# WATER RESOURCES MONITORING AND MANAGEMENT USING ADVANCED GEO-SPATIAL TECHNOLOGY OF ARAKHASA WATERSHED IN BANKURA AND PURULIYA DISTRICTS, WEST BENGAL, INDIA

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## ABSTRACT

*The integrated approach to water resources management is to ensure increased coordination in development planning between water managers and the various development planners. An integrated water resources management and their temporal and spatial distribution within a river catchment is need of the day. This should be based on its physiographic and socio-economic conditions, and integrated with water demand and utilisation analysis. Parameters relevant for hydro-geology are spatially distributed and may show significant temporal variability. Earth Observation (EO) data, when used jointly with in situ data, can provide an essential contribution for the creation of inventories of surface water resources. The large area coverage of each observation, on the one hand, helps moving beyond the point-based readings provided by gauge networks to –for instance- basin-wide measurements of discharge and storage. Repeatability of observations allows the generation of a time-series of observed parameters and may result in an improved capability to analyse, monitor and forecast the evolution of phenomena, facilitating water resources management. The villages of the study area are fast heading towards a water crisis. The most part of the area have traditionally relied on local rainfall for meeting the water requirements for drinking, washing and other purposes and also for agriculture. Its' shortage is likely to be so acute that the future may fight on sharing of water resources among various villages. Geographical Information System (GIS) with its capability of integration and analysis of spatial, multi-layered information obtained in a wide variety of formats both from remote sensing and other conventional sources has proved to be an effective tool in planning for micro-watershed development. In this study geospatial technology has been applied to identify the natural resources management problems at micro-watershed level. Micro watershed management through the geospatial technology is developed and tested for the evaluation of the water resources of the study area. The present study reveals the availability of water is quite less on the surface as well as at sub-surface. The ground water level is more than 100 meters from sea level and even more than 200 meters also at some places. It is also observed that Hura and Kasipur block is under high scarcity. Chatna, Indpur have good water potentiality because of low slope, high drainage density, infiltrated soil, porous and soft lithology. On the other hand, Hura, Indpur have low water potentiality because of high slope, low drainage density, hard lithology, non porous soil etc.*

***Keywords:*** *GIS, Multi-layered, Micro-watershed, Surface, Sub-surface, Management.*

## INTRODUCTION

Water resources affect all social economic sectors and sustainability of the natural resources base. Presently surface water addressing requires an intersectional and multidisciplinary approach. Managing of water resources is in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Remote Sensing data and GIS is a flexible, efficient, speedy, cost-effective and reliable technology for obtaining information on Water resources, forest and agricultural research and natural resource management (Jain-2011). In this study, an attempt has been made to assess the Water Resources monitoring and Management using shape, size, texture and tonal variations from remotely sensed images (Bandyopadhyay and Bera 2015). Natural resources are useful raw materials that we get from the earth. They occur naturally, which means that humans cannot make natural resources. In the past decade, water resources management has faced multiple paradigm shifts: from supply to demand management, from engineering to an environmental perspective, from a top-down to a participatory management. There is a broad consensus on the need

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to achieve a better balance between economic efficiency and environmental quality in the sense of the sustainable development of natural resources. The development of water resources and its utilisation in appropriate manner in the context of "climate change" have been expressed as "conserve, water beneath the ground water, water within the plant bodies, water up in the sky and the water is the atmosphere, may all quarters of the earth be full of following water for us".

## OBJECTIVES

- Preparation of Drainage Network map from SRTM DEM Data.
- Geology and geomorphology mapping from Geology map of GSI.
- Mapping of relief, soil, slope, aspect, LU/LC & Surface water body.
- Identification of ground water potential zone.

## STUDY AREA

The present study area belongs to the Arkasa in Beko watershed of Dwarakeswar River basin which is located in the Chhatna, Indpur and Bankura-I block in Bankura district and Puncha, Hura and Kashipr in Puruliya district of West Bengal state. The covering study area is located in $22^0$ 57' to $23^0$31' 38.683 N latitude and $86^0$31' 03.683 to $87^0$ 02' 45.183 East longitude. The total geographical area of the study is 341.14 $KM^2$. The location of the study area is shown in Fig. 1.

