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Ground Water Irrigation: Its Gain and Risk: A Review Study on Some Districts of West Bengal, India

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Review Article

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ABSTRACT

Irrigation is an essential component for agricultural production in India. To produce high yield crops good amounts of irrigation is needed. India has a good amount of Ground water which used for irrigation over the few decades. West Bengal is one of the highest food productive State in India. For the successful agricultural production, it needs enough irrigation. In case of cropping intensity West Bengal holds a reputed rank in all over India. Ground water irrigation is considered as an important source of agricultural production in West Bengal. But over exploitation of the groundwater, fill the water bodies for rapid Urbanization makes stress upon ground water and reached in scarcity level in sone regions in West Bengal. This paper is a review paper which focus on the ground water scenario in West Bengal, it is importance in increasing crop intensity in the several districts of West Bengal and to maintain the healthy level of ground water Sustainability. Several research papers, journals and newspaper reports used as a source of the data.

INTRODUCTION

With the development of agriculture farming, management of water supply in agriculture was also continuously in progress. To maintain the water supply for agricultural production is a challenge for each country. Thus, irrigation constitutes an important agenda in the planning of Government. Proper irrigation consists of utilizing the water in the nature in such a way that it becomes most beneficial for agricultural production. This becomes necessary because of the unpredictable nature of rainfall, which fluctuates year to year, sometimes leading to extreme situations like flood or drought. Again, some regions in India have great geographical and geological advantage towards crop production, due to land quality, rainfall, infrastructural facilities, etc. High yield crops and development of industries require enough water supply. To fulfill the demand of water supply both surface and ground water are

needed to be utilized properly. But India lacks sufficient amount of surface water storage, though there are some dams. There are also some canals to take the river water to the fields. Shortage of surface water or rather shortage of utilization of surface water necessitates extraction of ground water. But ground water exploitation has many shortcomings. First, too much of ground water exploitation leads to fall in the water level. So, one has to dig deeper and deeper. Depletion of ground water also leads to other hazards like more absorption of surface water by earth, earthquakes, etc. Second, there is a danger of arsenic poisoning. Many areas in India have been seen to be arsenic affected. Due to prolonged use of arsenic affected water, people develop skin disease and ultimately it may result into mortality [1].

Because of ground water irrigation, the growth of irrigated area has also increased over last few decades in India. Around 70% of the agricultural food grain production area irrigated through ground water as the major source of irrigation. From the 1998 census it is found that the estimated replenishable ground water availability in India was 43.57%, in which only 7.15% was used for domestic, industrial and other purposes, 36.42% of water available Ground Water Resources for Irrigation in Net Terms. Out of the total available ground water resources utilizable ground water for irrigation is about 32.77% and the ground water development is 32.07% from its useful aggregate. River basin wise irrigation system show's that out of the total replenishable groundwater resources of 431.42 billion cubic meters, the Ganga basin alone accounts for nearly 40 percent. From the 2001-02 Ministry of Water Sources census it is found that in West Bengal the ground water irrigation potential is 6918 Ha, in which ground water potential were 3318 Ha. West Bengal has 48% Share of Ground Water in Total Ultimate Irrigation Potential.

This paper aims to do thorough reviews of papers on benefits and disadvantages of ground water irrigation in West Bengal and then highlights the needs to manage and preserve the vital natural source, which has one of the major roles in Sustainable Development. As envisaged in the proposed aims and objectives, the data have been collected through secondary sources only, namely books, journals, newspapers, internet sources and administrative materials.

LITERATURE REVIEWS

West Bengal consists of 20 districts and 341 blocks and the entire area is covered by three major river basins – Brahmaputra, Ganga and Subarnarekha Basins. The major source of ground water recharge is the monsoon rainfall. West Bengal has good potential of ground water storage because of its geographical location and high rainfall. The state has 2.7% land area and it covers 6% of total replenishable ground water in India. In West Bengal ground water is the most exploited sources for agriculture. From 1986 to 2001 shallow and deep tube well has increased rapidly and over exploitation of the ground water has resulted into decrease in the ground water level, but the condition is not yet severe. In 1993 restriction on low duty tube wells were imposed in several states of West Bengal. In 2002 the minor irrigation census reveals that the ground water exploitation increased in many folds because of the privately owned low duty tube wells. In 2005 West Bengal ground water bill has been imposed and the Government has taken some initiatives to control and restrict the placing of tube wells with submersible pumping devices (Table 1).

