

## Situational analysis of agriculture in Kangshabati Irrigation Command Area, West Bengal: An observation to the issues and challenges

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**ABSTRACT :** The fulfillment of the ever increasing demand of food crops is a significant issue in India. To assure the food security of the common people, the agricultural practices should be improved in mand Area (KICA) is a vulnerable agricultural region of West Bengal. The region suffers from frequent agricultural producing proper technological know-how. The Kangshabati Irrigation Com drought. The present paper dealt with the status of agricultural production and the identification of spatial distribution of paddy culture both in rabi and kharif season in KICA. Primary as well as secondary data were incorporated properly to assess the irrigation system, trend and intensity of crop production at block levels. RS & GIS tools were applied to assess the spatial distribution of paddy in KICA. The study revealed that most of the district blocks of KICA are attributed with moderate to high level of agricultural drought where immediate attention is to be paid for the improvement of paddy culture as well as agricultural development.

**Key words:** RS & GIS, agricultural production, intensity, paddy culture, KICA.

Most of the developed nations have attained the steady and balance growth of agricultural production with the application of technological know-how. This pattern of agricultural growth is different with respect to the developing and under developed nations because all these nations have introduced modern technologies at very later stage in agricultural production. In developing nations, the population growth at an alarming rate has led to an increase in the number of people and has put a major thrust to the agricultural production to assure the ever-increasing demand of food crops. Agriculture is the back bone of Indian economy and workforce depend on it. Not only that the growth of others economic sector depends on the performance of agriculture to a greater extent. Agriculture basically includes the production of all sorts of crops, animal husbandry, agro forestry and pisciculture. Till 1971, around 80% of the total population lived in rural areas and depended directly or indirectly on agriculture and it contributed about 45 % of Gross Domestic Product (GDP) in this time.

Due to its ever increasing growth of human population, Indian Agriculture is largely dominated by the predominance of the food crops which include rice, wheat, jowar, bajra, maize, barley, ragi and gram. Amongst all these food crops production, the paddy culture has attracted highest attention of our planners, policy makers, administrators and agricultural scientists in India. In West Bengal Kangshabati Irrigation

Command Area is dominated by Paddy Culture. The present study involves the application of Remote Sensing technique and GIS tools to estimate the distribution and areal coverage of paddy culture in relation to deficit and excess rainfall year for both rabi and kharif season. The production from the agricultural field is mostly dependent on ground water availability and such relationship was studied by Tucker *et al.* (1985) and Sharma and Saraf (2002). Nagarajan and Singh (2008) studied ground water prospect zonation using RS & GIS.

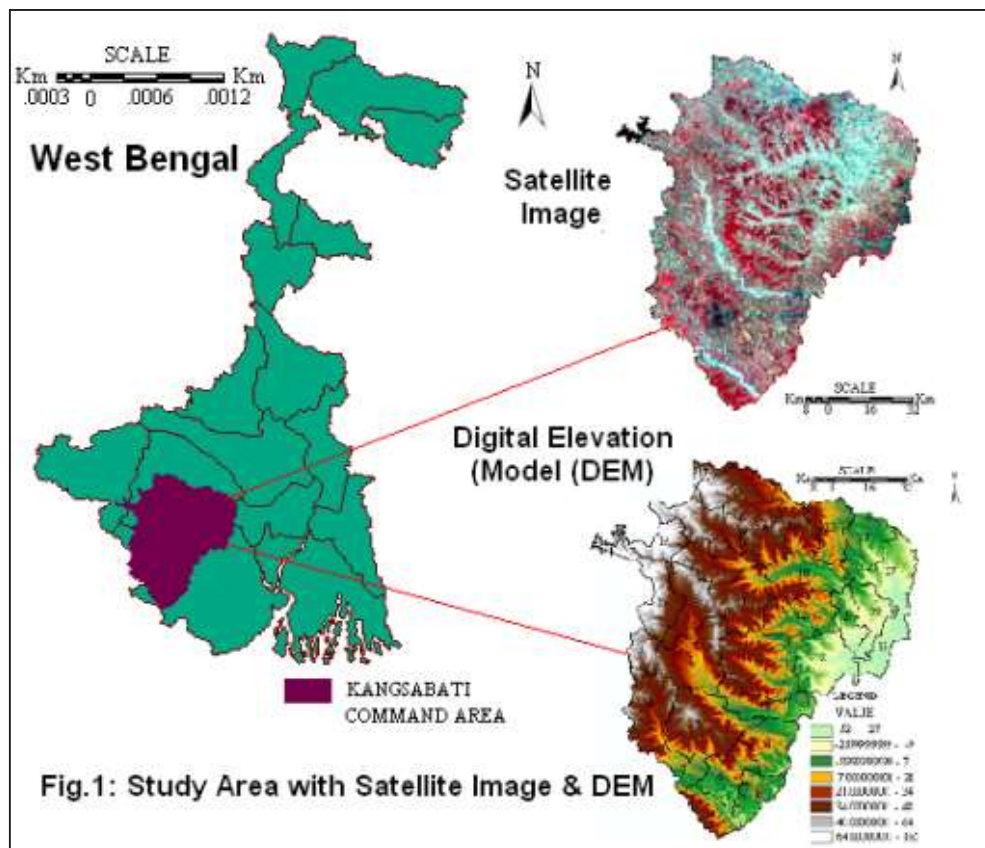
In Assam, West Bengal and Coastal Region of Peninsula as many as three successive crops of rice are grown in a year. Rice is an indigenous crop. India is the second largest producer of rice in the world after China. The regional variation of the intensity of rice production takes place because of the variation of geomorphologic and climatic attributes. To mitigate the problems of agricultural drought situation, Murali (2002), Murali *et al.*, (2008) and Rupesh Kumar (2000) assess the agricultural drought severity based on RS & GIS. The rural economy of our nation is mostly dependent on the paddy cultivation and allied activities. For the rational utilization of water resources and to promote developmental activities Central Government sponsored Command Area Development Program. Under this scheme two important areas have been chosen in West Bengal- Kangshabati Irrigation Command Area and Mayurakshi Irrigation Command Area. The main purpose

