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Issues and Challenges of Surface Water Management in Agriculture: A Case Study in Purulia District, West Bengal

Arindam Dasgupta
Associate Professor of Geography and JDPI at Education Directorate, Bikash Bhavan Salt Lake, Kolkata

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ABSTRACT

Purulia district is situated in the western part of West Bengal and characterised by undulating topography with rugged hilly terrain in its south and south western part. Geologically this district is dominated primarily by granite-gneiss rock, a hard crystalline rock and acts as major constrain in water percolation and water table formation. In Purulia, more than seventy per cent of the population depends on agriculture which is frequently affected by the vagaries of monsoon. Under the circumstances, the Irrigation Department of the State Govt. has constructed a number of small dams to hold water from streams, jhoras, rivers and supply irrigation water to the agriculture field in the lean period. These dams are supposed to recharge the ground water for long term basis. But lack of maintenance of these projects, problem in water sharing attitude among the farmers in the command area, poor rainfall in the catchment area have reduced the desired effect of such projects in agriculture. Some of the projects have become redundant due to high rate of siltation and frequent erosion along the canal banks. In this context the present paper tries to find out important issues and challenges associated with surface water management in agriculture in Purulia district and also make a modest attempt to explore new ways to store, conserve and supply of surface water which will be helpful for agriculture, solving acute drinking water crisis during summer and socio-economic development of the local people.