Table 1. Sector Wise Percentage of Projected Water Requirements in West Bengal in 2000, 2011 and 2025.

Sectors	2000	2011	2025
Agriculture	49.6	59.3	62.4
Domestic	2.4	2.2	2.2
Industry (including thermal)	5.3	2.9	3.4
Inland Navigation	33.5	27.9	20.6
Forestry	0.1	0.1	5.7
Ecology, Environment and Others	9.2	7.7	5.7
Total	100	100	100

In Table 1 sector wise percentage of projected water requirements in West Bengal are given for the years 2000, 2011 and 2025. It can clearly be seen that agricultural sector holds not only the dominant position in West Bengal,

but also captures more than 50% of the requirements almost from the beginning of this millennium. In 2025 it will exceed 60%.

State Irrigation Department, 1987 estimated that the whole availability of ground water (1.46 million-hectare meter) utilized in West Bengal.

From the District-wise groundwater resource of West Bengal, 2009 it is found that the Annual Replenishable Groundwater Resource in monsoon season was 18.16 bcm from rainfall and 2.17 bcm from other sources. Paschim Medinipur district show the highest frequency of Replenishment of Groundwater from rainfall and district Bardhhaman shows the highest frequency of Replenishment of Groundwater from other water sources (viz. canal seepage, return flow from irrigation, recharge from tanks, ponds etc.) among the states of West Bengal (Table 2). In non-monsoon season ground water replenishment from other sources is higher when the rainfall decreases [2].

Table 2. Annual reprehensible ground water resources in monsoon season in bcm.

Name of District	Recharge from Rainfall	Recharge from other sources
Maldah	0.96	0.05
Nadia	1.12	0.18
Koch Bihar	1.58	0.04
North 24 Parganas	0.95	0.08
Dakshin Dinajpur	0.69	0.05
Uttar Dinajpur	1.18	0.07
Bankura	1.07	0.3
Purulia	0.53	0.11
Jalpaiguri	1.99	0.02
Bardhhaman	1.72	0.37
Murshidabad	1.34	0.19
Birbhum	0.71	0.25
Haora	0.19	0.03
Darjiling	0.39	0.01
Hugli	0.88	0.18
Purba Medinipur	0.55	0.02
Paschim Medinipur	2.31	0.22
State Total	18.16	2.17
Source: CGWB and SWID, 2011		

Among the districts of West Bengal, Paschim Medinipur (3.39 cm) and Barddhaman (3.06 cm) show the highest frequency of net ground water availability whereas Haora (0.33 cm) and Darjiling (0.47 cm) show the least amount of net ground water availability. District Nadia show highest amount of 2011 ground water draft for irrigation (1.68 cm) though the net ground water availability was 1.99 cm. Purulia, Darjiling and Jalpaiguri show an alarming situation in case of existing ground water draft for irrigation. Paschim Medinipur and Jalpaiguri show the highest frequency of Net ground-water availability for future irrigation development though existing ground water draft for irrigation is poor (Table 3).

Groundwater irrigation in West Bengal: Gains, Costs, and Risks concentrated on the lower Gangetic plains in order to see the ground water irrigation scenario in West Bengal. This study was based on the minor irrigation report of the government of West Bengal in the year 2000-2001. It reveals that the use of ground water is maximum in Murshidabad (1.92 lakh ha), Medinipur (1.88 lakh ha ha), Bardhaman, Nadia, North 24 Parganas and Hooghly districts of West Bengal, India. The number of tube wells has been seen to increase rapidly in an alarming rate (10% annually) and canal irrigation, tank irrigation and other sources of irrigation have decreased rapidly over the few decades. Ground water irrigation in summer for the Boro rice cultivation was maximum in Midnapore (1.08 lakh

ha) and Burdwan (0.99 lakh ha). Overexploitation of ground water in summer causes serious drinking water crisis in the districts of West Bengal. Arsenic contamination in ground water drags the people towards serious health problems in those areas. The study also reveals that in West Bengal the ground water depth reaches maximum to the limit of 5-6 meter below ground level (mbgl) during May and June in the highland areas where in low land areas it reaches 1.5–5 mbgl depending upon the ground water exploration for cultivating summer rice. The fall of the ground water level is seen to be faster in winter months (November to February) while in the low land areas it happens in pre-monsoon seasons (February to May) and in summer the fall is maximum because of the surface water evaporation.