of the program is to promote sustainable development in agricultural sectors and allied activities by extending required facilities. The Kangsabati Command Area is bounded on the North by Birbhim district, South by Purba Medinipur district, West by singbhum district of Jharkhand, and East by Haora and Hoogly districts. The command area covers 9632.3 km<sup>2</sup> and including 13 blocks of Bankura, 21 Blocks of Midnapur and 1 Block of Hoogly districts in the State of West Bengal. The study area is covered by quaternary Sediments, except in the north western part, where older rocks are exposed. The older rocks of the area belonging to palaeo proterozoic age are represented by i) Singhbhum group consisting of Mica Schist, phyllite, gravel-stauroilite schist and quartzite ii) Dalma Volcanic, consisting of carbon, phyllite, pyroclastics, and hornblendes schist. iii) Younger Intrusive belonging to Meso Proterozoic age, consisting of kuilapal granite and quartz – tourmaline rocks. The Kasai or Kangsabati and the Subarnarekha are the two main rivers of the study area. The Silabati is another important river in the command area. Maximum area is covered by plain regions. Irrigation Canals have been constructed on both the banks of river Kangsabati

starting from two ends of the dam; left bank canal on its way meets the river the Silabati and the Dwarakeswar River. In right bank canal similar barrages have been constructed over the Bhairabi River and the Tarafeni River to irrigate lands in Jhargram and Midnapore South Sub-divisions of Midnapore district. In our present study the estimation of areal coverage of paddy practice in various geomorphological units will help planners, policy makers, administrators and agricultural scientists to take suitable methods for the improvement of agricultural sectors for Kangshabati Irrigation Command Area in West Bengal.

#### *Agricultural Status in different blocks of Bankura and Paschim Medinipur*

The tropic of cancer is passing through middle of the district of Bankura. The district is covered by two agro-climatic zones such as undulating Red Lateritic and Vindhayan Alluvial Zone. The red lateritic zone is characterized by tropical dry sub-humid climate having rainfall ranging between 1100 mm and 1400 mm. and the temperature varies from 10<sup>0</sup> C to 45<sup>0</sup> C. Soil in this



**Fig. 1:** Study Area with Satellite Image & DEM

location is well drained and susceptible to soil erosion due to sufficient run-off. The prevalence of moisture stress on standing crop in late monsoon period is very common. Major parts of the district blocks are experienced the harvesting of more than one crop utilizing canal irrigation as well as ground water. The agricultural production is largely dependent on the vagaries of monsoon and drought exhibits a major natural hazard in the districts. The irregular and uneven precipitation and moisture stretch during the monsoon give rise to the serious setback in the production of paddy during the Kharif season, which is the main stay of agriculture in the district blocks. Besides, the soil is acidic and the  $p^H$  ranges from 4.5 to 5.5 which affect the agricultural production. The problems of production have also been aggravated as a result of unscientific use of chemical fertilizers.

The blocks of Onda, Raipur, Kotalpur, Simlapal,

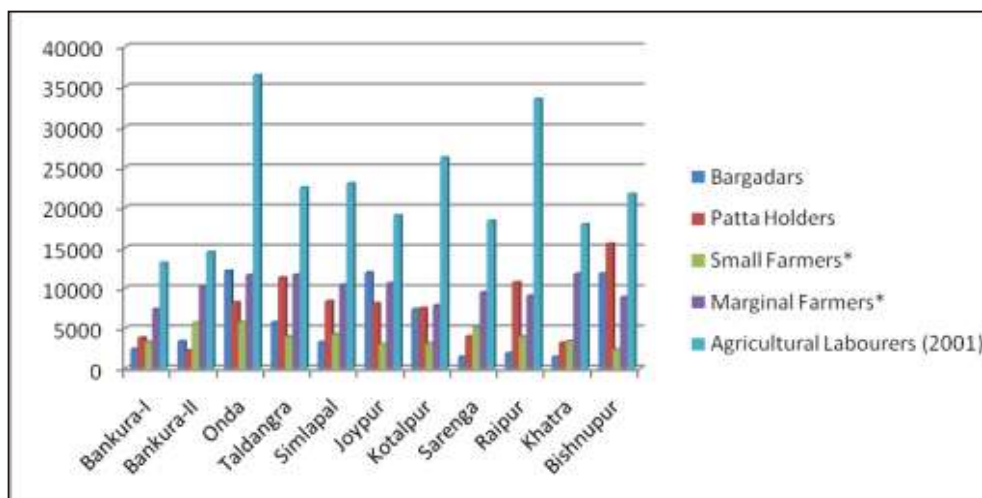
Taldangra, Bishnupur and Khatra are dominated by large number of agricultural labourers. Patta Holders are largely found in the blocks of Bishnupur, Taldangra, Raipur, Onda and Simlapal. Small farmers are being found in all the blocks of Bankura but less in comparison to agricultural labourers and Bargadars. All the blocks are characterized by a reasonable number of marginal farmers (Fig. 2). With regard to the persons engaged in agricultural activities, agricultural labourers rank first and followed by Patta holders and Bargadars (Table.1).