Key Words: *agriculture; command area; dams; irrigation*

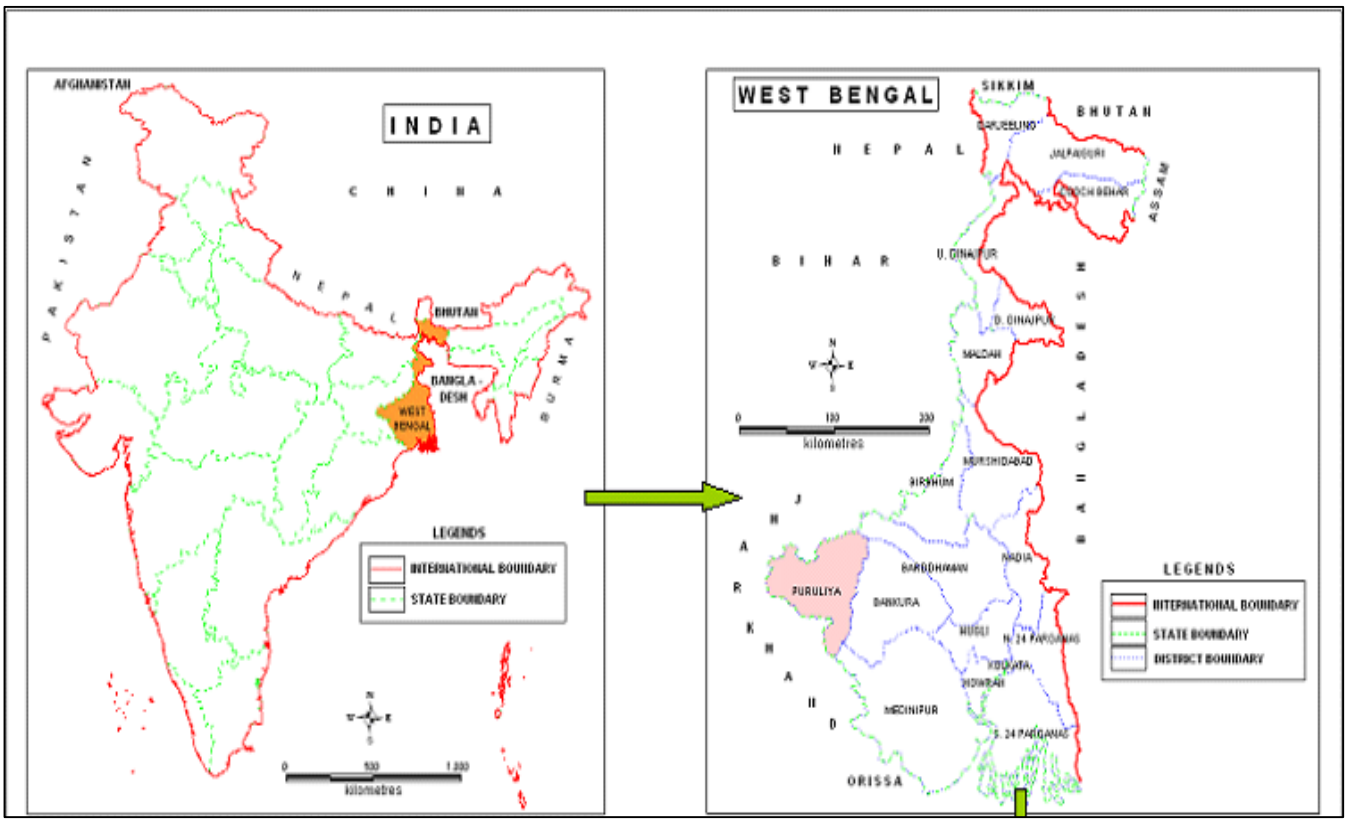
Introduction

1.1. Study Area

Purulia is the western most district of West Bengal with all India significance because of it's tropical location, it's shape as well as function like a funnel. It funnels not only the tropical monsoon current from the Bay to the subtropical parts of north-west India, but also acts as a gateway between the developed industrial belts of West Bengal and the hinterlands in Orissa, Jharkhand, Madhya Pradesh and Utter Pradesh. Purulia has its boundaries on the east with Midnapore and Bankura districts of West Bengal; on the north Burdwan district of West Bengal and Dhanbad district of Bihar; on the north west and south west with the Hazaribag, Ranchi and Singbhum districts of Jharkhand.

1. Corresponding author and e-mail: Arindam Dasgupta; arindam.dasgupta184@gmail.com

Fig. 1: Map of the study area



1.2. Condition of Agriculture in Purulia

Agriculture is the main source of livelihood in Purulia district. Almost 65 per cent of the working population are employed in agriculture either as cultivators or as agricultural labourers. Cultivation of this district is predominantly mono-cropped. About 60 % of the total cultivated land is upland. Out of the total agricultural holding, about 73 % belongs to small and marginal farmers having scattered and fragmented smallholding. Paddy is the primary crop of the district. 50% of the total land is under net-cropped area and only 17% of the net cropped area is under multi crop cultivation. 77% of the net cropped area is under Aman paddy cultivation. The crops are grown mostly under rainfed condition with low fertiliser input. Productivity is much lower than other district of West Bengal. While the labour participation ratio in the field of agriculture is significantly high, the average income of a cultivator is very low and this shows poor development of agriculture sector. The reasons are high dependency of agriculture on monsoonal rainfall, lack of irrigation facilities and presence of largely distributed waste land.

1.3. Geological Configuration and Emphasis on Surface Water Use in Agriculture

Regionally the area is a part of Chhotanagpur Gneissic Complex (CGC) of Eastern Indian Peninsular Shield area. Geological set up of Purulia district shows that the district is underlain by Pre-Cambrian Metamorphic except in some parts of northeast where Gondwana sediments predominate. Underlain granitic-gneissic hard crystalline rocks forms constraints in water percolation, thus restricts the water table formation. (Halder, 2015). It has also been observed

that only 13% of the ground reserve can be extracted due to hard crystalline rock cover. As a result agricultural activities in this district have to depend on the surface water.

1.4. Problems of using Surface Water in Agriculture

The annual average rainfall in the district is 1325 mm, but its distribution is very uneven. About 80-90% rainfall occurs from mid-June to mid- September. It has been estimated 50% of the annual rainfall has just lost due to high surface run off caused by geological and topographical factors and land use related changes in this district. There are a number of rivers flowing in this district i.e., Dwarakeshwar, Kangsabati, Kumari and tributaries of Subarnarekha, Danodar and large number of rivulets. Owing to natural topography of the district these rivers offer little irrigation facilities and in summer months these rivers and rivulets become almost dry and as a result surface water from these sources cannot be used adequately in agriculture. Under the circumstances surface water based irrigation is only possible through bunds (small embankments store runoff water), tanks. But these can provide irrigation to small agricultural land and in summer most of these bunds and tanks become dry and useless. Later on Irrigation Department of West Bengal has constructed a number of small irrigation projects to irrigate comparatively larger area but these schemes are also suffering from a number of problems. In this context the paper tries to explore the issues and challenges associated with surface water use in agriculture in Purulia district and suggest some probable solutions.