Table 3. Ground water sources availability and development for future irrigation in West Bengal.

Name of District	Net Annual Ground-water availability (bcm)	Existing Gross Groundwater draft for irrigation (bcm)	Net ground-water availability for future irrigation development (bcm)
Maldah	1.31	0.49	0.74
Nadia	1.99	1.68	0.35
Koch Bihar	2.1	0.38	1.68
North 24 Parganas	1.37	0.77	0.51
Dakshin Dinajpur	0.98	0.42	0.54
Uttar Dinajpur	1.62	0.71	0.85
Bankura	1.95	0.54	1.35
Puruliya	0.75	0.01	0.68
Jalpaiguri	2.37	0.07	2.26
Barddhaman	3.06	1.45	1.55
Murshidabad	2.18	1.63	0.61
Birbhum	1.47	0.3	1.11
Haora	0.33	0.05	0.27
Darjiling	0.47	0.01	0.45
Hugli	1.5	0.49	0.94
Purba Medinipur	0.72	0.19	0.49
Paschim Medinipur	3.39	0.93	2.37
State Total	27.56	10.12	16.75
Source: CGWB and SWID, 2011			

Hooghly district is another major crop producing district of West Bengal and bounded with two rivers – Hooghly river in the east and Damodor river in the west. A study on the availability and utility of ground water for irrigation on the Hooghly district reveals that high rate of utilization of ground water is seen in a single block Pursurah in that district. The study reveals that the percentage of increased cropping intensity and net sown area are not only the result of economic factors but also several other factors like socio-cultural, human and natural factors. The exploitation of ground water for irrigation has taken place at a medium rate of 35-40% of the total available resource, which needs to be controlled. Nevertheless, surface water and rainwater utilization for the irrigation purpose need to be increased in that areas [3].

A study on the ground water potential for irrigation has been taken place in Durgapur – a semiarid climatic region in West Bengal. In this region surface water resources are insufficient so that ground water is the major source of water supply. From the calculation of electrical conductivity and Sodium Adsorption Ratio it is found that salinity hazards in the water sample were 31% and 26% good in pre and post monsoon season while 52% and 57% of water classified as the unsuitable water for irrigation under normal condition during pre and post monsoon season in some areas. Sodium hazards in water is greater in the pre monsoon season making water unsuitable for irrigation in few areas in Durgapur but the overall ground water quality for irrigation is good and safe.

The economy of Mursidabad district in West Bengal is exclusively supported by agriculture. There was an excessive population growth over the few decades in this area. Moreover, the farmers left the traditional multi cropping pattern and adopted water intensity monoculture for production. The study on dependency upon the cropping intensity and irrigation intensity reveals that it has decreased over the time from 1994-95 to2010-11. Barwan and Bharatpur-I blocks showing high changes in cropping intensity and irrigation intensity than other blocks in Mursidabad. With increase in the irrigation the exploration of ground water also increased and Musirdabad district have a high chance of ground water scarcity for future generation which needs an integrated water resource management approach. It is found that ground water in the Mursidabad district has declined at the rate of 0.1 to 0.4 meters per year and it is rising at the rate of 0.01 to 0.18 meter per year. The focus of the water management project should not only the management mechanism but also sustainable utilization of the resources.

A study in comparison of the growth of agricultural land through ground water and surface water irrigation has been carried out in the four districts of Burdwan, Nadia, Hooghly and Birbhum in West Bengal. It is found that some areas of Burdwan and Birbhum districts reveal negative compound growth rates of the agricultural area because of surface water irrigation but some areas of Nadia and Hooghly district show positive compound growth rates through surface water irrigation. It is observed that all the districts show positive compound growth rates because of ground water irrigation. From the study of the combined area the compound growth rates are estimated to be -0.16% for surface water irrigated area and +1.66% for the ground water irrigated area.