The analysis of cropping intensity reveals that the western part of Southern Bankura is lagging behind in production and it needs much attention. The strategy to cope up the situation is to introduce diversified cropping system and dry land farming system. In diversified cropping system the study area is registered with various types of crops such as Aman paddy, Aus paddy, Boro paddy, Wheat, Arhar, Maize, Khesari, Kalai, Lentil,

**Table 1: Number of persons engaged in agriculture in Bankura, [2006-07]**

Name of the blocks	Bargadars	Patta Holders	Small Farmers*	Marginal Farmers*	Agricultural Labourers (2001)
Bankura-I	2419	3813	3300	7372	13134
Bankura-II	3368	2238	5695	10202	14458
Onda	12124	8181	5755	11588	36419
Taldangra	5766	11312	3969	11647	22497
Simlapal	3273	8370	4224	10398	22992
Joypur	11898	8109	3047	10575	19020
Kotalpur	7356	7504	3136	7846	26192
Sarenga	1457	3983	5097	9456	18335
Raipur	1895	10705	3991	9035	33456
Khatra	1440	3195	3455	11738	17893
Bishnupur	11761	15498	2374	8865	21670

Source: Census of India (B.L.& L.R.O., Bankura). \*as per agricultural census (2005-06).



**Fig. 2: Persons engaged in agriculture (2001)**

Gram, Pea, Summer Pigeon Pea (Mung), Mustard, Linseed, Winter sesame, Summer sesame, Potato, Summer vegetables, Winter vegetables, Kharif Chilli, Rabi Chilli, Jute and Mesta (Table 2).

Amman and Aus Paddy could not show a remarkable change in the production since 2000 to 2006. The production of Boro Paddy has been increased remarkably as a result of improvement in irrigation and others agricultural technologies. There is an increasing trend of potato production. The productions of Jute, Mesta, Kharif chilli, Kharif vegetables, Linseed, and Kalai have witnessed a decreasing trend during the period of 2000-2006. It is observed that monsoon rainfall dependent crop production is irregular and fluctuating in nature. This type of production has forced the rural farmers to adopt dry farming agricultural practice.

#### ***Cropping intensity and productivity in Bankura***

With regard to the net sown area (in hectare) in Bankura District, the block of Onda ranks first which is followed by Kotalpur, Taldangra, Bishnupur, Joypur, Sarenga, Simlapal, Raipur, Bankura-II, Bankura-I and Khatra. The district blocks of Sarenga, Raipur, Simlapal,

Taldangra and Bishnupur are dominated by more than crops grown. The cropping intensity is high in the blocks of Simlapal, Taldangra, Sarenga, Raipur and Jaipur and low in the blocks of Bankura-I, Onda, Bankura-II and Khatra (Table.3).

#### ***Trend of agricultural production***

Agricultural production since 1994 to 2002 in various blocks of Bankura reveals that there was an increasing trend of the production at all the blocks. But in 1999, the production of food grain falls down in all the blocks of Bankura noticeably because of the scarcity of rainfall (Table 4). The same situation was observed in 2002 at some blocks of Bankura-II, Taldangra, Simlapal, Sarenga, Raipur, and Khatra as a result of deficient rainfall and lack of irrigation facilities. The study on the status of agricultural production depicted a clear picture on the frequent fluctuation of the food grain production in KICA.

The production rate of aman rice at all the blocks of Bankura district in Kangshabati Irrigation Command Area (KICA) increased from 2003-04 to 2006-07 except the block of Sarenga and Bishnupur. Notable increase in