1.5. Literature Reviewed

Agriculture Finance Corporation, Eastern Regional Centre, Kolkata (2015) in their report strongly advocated more development of surface water based irrigation system in order to enhance agricultural productivity in this district. They suggested that apart from canal based minor irrigation schemes, more investments have to be made to other options such as river lift irrigation system, tank irrigation, check dams, nulah dams in order to enhance their efficiency and coverage.

Ghosh (2015) has made an attempt to evaluate land resources of Purulia district for sustainable land management where it is observed that the cultivation of the area is done by only surface water irrigation in lean period. But only 14% of the area is irrigated. Therefore, more area has been brought under cultivation by digging new tanks, reservoirs at fallow land or suitable places where land is available. More jhore bandh, small reservoirs are constructed in the suitable places of tributaries and rivers.

Halder (2015) has tried to analyse the reasons behind water scarcity in Purulia district which affect agricultural activities to considerable extent. The paper has identified four factors i.e., geological, topographical, hydro meteorological and anthropogenic responsible for such water scarcity. Surface water management in agriculture is emphasised especially as agriculture is the dominant economic activity in this district. According to his opinion, water-saving systems and the higher efficiency of drop-by-drop irrigation in food production require adequate technologies such as mulching, micro-irrigation tunnels, bio-fertilisers, reuse of agricultural by-products, sensors to measure soil humidity, and the development of efficient irrigation plans according to specific crop needs. It is concluded that Government organisation and NGOs have to work hand in hand in order to solve this problem.

Goswami (2014) has studied on the efficiency of village tanks in irrigation in Purulia and Bankura district. The study has revealed that in Purulia, tank irrigation account for more than 40% of the irrigated land. But their efficiency is declining due to lack of maintenance and introduction of canal irrigation. It is observed that most of the tanks have been given lease for pisciculture, so its role in irrigation is declining. It has suggested the formation of village level

committee who will look after tanks maintenance and the money earned from leasing the tank should be used in its maintenance.

Roy (2014) has suggested micro water shade planning with a particular view of rain water harvesting in order to tackle drought situation which affects agriculture most every year in Purulia.

Das (2013) in the study in Arsha block of Purulia district has assessed surface and sub surface water potential in order to evolve a conservation strategy for future use. The study has identified suitable spots for constructing rain water harvesting structures such as check dams with low height, percolation tank, recharge pit, shaft etc in order to store surface water and recharge ground water.

The above literature shows that there is scarcity of water in Purulia and this adversely affect agricultural production on which substantial population depends. In this light the objectives of the paper have been set.

1. Objectives

The major objectives of the paper are:

i) To examine the present condition of surface water based irrigation system in Purulia.
ii) To identify the major issues related with the use of surface water in agriculture.
iii) To list the major problems in managing the use of surface water in agriculture.
iv) To suggest some probable ways for better utilization of surface water in agriculture.

2. Material and Methods

To fulfil these objectives, the study has taken help of secondary data from Irrigation and Waterways Directorate, Purulia district, District Agriculture Office, Purulia and Directorate of Agriculture (Evaluation), Govt. of WB Office of Executive Engineers, Agri Irrigation, Purulia, Department of Public Health Engineering, Purulia

The article is also based on field visit to some selected irrigation project areas in order to understand the problems associated with use of surface water in agriculture and interacted with the farmers in different stretches of the command area divided into head, middle and tail section for better understanding of their problems.

3. Major Findings of the Study

4.1. Present Condition of Surface Water based Irrigation in Purulia

At present there are mainly four systems in the district through which surface water has been utilised in agriculture. These are (a) Bundhs (b) Tanks (c) Reservoirs and Jore Bundhs schemes (d) River Lift Irrigation (RLI). Besides there are small, medium and big ponds which are personal properties have also been used in agriculture.