A study on the ground water quality and sustainability for irrigation in Rajnagar block, Birbhum district, West Bengal, India has been carried out in which pre and post monsoon dissolved solids in the water like Ca, Mg, Na, K and anions like Cl, HCO3 and SO4 etc. have been examined. The study reveals that pH level of the water ranges from 6.32 and 7.26 during pre-monsoon season and around 6.3 to 7.33 in post-monsoon season, which shows slightly acidic in nature. The total harness ranging also varies which shows moderately hard to awfully hard. Different calculated values of Sodium Absorption Ratio (SAR) indicate permissible range of water use for irrigation but Magnesium Adsorption Ratio (MAR) in water prohibits its use for agricultural purposes.

Irrigation is the key to any kind of crop production. After the green revolution, Indian agriculture faced drastic change in terms of high-quality cropping, which needs developed. A study on the blocks of Birbhum district shows that there is a moderate and positive association between cropping intensity and irrigation intensity. It is also found that the surface water irrigation (like river lift irrigation, canal, tank etc.) and ground water irrigation (like shallow tube well, deep tube well, open dug well etc.) have positive impact on cropping intensity rather than other sources of irrigation. Behind the corresponding relation between irrigation and cropping intensity, there are several other factors such as socio-cultural, political, economic, technological and infrastructure behind cropping pattern and intensity. Overexploitation of ground water for irrigation can be the major water problem in that area in near future.

Reason for declining ground water quality: West Bengal has a diverse geological feature. It has sufficient amount of rainfall in the rainy season. There is a great variation in ground water level despite great geographical advantages. The quality and amount of ground water are suitable for drinking, agricultural and industrial use. But in coastal tracts the ground water is saline and rich with fluoride, arsenic, iron, bacteria, and other heavy metals. For the over exploitation of ground water for agriculture in those areas, contaminations in the ground water are increasing at alarming rate. Except agriculture there is also industrial influence for the over exploitation of ground water.

Impact of land acquisition in irrigation: Acquisition of agricultural land for Rapid urbanization in West Bengal is the major concern because of the corrosion of irrigation system and its effects on the ground water recharge. The Kolkata New Town planning project in Rajarhat, West Bengal, is a planned township project which aims to solve the increase of crowding and squalor problems in the metropolitan city of Kolkata. This area consists of 68.36% of water bodies. For the purpose of the project 3075 hectors of agricultural land have been acquired. It will have a tremendous impact on the livelihood of the local people who were involved in agriculture. In the year 1975 the River Lifting Irrigation (RLI) scheme was introduced in the local canals by the Central Government of India in which Bagjola, Krishnapur and Nowai cannals are important. After the installation of RLIs scheme almost all the cultivated land become three cropped land. Till 1999, three kinds of rice crops, vegetables were cultivated and during the monsoon season fishing were another source of their livelihood. The annual average rainfall of the area during 1970-97 was 1679.10 mm and afterwards the annual average rainfall has come down to 1431.15 mm. This is possibly because of land acquisition in 1999 and rapid urbanization. This change also affects the ground water level which decreases from 6.06 mt to 4.1 mt in that area. Rapid town planning and decreasing RLI scheme effect on the recharge of ground water and scarcity of safe drinking has taken place [4].