**Table 2: Area covered by various crops in last five years [in Hectare]**

<b>Crops Name</b>	<b>2000-01</b>	<b>2001-02</b>	<b>2002-03</b>	<b>2003-04</b>	<b>2004-05</b>	<b>2005-06</b>
Aman paddy,	28355	351702	298929	331205	335497	311403
Aus paddy	26177	32971	24504	23776	28815	21254
Boro paddy,	19965	44490	39168	42781	46315	47625
Wheat	10100	17025	12553	12920	12497	10259
Arhar	1576	1417	1289	939	1117	1712
Maize	1136	2195	1909	1722	1804	2702
Khesari	817	997	1609	1168	906	762
Kalai	1688	1828	1232	1435	1327	1043
Lentil	488	747	1578	1391	835	1046
Gram	351	564	1170	950	638	924
Pea	257	352	338	433	354	326
Summer Pigeon Pea	362	618	1264	653	712	488
Mustard	14206	14155	14107	15500	16138	13314
Linseed	824	826	1064	897	726	628
Winter sesame	888	695	1167	891	539	561
Summer sesame	10780	10954	16308	17691	22964	12003
Potato	27133	33387	38103	37137	39808	42696
Summer vegetables	7683	8928	8674	9311	9514	8869
Winter vegetables	13905	13780	13784	13525	12639	13751
Kharif vegetables	13746	13683	12937	11878	12590	11107
Kharif Chilli	571	563	632	646	585	560
Rabi Chilli	764	984	777	891	859	807
Jute	440	582	633	524	305	374
Mesta	701	1398	782	821	567	665

Source: Office of the Principal Agricultural Officer, Bankura.

**Table 3: Block Wise net sown area, gross cropped area and cropping intensity [2003-2004].**

Name of the Blocks	Net area sown (in Hec.)	Area where more than one crop is grown (in Hec.)	Gross Cropped area (in Hec.)	Cropping intensity
Bankura-I	10844	1869	12713	117
Bankura-II	10859	3501	14360	132
Onda	26981	6712	33693	125
Taldangra	16168	11930	28098	174
Simlapal	11282	10075	21357	189
Joypur	14039	9650	23689	169
Kotalpur	17741	12446	30187	170
Sarenga	12947	10601	23548	182
Raipur	11256	10682	21938	195
Khatra	10222	4658	14880	146
Bishnupur	16123	11904	28027	174

Source: Office of the Principal Agricultural Officer, Bankura.

**Table 4: Agricultural production in various blocks of Bankura District.**

Name of the Blocks	Actual production of food grains [Rice] in '00 MT.								
	1994	1995	1996	1997	1998	1999	2000	2001	2002
Bankura-I	200	235	268	220	215	149	209	235	266
Bankura-II	328	349	378	399	403	346	365	357	341
Onda	753	821	882	776	756	657	713	730	772
Taldangra	301	354	496	466	487	440	529	574	498
Simlapal	219	391	464	400	401	386	486	438	373
Joypur	474	487	482	480	454	423	393	444	496
Kotalpur	604	646	710	761	779	747	705	651	615
Sarenga	433	451	435	419	447	437	468	402	294
Raipur	416	440	480	410	411	398	459	426	362
Khatra	237	234	319	315	296	237	294	302	275
Bishnupur	463	550	649	589	438	393	439	467	490

[Source: Bureau of Applied Economics and Statistics, BAES, West Bengal].

**Table 5: Productivity in different blocks of Bankura (Production rate of Aman)**

Name of the blocks	Yield rate of Aman (in kg/hectare), 2003-2004	Yield rate of Aman (in kg/hectare), 2006-2007
Bankura-I	2097	2917.33
Bankura-II	3118	3088.55
Onda	2751	2892.69
Taldangra	2650	2896.55
Simlapal	2428	2423.98
Joypur	2952	3196.53
Kotalpur	2364	2727.55
Sarenga	3056	2303.23
Raipur	2594	2693.37
Khatra	2798	3022.03
Bishnupur	2878	2582.72

[Source: Bureau of Applied Economics and Statistics, BAES, West Bengal]

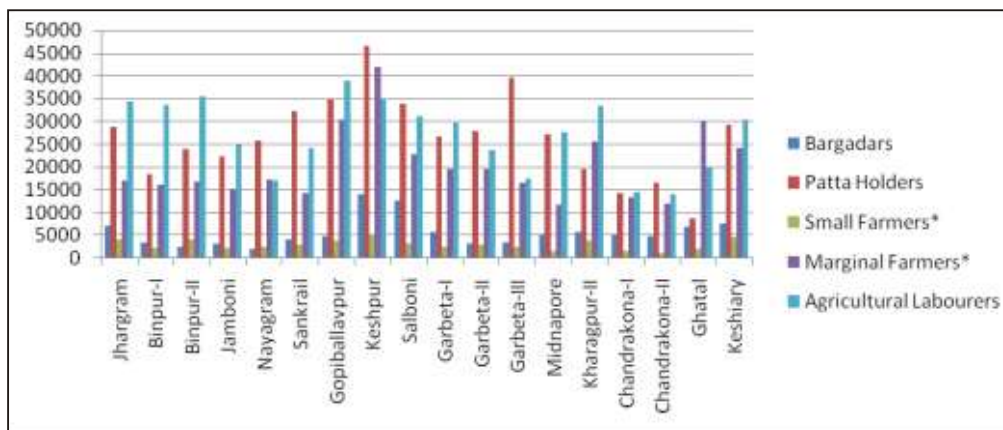
the production took place in the blocks of Kotalpur, Khatra, Taldangra, and Bankura-I (Table 5). The numbers of persons engaged in agricultural activities in

Kangshabati Irrigation Command Area (KICA) are categorized into bargadars, patta holders, small farmers, marginal farmers and agricultural labourers (Table 6).