The Bundhs of the district are normally the embankments thrown across a favourable dip in the general level of the ground. In some cases, the embankments is a comparatively high one across a deep valley, but ordinarily any existing natural depression is made use of by raising a low bank on one or more of its sides. In few cases as much as 100 acres of land may be irrigated from such a bundh, but in most cases the area irrigated is from 5 to 10 acres only. Such Bundhs have been constructed practically wherever it is possible to catch a certain amount of surface water and at the same time to terrace a few rice fields below them. The irrigation is affected ordinarily by percolation; only in exceptional cases is the bundh cut or the water drawn off by a pipe or some other outlet as is done when water is required to preserve the seedlings

or, towards the end of the season, to make up for the deficiency of the rainfall. But these bundhs are of little value in a year of very deficient rainfall.

Tank irrigation plays an important role in irrigation in this district. The main objective of tank irrigation is to bring additional areas under irrigation for both khariff and rabi cultivation and to increase the average yield of the crops. Multiple cropping and fish rearing are the twin objectives of such facilities.

There is altogether 32 Nos. of medium and minor irrigation Schemes (17 under Purulia Irrigation Division, 6 under Construction Division and 9 under Investigation & Planning Division) in this district. Out of these 32 Schemes, 23 are completed and 9 are in various stages of execution. Four new schemes Karru, Dambera, Dudhiajore and Horai are programmed for execution during the 10th Plan.

There are altogether 135 RLI schemes with effective command area 138 hectares. Out of which 21 are electrified and rest 114 are diesel operated. Out of these schemes 16 are permanently defunct. 17 number mini RLI in the different remote areas has been installed so far. There are altogether 61 Minor Irrigation Schemes. The total Irrigation Potential created is 8541 hectares in Kharif and 1955 hectares in Rabi upto 2013-14(CADP, 2015).

4.2. Major Issues Related to Use of Surface Water in Agriculture

Table 1: Share of different surface water based irrigation system in Purulia

Year	Irrigated land (in thousand hectares)	Sources of surface water irrigation (% of irrigated land)			
		Canal	Tank	RLI	Others
2004-05	65.75	46	42	5	7
2005-06	72.13	41	38	6	15
2006-07	56.71	41	39	6	14
2007-08	87.93	39	39	6	16
2008-09	97.12	42	40	5	13
2009-10	112.90	41	41	5	13
2010-11	103.78	43	39	6	12
2011-12	123.45	40	37	8	15
2012-13	117.78	42	34	7	17
2013-14	127.20	44	33	7	16

Source: 1. Irrigation and Waterways directorate, Purulia Division, 2015
2. Bureau of Applied Economics and Statistics, District Statistical Handbook, Purulia, 2006 & 2009

The above table shows that there has been almost double increase in absolute area in irrigated land for last ten years (93%) from surface water based irrigation system in this district. One interesting fact is although the total number of tanks in this district has been increased from 9000 in 1999-2000 to 9281 in 2006-07(Survey on Minor Irrigation Scheme, Govt. of WB, 2008-09) but there has been a constant decline in area irrigated by tank irrigation whereas others source of irrigation (Bundh, reservoir and Jore-Bundh schemes, Ponds etc) has increased significantly.

Another important issue is although there are 32 medium and minor irrigation schemes in the district but the share of these irrigation schemes has not increased for the last ten years rather it has been reduced. Although these schemes are supposed to irrigate considerable amount of irrigated land, the expectation has not fulfilled.

There is good potential for development of river lift irrigation in this district. But it has been observed that since 1999-2000 there has been no increase of river lift irrigation schemes till now. Some of these schemes have been defunct also and as a result the coverage of irrigation under this scheme has not increased. The other water bodies such as ponds of different sizes have been used in very small scale irrigation as most of these are personal properties. Rain water harvesting structures are not adequately developed in this district although there is good potentiality for development of these structures.

