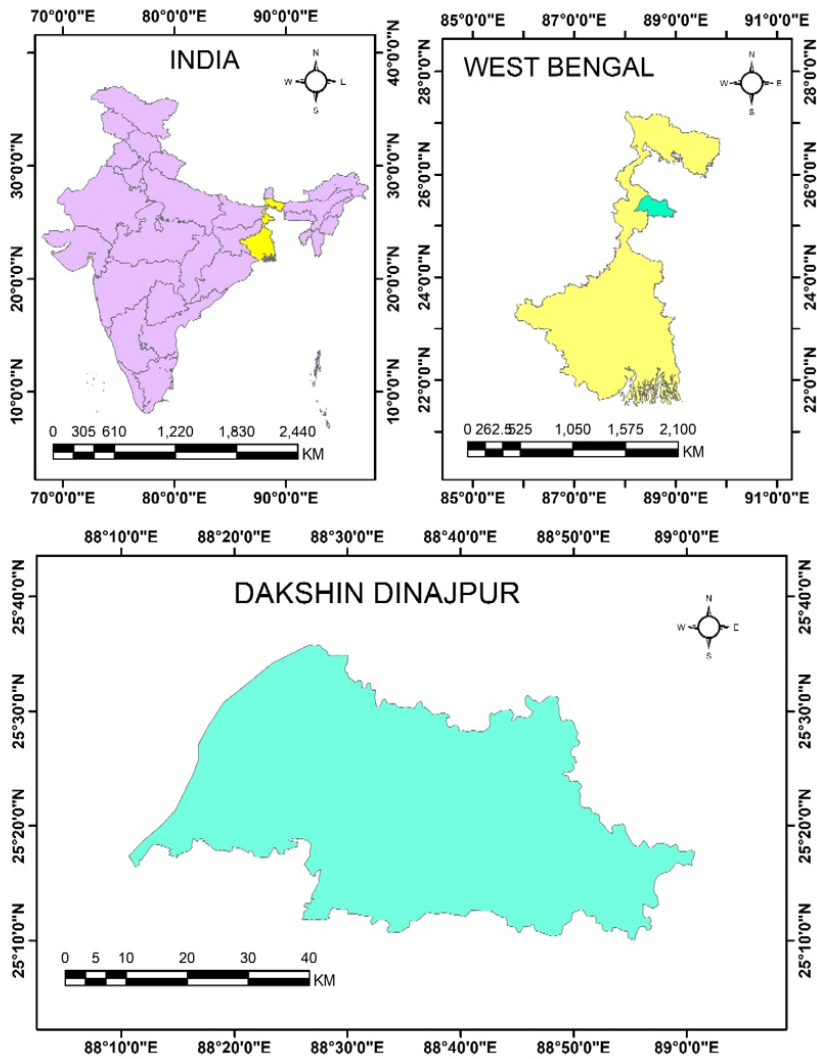


Figure 1
Location Map of the study area

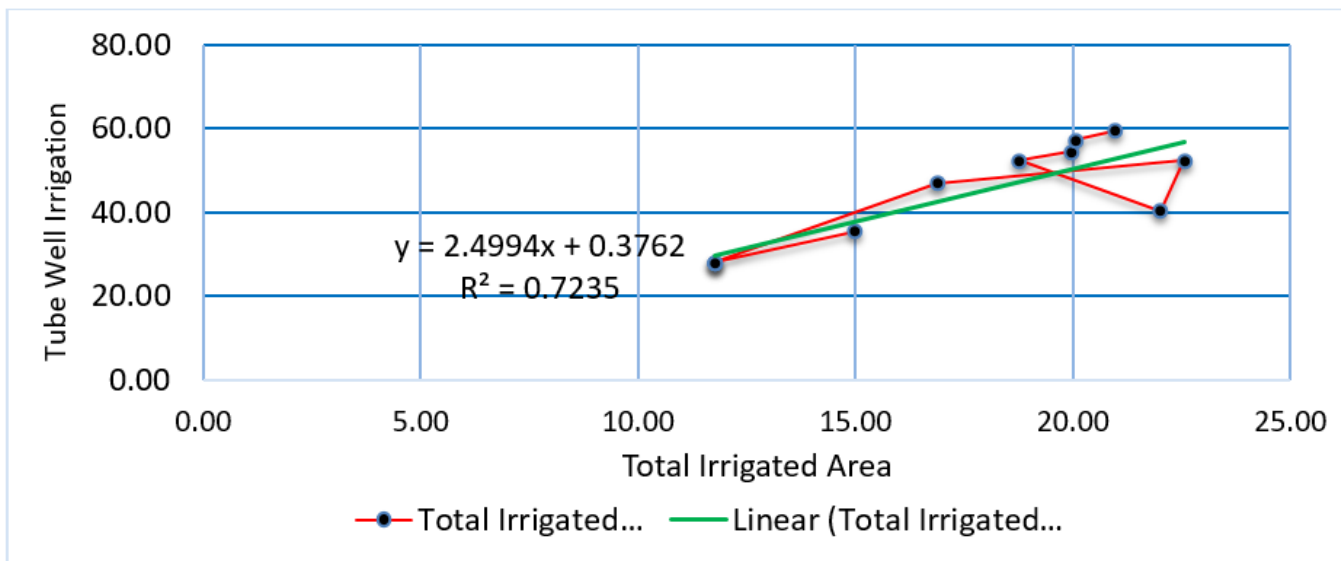


Figure 2

Scatter plot shows the relation between tube well irrigated area and total irrigated area in Dakshin Dinajpur district (2006-2017).