**Table 6: Population engaged in agriculture in Paschim Medinipur, 2010-2011.**

SI No.	Name of the Blocks	Bargadars	Patta Holders	Small Farmers*	Marginal Farmers*	Agricultural Labourers
1	Jhargram	7166	28802	4198	17059	34417
2	Binpur-I	3372	18531	2297	16186	33660
3	Binpur-II	2616	24036	4059	16776	35543
4	Jamboni	3302	22374	2289	15127	24886
5	Nayagram	2117	25809	2442	17251	16984
6	Sankrail	4106	32356	3062	14299	24178
7	Gopiballavpur	4789	34768	3876	30345	38847
8	Keshpur	14157	46516	5288	42023	35019
9	Salboni	12735	33766	3223	22828	31062
10	Garbeta-I	5662	26841	2516	19653	29742
11	Garbeta-II	3201	27934	3052	19485	23650
12	Garbeta-III	3554	39647	2586	16539	17455
13	Midnapore	5410	27133	1562	11852	27540
14	Kharagpur-II	5758	19667	3889	25631	33421
15	Chandrakona-I	5255	14216	1698	13437	14606
16	Chandrakona-II	4937	16677	1221	12096	13948
17	Ghatal	6955	8794	2069	30146	19809
18	Keshiary	7556	29245	4702	24079	30345

Source: Agricultural Census (2005-06).

**Fig. 3:** Groups engaged in agriculture in Paschim Medinipur, 2010-2011**Plate 1:** Paddy Culture in Bishnupur, Bankura**Plate 2:** Paddy culture in Kharagpur-II Block



**Plate 3:** Source of Irrigation



**Plate 4:** Concrete drains for irrigation



**Plate 5:** Sources of irrigation



**Plate 6:** Paddy cultivation in Garbeta-II Block



**Plate 7:** Mustard Cultivation, Garbeta



**Plate 8:** Mustard Harvesting, Garbeta

It is observed that the blocks of Keshpur, Gopiballavpur, Salboni, Sankrail and Garbeta-III are dominated by patta holders. Agricultural activities in all the blocks in Paschim Medinipure are regulated by Agricultural labourers and Patta holders which are followed by marginal farmers, small farmers and bargaders. The blocks of Keshpur, Gopiballavpur, Garbeta-III, Kesiary, Sankrail, and Jhargram are dominated by Patta holders (Fig.3).

***Irrigational status of Kangshabati Command Area***

***Application of RS & GIS to assess paddy culture in KICA  
Rainfall Data analysis***

Rainfall is a key factor in snapping the vegetation, hydrology and water quality as well as critical to agriculture. Analysis of historic rainfall data reveals the year of 2007 and 2011 as excess and deficit rainfall in the study area.

**Table 7: Sources of irrigation and area irrigated (hectare) in various blocks of Paschim Medinipur (2010-11)**

Sl. No.	Name of the Blocks	Tank	DTW	STW	RLI	ODW
1	Jhargram	1900	200	4100	305	350
2	Binpur-I	550	415	6100	280	250
3	Binpur-II	530	-	-	350	100
4	Jamboni	225	15	1600	425	25
5	Nayagram	150	300	600	500	900
6	Sankrail	95	455	1950	525	90
7	Gopiballavpur	248	130	5530	2500	1203
8	Keshpur	2825	9525	12803	540	8
9	Salboni	2050	840	2400	300	1350
10	Garbeta-I	450	5875	4360	340	700
11	Garbeta-II	1020	325	1500	150	890
12	Garbeta-III	400	1250	2800	400	600
13	Midnapore	1415	1060	4000	450	-
14	Kharagpur-II	205	855	4825	526	-
15	Chandrakona-I	500	7056	2800	180	-
16	Chandrakona-II	1400	1500	2400	100	-
17	Ghatal	900	6669	369	3700	-
18	Keshiary	200	530	3000	900	-

[DTW, deep tube well; STW, shallow tube well; RLI, river lifting; ODW, open dug well].

Source: Div. Engr./Asst. Engr./Agricultural Irrigation, Paschim Medinipur.

**Table 8: Sources of irrigation and area irrigated (hectare) in various blocks of Bankura (2010-11)**

Sl. No.	Name of the Blocks	Tank	DTW	STW	RLI	ODW
1	Bankura-I	1500	NA	40	108	150
	Bankura-II	900	NA	1075	130	110
3	Onda	1812	462	4175	230	155
4	Taldangra	1180	115	829	550	10
5	Simlapal	1300	15	2460	386	250
6	Joypur	1600	408	505	113	150
7	Kotalpur	122	352	1050	115	6
8	Sarenga	100	NA	2600	67	NA
9	Raipur	1600	NA	310	155	142
10	Khatra	1350	NA	NA	200	300
11	Bishnupur	150	528	10470	319	20

[DTW, deep tube well; STW, shallow tube well; RLI, river lifting; ODW, open dug well].

Source: Div. Engr./Asst. Engr./Agricultural Irrigation, Bankura.

### Preparation of Land use and Land cover Map

To prepare district wise Land use and land cover map of Kangshabati Irrigation Command Area the following steps were taken into account.