4.3. Problems of Management of Surface Water in Agriculture

Purulia is a drought prone district and it frequently affects agricultural productivity. Despite considerable effort from Department of Irrigation so far only 22% of the agricultural land have been brought under irrigation (CADP, 2015). This needs to be increased as demand for more production is rising day by day. For this purpose the efficient use of irrigation water is mandatory. But this district is facing a number of problems in managing surface water in agriculture.

The first and foremost problem is general topography of the district. The general topography of the district is highly undulating and land is of three types. The upper land is called Tanr which are mostly in the advanced state of degradation, lacking humus and major plant nutrients. These are untreated land which supports low intensity of cropping and low productivity if not actually remain fallow and barren. The midlands (Baid) are mostly terraced paddy fields with thin soil cover and poor moisture retention capacities. Upland and midland constitute almost 70% of the total land and most of the agricultural land is mono-cropped. Annual paddy is cultivated in lower land (kanali/bahal) which is fertile and suitable for agriculture. So here the main challenge is to minimise the loss of irrigation water and brought more land under irrigation.

Second, the canal based irrigation system failed to provide irrigation water till the end of the command area due to frequent slumping of canal banks, increased siltation in the reservoir, wrong planning of the canal route, small catchment area leading to inadequate storage of water and cannot provide water sufficiently to comparatively large command area.

Third, it has been often found that canal head farmer have cut the canal and diverted water towards his agricultural plot. As a result, water often does not reach till the end and the canal end farmers are deprived.

Fourth, the tanks although have increased in numbers but they are rendered derelict for want of timely repairs or thorough neglect of their owners for long years. The decline in tank irrigation is also due to multiple division of family, growing disinterest of traditional tank owners (Zamindars, Rajas or High caste landlords) in agriculture due to land reforms, increasing control of non-users, increasing use of tank for pisciculture purpose

Fifth, the big ponds are also losing their capacity to hold large volume of rain water due to gradual siltation in the pond bed and uncontrolled land use surrounding the pond bank.

Sixth, there is lack of initiation in developing rain water harvesting structures throughout the district. Rain water harvesting structures such as percolation tanks, new tanks, more reservoirs are urgently needed in this district.

4.4. Probable Measures for Managing Water Resource in Agriculture in a Better Way

First, there was a need for continuous maintenance in order to run the project efficiently and its fullest potential after implementing the projects. Canal banks have to be made concrete and while aligning the canal route attention should be given to the fact that the canal can provide water to the maximum agricultural land possible.

Second, while delineating the command area, the project officials should have taken into consideration the total amount of stored water in the reservoir and the probable water demand in the command area. The mismatch between water demand and supply will pose serious problem regarding equitable distribution of irrigation water.

Third, the end of main canal and the distributaries may be connected with the water bodies. In the lean period the water stored in the water bodies may be distributed in the fields.

Fourth, to solve the problem of disparity in water use in the command area, a village level beneficiary committee should be there which will look after the distribution of water in the respective villages of the command area.

Fifth, renovation of traditional water bodies including de-silting of tanks, creation of community ponds, new rain water harvesting structures, de-siltation and concretisation of the banks of the big ponds, planting trees surrounding the banks of the water bodies reservoirs, big ponds and controlled land use, creation of more surface water based irrigation system especially river lift irrigation system, construction of small check dams – all these will give big boost in increasing the total storage capacity of surface water in this district and provide more irrigation facilities to agricultural land

Sixth, in a bid to conserve surface and rain water to provide round the year assured irrigation, the West Bengal government has taken up a project 'JALTIRTHA' to construct around 800 check dams and other water harvesting structures and surface flow minor irrigation schemes in Purulia, Bankura, Birbhum and Pachim Medinipur. The objectives of such scheme are - to prevent soil erosion, recharge ground water aquifers, improve production and productivity of agriculture, fishery, duck rearing and animal feeding etc. It will help irrigate an area of nearly 32,000 hectares benefiting around 4,000 farmers. The total cost of this scheme is 500 crores

Lastly, the concept of community water management has to be introduced in this district. The sense of belongingness about the water sources will ensure better management scenario. The participation of local people regarding the planning and execution of the project will give better returns from the project and will help the authority to store, conserve and utilize surface water efficiently.

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