ABSTRACT

TITLE: PROBLEMS AND PROSPECTS OF IRRIGATION IN KOCH BIHAR DISTRICT, WEST BENGAL - A GEOGRAPHICAL ANALYSIS

Agriculture has been the first livelihood option of humankind to start sedentary human civilisation and water was of primary importance for field crops after soil. Regular watering of plants gave augmentation of farm products, which lead to the birth of the idea of irrigation. Gradually the processes of irrigation evolved from traditional to modern with due course of time diffused different parts of the world. Irrigation is defined as the artificial application of water to soil for continuously supplying the moisture essential for plant growth. It accomplished in different ways by flooding, furrows, spreading, by applying water underneath the land surfaces by sub-irrigation. Irrigation is closely related to different physical and cultural aspect.

Indian agriculture history dates back to some millennia and Bengal has been rice bowl for the country. Koch Bihar (erstwhile Kamtapur Kingdom) is one the marginal district of northern Bengal. From the dates back, the economy of the district was agrarian and irrigation was the parts and parcel of the livelihood of the people. The present research has been carried out based on problems and prospects of irrigation in the district.

The prime objectives of the study are i) Finding out the determinants of irrigation, ii) Examining the Spatio-temporal variation of irrigation, iii) Exposing the impact of irrigation on agriculture and economy of the farmer, iv) Identifying the problems related to irrigation in the district and v) studying the irrigation availability both surface and ground water in the district.

Considering the all above objectives the present investigation has been made with a title Problems and Prospects of Irrigation in Koch Bihar district, West Bengal- A Geographical Analysis.

To obtain the primary data at the household level 58 mouzas have been selected from the 12 blocks of the district out of the 58 mouza 46 mouzas were selected based on different irrigation system practiced such as 12 STW dominated mouzas, 12 DTW dominated mouzas, 12 RLI dominated mouzas, 6 Dug Well dominated mouzas and 4 Tank

dominated mouzas. Another 12 poorly irrigated mouzas has taken into consideration. The researcher has also conducted a focus group discussion among the farmers.

A field survey was conducted in 2014 and 42 shallow tube wells were selected taking 3 to 4 points in each block in the district for ground water depth measurement. For determining water quality in the study area, 48 sample sites has been selected on the basis of purposive random sampling in the year 2016. Out of 48 points, 24 be chosen from ground water and 24 samples were chosen from surface water from 12 blocks. The water samples collected during the Boro Cultivation (Winter Season). The Water Temperature, pH, Electrical Conductivity (EC) and Total Dissolved Solids (TDS) measured readily at the sample sites by handheld digital meter. The other chemical parameters were tested at the laboratory.

Besides primary data, the researcher used secondary data of different sources such as Minor Irrigation Census, Agri-irrigation Census, District Census Hand Book, satellite imageries, Google Earth image, Bhuvan image etc. The collected data has been analysed using in different cartographic and statistical techniques.

The thesis is presented in six chapters. The first chapter deals with the scope, hypotheses, objectives, methodology, and literacy review of the present study. The second chapter incorporates the general background of the study area, the Koch Bihar District. Chapter three deals with the determinants of irrigation in the district. This accounts the physical determinants and demographic determinants. This actually related to irrigation and physiography, geology, soil, rainfall, agricultural labour, cultivators, rural population. Chapter four discusses the spatio-temporal distribution pattern of irrigation practices in the district from 1991-92 to 2011-12. In chapter five impact of irrigation on agriculture and economy of the farmer are dealt with. Hence the relation of cropping intensity and irrigation intensity, cropping pattern, production, cost-benefit analysis and socio-economic condition has been analysed. Chapter six discusses the main constraints of irrigation and prospect of irrigation has been identified and chapter seven reveals the necessary recommendations for the corrective measures to be taken for the development of irrigation and agriculture followed by overall conclusion considering the essential lesson from the preceding chapters.

The mean elevation of Koch Bihar is 60 m at mean sea level. Koch Bihar district is entirely underlain over Quaternary alluvium soil and drained by a numbers of perennial

rivers. Mean daily maximum and minimum temperature of the district is 32.5 °C and 20.2 °C and the average annual rainfall is 3201 mm. The average density of rural population is 1970 persons per 100 hectares of irrigated land in the district. These physical and cultural parameters were directly or indirectly control of irrigation system of the study area.