- Georeferencing of the corresponding topo-sheets to the projection UTM, Spheroid/Datum Name-WGS 84, Zone-45 North.
- Rectification of block wise district planning map of the study area with the help of SOI topo-sheet by using ERDAS IMAGINE 9.0.
- Extraction of Study area from Satellite Image (FCC) on the basis of block map obtained from the District

Planning Map with the help of AOI tools in ERDAS IMAGINE Software.

- Supervised classification for obtaining spectral classes which represents various land use and land cover classes.
- Finally the study area was classified into 11 individual land use and land cover types.

### Paddy area Estimation

By registering the Landsat TM image of excess (2007) and deficit (2011) rainfall year *land use and Land cover Classification method* was applied to derive the area under paddy culture in Kharif as well as Rabi Season for both



**Table 9: Block wise Areal coverage (in hectare) of Paddy Culture in Kharif and Rabi Season and its relation with ground water prospect.**

Sl. No.	Name of the Blocks	Kharif-2007	Kharif-2009	Rabi-2007	Rabi-2009	Ground water prospect
1	Jhargram	3908.83	3371.24	3164.55	2683.2	Moderate-good
2	Binpur-I	5003.47	3577.13	3163.13	2515.1	Excellent
3	Binpur-II	4683.62	4114.12	2913.13	1944.11	Excellent
4	Jamboni	4196.24	3596.21	2875.24	2407.13	Moderate-good
5	Nayagram	3512.74	2910.14	2926.33	1998.33	Moderate-good
6	Sankrail	4889.52	4883.12	2836.89	2857.22	Good-excellent
7	Gopiballavpur	3844.71	3046.01	2367.26	2044.21	Moderate-good
8	Keshpur	5660.38	4134.02	3631.21	3215.11	Moderate-good
9	Salboni	4452.07	4286.11	3602.32	3156.43	Moderate-good
10	Garbeta-I	5582.89	5001.21	2696.09	2538.02	Excellent
11	Garbeta-II	4574.61	3403.14	2583.27	2578.31	Moderate-good
12	Garbeta-III	5268.22	4094.1	2677.79	2573.29	Moderate -good
13	Midnapore	4467.47	4385.03	3071.11	2215.01	Excellent
14	Khaghpur II	4781.09	4695.59	3488.58	3016.43	Poor
15	Chandrakona-I	5995.83	4805.21	3853.24	3518.91	Excellent
16	Chandrakona-II	6186.41	5861.89	3707.71	3348.92	Excellent
17	Goghat	5987.4	4321.24	2894.61	3212.2	Excellent
18	Ghatal	5991.77	5212.58	3942.85	3348.5	Excellent
19	Keshiary	1945.25	4124.79	3690.79	3417.61	Poor
20	Bankura	2917.33	3296.33	3456.05	2401.33	Moderate
21	Onda	5085.32	4202.58	2494.09	2132.01	Moderate-good
22	Taldangra	4952.14	3973.65	2718.13	2513.12	Moderate-good
23	Simlapal	2423.98	2103.3	2657.97	2014.32	Good-excellent
24	Joypur	5993.68	4121.9	3127.34	2809.34	Excellent
25	Kotalpur	5934.2	4324.1	3322.25	2311.29	Excellent
26	Sarenga	2303.23	1821.03	2056.03	1921.02	Good-excellent
27	Raipur	2693.37	2510.21	2729.09	2503.01	Moderate-good
28	Khatra	3022.03	2869.58	2565.63	2413.01	Moderate-good
29	Bishnupur	5484.89	4871.61	2784.77	2413.76	Moderate

Source: Author himself

rears. Firstly, ERDAS Imagine Software was used for supervised classification to demarcate the crop area and then areal coverage under paddy culture was estimated for two seasons by applying Arc GIS Software 9.2. The production of paddy in both Kharif and Rabi season the area was less in rainfall deficit year of 2009 in comparison to rainfall excess year of 2007. But the decreasing tendency of the area is insignificant in Kharif season with moderate to excellent ground water prospect but it showed the significant change in the Rabi season (Table 9).

#### ***Production of Paddy in Kharif season (2007 and 2011)***

The paddy culture in Kharif season (2007) is distributed significantly in Eastern and South Eastern part of Kangsabati Command Area consisting the blocks of Chandrakona I (28), Chandrakona II (29), Goghat (27), Kotalpur (23), Midnapore (13), Keshpur (8), Kharaghpur

II (14), Keshiary (16), and Sank rail (6). Western part of the Kangsabati irrigation command area is registered with sufficient paddy production. Middle most section the area is attributed as lesser amount of production as a result of poor ground water potentiality. In Kharif season (2011) the production of paddy is more or less equally distributed to all the blocks of Kangsabati Irrigation Command area because of reactionary amount of water availability throughout the region, but the blocks of Midnapore (13), Keshiary (16), Keshpur (8), Kotalpur (28), Ghatal (15), Sankrail (6), and Khatra (19) have shown significant amount of paddy production (Fig.4 & 5).