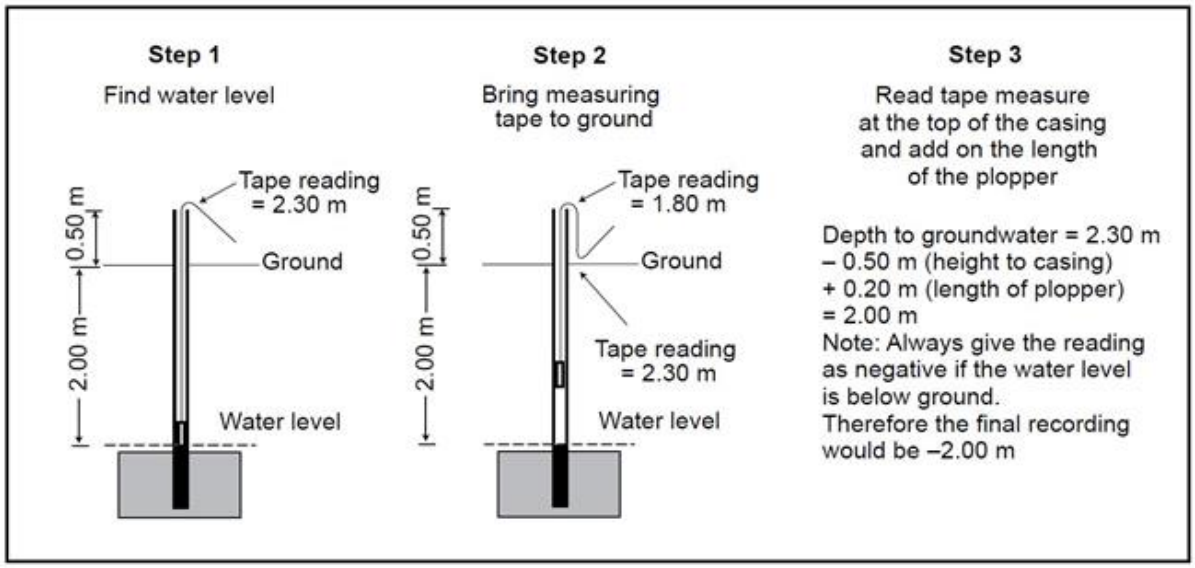
Initiatives taken for Ground water management: In West Bengal, ground water is declining rapidly, and alternative water resource is not yet developed. The quality of ground water needs planned development, also it is necessary

to restrict exploitation of ground water in order to fulfil the future needs. Ministry of water resources initiated several bills and circulated them since 1990 to 2005 to manage the ground water. Some initiatives have already been taken in some rural areas. In urban areas, rainwater harvesting seems to be beneficial and it helps recharge the ground water. Several states of India including, West Bengal made the law of mandatory roof top rainwater harvesting structure in the buildings. According to the 'The West Bengal Ground Water Resources (Management, Control and Regulation) Act, 2005' three authorities must be formed at the Indian States to manage ground water resources. These authorities can be formed district and corporation level in West Bengal. If any person flinches to get along with the provisions of the act made by government bodies, he/she shall be punishable and must give fine one the basis of rules.

Ground water level monitoring through Tape and Plopper technique:

Focusing on ground water it found that it is a complex form of water than surface water because it is invisible so, that the exploitation and over exploitation is not so clear for the users. So first we need to adopt some equipment's that can easily measure the level of ground water and local people can measure and understand the ground water level that will help the users to understand when to use and when to stop using. The tape and plopper measuring technique give accurate results of ground water level bore well/tube well within 1 cm. If the tape found the water level below the ground the record shows as negative (-) and if it is above the ground it shows positive (+) result, which helps very time saving and low cost ground water monitoring with authentic results (Figure 1) [5].

Figure 1. Steps taken when monitoring ground water levels.



CONCLUSION

It is clear, from the above discussions, that ground water has become almost inevitable for high yield crop cultivation and increase productivity in agriculture. Rapid increase in productivity by exploiting ground water, should keep pace with the increase in population. In short, the ground water situation in West Bengal is approaching an alarming state due to over-exploitation. The situation is not different in other States in India. Ground water inanition and erosion have become the burning issue for many of the states and planned township in India.

Several impurities like arsenic, fluoride, bacteria etc. contamination in ground water are in increasing trend and harmful for human use. In West Bengal, industrial growth is not much, but rapid urbanization has much impact upon ground water. Government should explore ways to take artificial methods to recharge ground water. New acts may be enacted to preserve the ground water resources. In case of agriculture, other irrigation systems such as surface water, rainwater, canal water irrigation etc. should be stressed. If necessary, incentive schemes may be introduced in irrigation systems other than ground water irrigation.

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