Well irrigation was popular during the 19th century in the district. In 2011-12 only 47.71 per cent area were irrigated. Highest irrigation intensity was found in Tufanganj-II block (66.88 per cent) but the decadal growth rate was recorded in Mekhliganj (12.63 per cent) during the time period 2001-02 to 2011-12. Among the different sources of irrigation STW's share is 100379 ha (78.17 per cent) of the irrigated area in the year 2011-12 followed by RLI 15,292 ha (11.91 per cent), Tank 5,853 ha (4.56 per cent), Dug Well 3,106 ha (2.42 per cent), DTW 2,078 ha (1.62 per cent), and Canal 1,704 ha (1.62 per cent).

The available secondary data were analysed applying Karl Pearson method, which gives the relationship between irrigated area and cropping area. The most significantly observed pattern is the area under Boro cultivation which show moderately strong value (r= 0.55 in 2001-02 and r=0.76 in 2011-12). It means availability of irrigation helps for boro cultivation in the winter season. As compared to total cropping area in the district, the irrigated area is found to be lower than district average. This may be the reason why Boro cultivation is moderately related. The 'r' value of crops such as wheat, potato and oilseed in the year 2001-2002 were r=0.56, 0.49 and 0.67 respectively which changed to 0.47, 0.32, 0.59 in the year 2011-12. It means that the cropping pattern not only depends on irrigation facility but also other factors like fertilizer, soil quality, and temperature and water quality.

The farmer's perception on the impact of irrigation and other factors has been tested by using Kendall's degree of concordance (W). This has been discussed by taking positive and negative perceptions. The positive perception value of Kendall's (W) is =0.50 which indicates the agreeability on the questionnaire. On the other hand the negative perceptions on irrigation and other factors showed a value of Kendall's (W) =0.22 which indicates the non -agreeability of the results. It indicates that irrigation is not alone the significant factors on the alteration of cropping pattern.

In most of well irrigated fields, boro and vegetables is the dominant cultivated lands because these crops has the market potential and to some extent water loving. In the areas with the provision of STW boro is the dominant as well as distinctive crop. Thus, it may be deduced that irrigation is one of the important factors for determining the cropping pattern

and diversity of crops depend both on the spatio- temporal factors particularly the district of Koch Bihar.

Apart from the difference in cost-benefit of good irrigation in different mouzas and different irrigation systems, the spatial pattern is also uneven at micro level i.e. one irrigation system to another irrigation system. The Z-Score value in case of Co- operative RLI (+1.80) scored highest which indicates the maximum net profit for boro cultivation. The lowest score which is observed in the STW (rented) (-1.42) poor irrigated area indicates the least profit for boro cultivation.

Regarding the socio-economic condition of both irrigated and poorly irrigated areas factors like housing conditions, income, education, agricultural inputs, livestock number are high in the farmers with well irrigated area and is just reverse in case of farmers without irrigation facility. In case of rural out migration government irrigated ones have minimum followed by irrigation facility owned by themselves and non-irrigated ones. The rural out migration is more prominent and significant in irrigation facility owned by themselves and non-irrigated ones.

While studying the problems, the study revealed that STW has higher consumption rate (92.92). Out of 1495 of RLI 1397 RLI face several constraints during 1993-94 and out of 630 no. of RLI 593 of RLI were non-functional due to several causes in the year 2011-12 including mismanagement. In 2011-12, out of 171 DTW irrigation schemes, only 95 were active, 74 DTW were partially active and two DTW were non-functional in nature. Dug well traditionally practised in the study area and it less important than other sources of irrigation in the study area. About 78.33 per cent respondent reported that the Dug Wells had collapsed. Additionally most of the dug wells were constructed far from the cultivated area (78.33 per cent). Tank irrigation has also been facing problems due to the water crisis. Even for canals of river Teesta, it is in jeopardy. Some technical hindrances were observed in solar irrigation.

River Sankosh has the maximum discharge of water followed by Teesta, Torsa and Jaldhaka. Except in Teesta, there has been no attempt to harness water discharge of this potential river water for irrigation. It could be summarised such potentiality of river resources seem to be underutilised for irrigations due to government initiative and mismanagement. The ground water is found to be easily accessible (1.04 mbgl to 3.1 mbgl). On the basis of several indices such as NDVI, SAVI, MNDWI, WRI and NDMI form

LANDSAT-8 OLI satellite imagery block wise water potential area were mapped which indicates that Mekhliganj block posses highest value (3267.44 ha) and lowest is in Haldibari(560.16 ha). The water quality parameters like EC, TDS, and Iron concentration were also found to be within the safe limit. Also, the SAR value found to be within the safe limit.

The present investigation throws light on issues relating to the low production of crops in Koch Bihar and one of the reasons being underutilisation of potential water resources for irrigation. The study found various scopes for irrigation in the district mainly due to the availability of both ground and surface water. If irrigation is provided properly, the agrarian economy of the district may boost up.