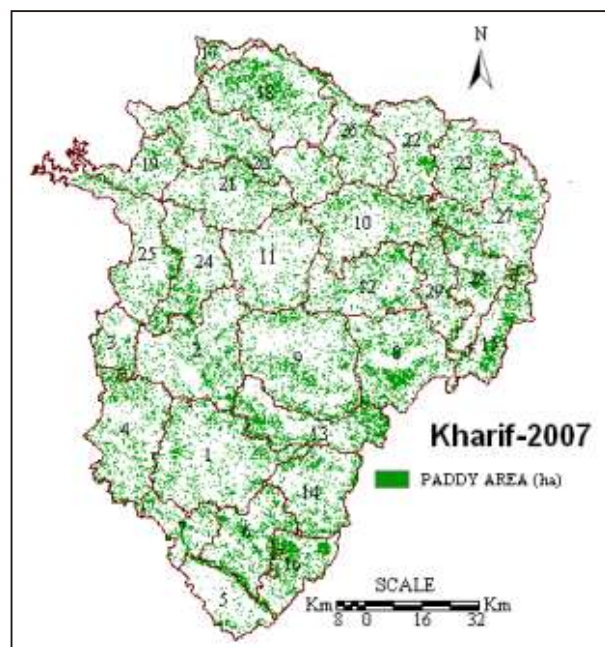
#### ***Production of Paddy in Rabi season (2007 and 2011)***

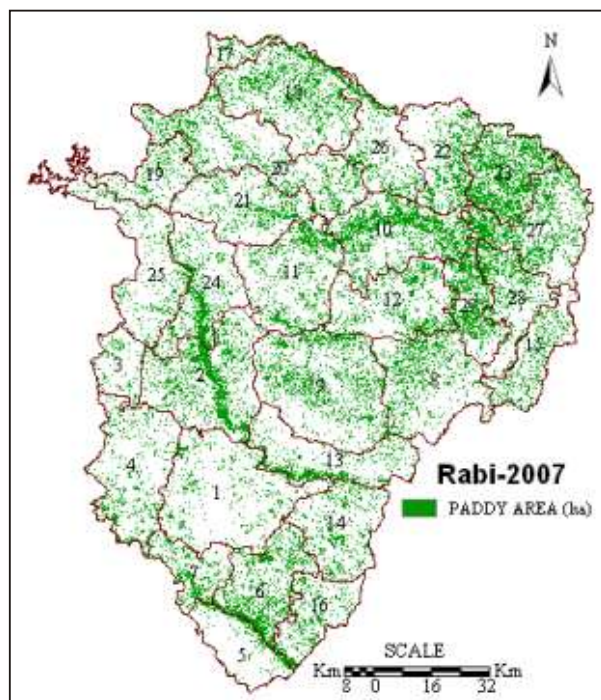
In 2007, the amount of rainfall was sufficient and the amount of agricultural production came into the

**Table 10: Areal coverage (in hectare) of Paddy Culture in Kharif and Rabi Season.**

Sl No.	Name of the Blocks	Kharif-2007	Kharif-2011	Changes in %	Rabi-2007	Rabi-2011	Changes in %
1	Jhargram	3908.83	3371.24	13.75322027	3164.55	2683.2	15.21069346
2	Binpur-I	5003.47	3577.13	28.50701613	3163.13	2515.1	20.48698599
3	Binpur-II	4683.62	4114.12	12.15939807	2913.13	1944.11	33.26387768
4	Jamboni	4196.24	3596.21	14.29922979	2875.24	2407.13	16.28072787
5	Nayagram	3512.74	2910.14	17.15469975	2926.33	1998.33	31.71207622
6	Sank rail	4889.52	4883.12	0.130892194	2836.89	2857.22	-0.716629831
7	Gopiballavpur	3844.71	3046.01	20.77399856	2367.26	2044.21	13.64657875
8	Keshpur	5660.38	4134.02	26.96568075	3631.21	3215.11	11.45899025
9	Salboni	4452.07	4286.11	3.727704192	3602.32	3156.43	12.37785649
10	Garbeta-I	5582.89	5001.21	10.41897655	2696.09	2538.02	5.862934843
11	Garbeta-II	4574.61	3403.14	25.60808462	2583.27	2578.31	0.192004707
12	Garbeta-III	5268.22	4094.1	22.28684451	2677.79	2573.29	3.902471814
13	Midnapore	4467.47	4385.03	1.845339756	3071.11	2215.01	27.87591457
14	Khaghpur II	4781.09	4695.59	1.788295138	3488.58	3016.43	13.53416003
15	Chandrakona-I	5995.83	4805.21	19.85746761	3853.24	3518.91	8.676594243
16	Chandrakona-II	6186.41	5861.89	5.245691766	3707.71	3348.92	9.676862538
17	Goghat	5987.4	4321.24	27.82777165	2894.61	3212.2	-10.9717716
18	Ghatal	5991.77	5212.58	13.00433762	3942.85	3348.5	15.07412151
19	Keshiary	1945.25	4124.79	-112.044210	3690.79	3417.61	7.4016673
20	Bankura	2917.33	3296.33	-12.9913311	3456.05	2401.33	30.518077
21	Onda	5085.32	4202.58	17.35859297	2494.09	2132.01	14.51751942
22	Taldangra	4952.14	3973.65	19.7589325	2718.13	2513.12	7.542317696
23	Simlapal	2423.98	2103.3	13.22948209	2657.97	2014.32	24.21584894
24	Joypur	5993.68	4121.9	31.22922812	3127.34	2809.34	10.16838591
25	Kotalpur	5934.2	4324.1	27.13255367	3322.25	2311.29	30.42997968
26	Sarenga	2303.23	1821.03	20.93581622	2056.03	1921.02	6.566538426
27	Raipur	2693.37	2510.21	6.80040247	2729.09	2503.01	8.284080041
28	Khatra	3022.03	2869.58	5.044622323	2565.63	2413.01	5.948636397
29	Bishnupur	5484.89	4871.61	11.18126343	2784.77	2413.76	13.32282379