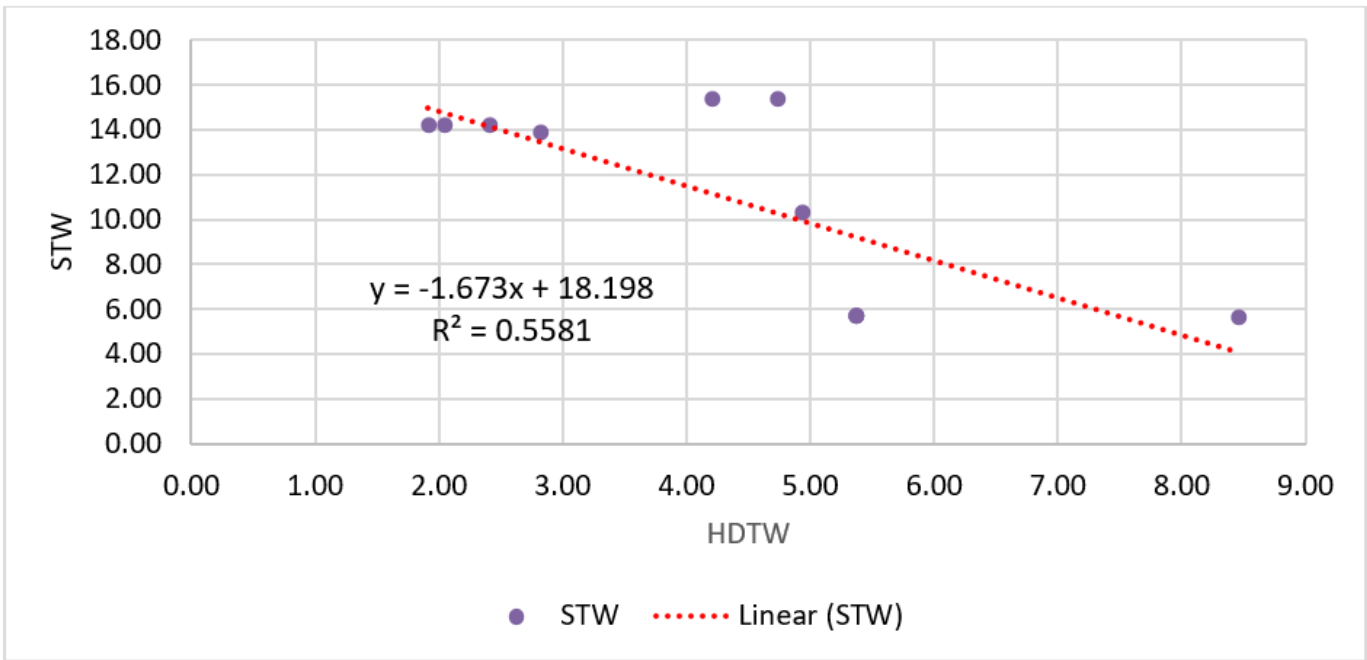


Figure 3

Scatter plot shows the relation between STW and HDTW in Dakshin Dinajpur district (2006-2017).

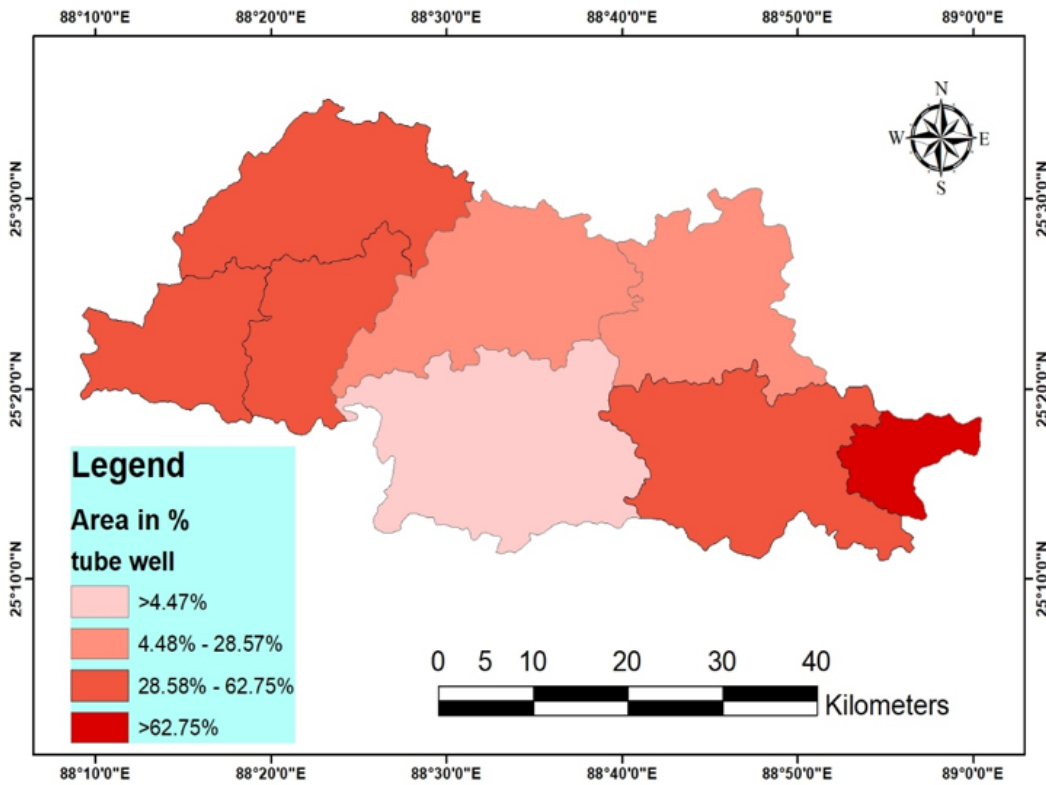


Figure 4

Percentage of Area Under Tube Well Irrigation