Source: Author himself

**Fig. 4:** Areal coverage of paddy area in Kharif season (2007).**Fig. 5:** Areal coverage of paddy area in Kharif season (2011).

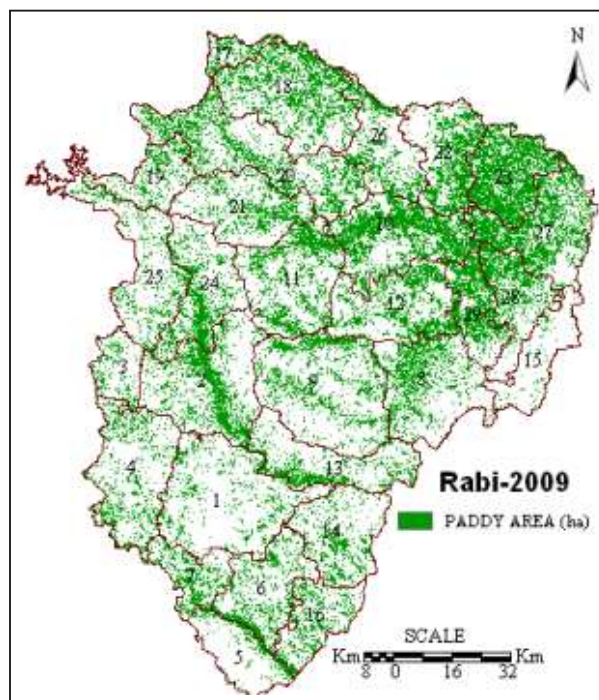


**Fig. 6:** Areal coverage of paddy area in Rabi season (2007).

satisfactory level. But few blocks such as Jhargram (1), Jamboni (4), Binpur II (3), Raipur (25), and Ghatal (15) where the production was very low due to insufficient rainfall and very poor ground water hydrological condition. In 2011, the blocks of Kotalpur (23), Goghat (27), Chandrakona II (29), Chandrakona II (28), Garbeta II (10), Binpur I (2), Midnapore (13), & Sank rail (6) are experiencing very high paddy production in Rabi season. All this blocks are subjected to good to excellent ground water potentiality. Lesser amount of agricultural production in Rabi Season is being found in the block of Binpur II (3), Jamboni (4), Jhargram (1), Raipur (25), Garbeta II (11), Simlapal (21), Bishnupur (26) and Taldangra (20) due to insufficient rainfall and poor ground water condition (Fig.6 & 7).

## CONCLUSION

The main purpose of agriculture is the production of food from land for human consumption. With the very long growing season and with varied topography, geomorphology, soil, drainage and different weathered conditions, presently West Bengal is in a unique position to grow some primary crops like rice, wheat, pulses, oil seeds, tobacco, maize, barley, jute and tea. West Bengal is most densely populated state in India and due to extreme population density, the stress on agriculture are very high. The man-land ratio in West Bengal is low which only 0.1



**Fig. 7:** Areal coverage of paddy area in Rabi season (2011).

hectare per capita. There is little crop diversification in the state. Since the man-land ratio is lowest in the state, the scope for further increase in the cropped area lies mostly in the improvement in cropping intensity. The factor behind such improvement are irrigation, fertilizers, appropriate crop rotations, selective mechanization, short maturity crop varieties and introduction of relevant institutions to strengthen the agricultural infrastructure in the state. To achieve in self sufficiency in agricultural production several irrigation development projects were being taken in 1952. As the rain is caused by the monsoon which is irregular and uncertain. Thus the rainfall cannot be considered as an important source of water for the development of agriculture in KICA. The River Kangshabati and Silabati which runs through the study area can be brought under canal irrigation. The underground water table in the state is not far below the surface. So both wells and tanks can be dug and used as means of irrigation.

Kangshabati Irrigation Command Area (KICA) is also characterized by variety of climatic and physiographic attributes and as a result the agricultural production and type of crop varies from place to place significantly. Immediate attention should be paid to the blocks of Binpur, Taldangra, Garbeta, Simlapal, Sarenga, Raipur and Khatra during the deficit as well as excess rainfall period by proper irrigation facilities. Various

irrigation schemes such as the establishment of deep tube well, shallow tube well; River Lifting water, and open dug well were already implemented in KICA. The analysis of paddy production in deficit and excess rainfall year in KICA will help a lot the planners and policy makers to formulate suitable plans for ensuring the rational utilization of land, soil and water.

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