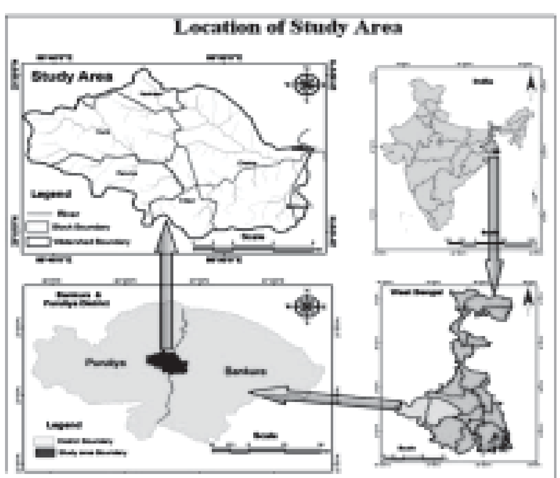


**Fig.1: Location Map of the Study Area**

## DATA USED

**Table 1**

| Sl. No. | Data | Source of Data | Year of Published |
|---|---|---|---|
| 1. | SOI Toposheet (1:50000) | Survey of India, Kolkata | 1975 |
| 2. | DPMS | Survey of India (Purulia District) and NATMO (Bankura District). | 2001 |
| 3. | Metrological Data | IMD, Shivanagar, Pune 411005, Maharastra. | 2015 |
| 4. | LISS-IV | NRSC Hyderabad | 2012 and 2015 |
| 5. | SRTM DEM | USGS website | 2008 |

## METHODOLOGY AND ANALYSIS

### Ground Water

The study area is known as drought prone area. Ground water availability of Pre-monsoon period is varying with depth and Post Monsoon time that in some parts of the study area quiet shallow than pre-monsoon. In maximum part of the study area, ground water level is more than 100 meters from sea level and even more than 200 meters also (Bera 2013). But due to high altitude and hard rock terrain, it is difficult to access the ground water.

### Surface water body

Drainage of the study area is under rain fed regime. Therefore very little normal flow of water in the drainage throughout the year. Due to lean flow of water and undulated high altitude regime, other surface water body plays very important role in their daily life in semi arid regions like Bankura and Puruliya district. The different types of surface water management plan have been observed like Happa, Percolation tank, Farm ponds, Check Dam, Small Reservoir Irrigation Tanks, Contour Bunds etc in the study area of Arkasa sub-watershed (Fig. 2).

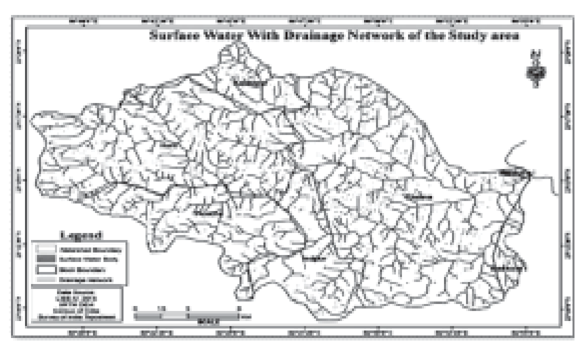


**Fig. 2**

## DISCUSSION AND MANAGEMENT

### Surface Water management

The body of surface water means a discrete and significant element of surface water such as a reservoir, a stream, river or canal, part of a stream, transitional water or a Pond (Bandh), a Percolation Tank, Nala Baund, Check Dam, Reserve or a small storage system.

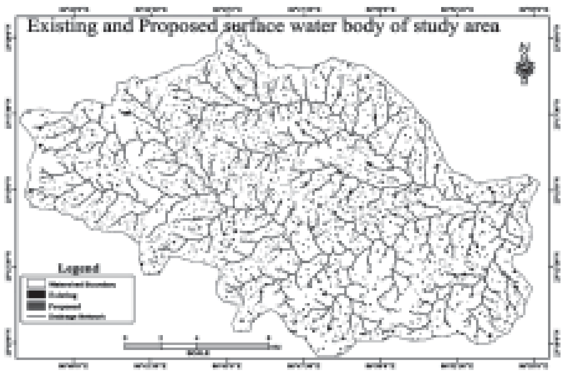


**Fig. 3**

In the study area, drainage water availability depends on the rain. Therefore, the very little normal flow of drainage water throughout the year. Due to lean flow of water and undulated high altitude regime, other surface water body plays very important role in their daily life in semi arid and arid regions like Bankura and Puruliya district. Various types of small model and management plan had been taken for surface water management particularly in this area (Semi arid region) i.e 5% model, 30-40 models, **Happa, Nala Baund** etc (Bandyopadhyay et al. 2015). Fig. 3 is showing the existing and proposed surface water body of the study area.

### Happa

One of the surface water management plan happa is used here for domestic and irrigation purpose. A happa is a mud-excavated rain water harvesting structure and does not have any cement work or stone revetment. The sides of a happa are stepped with a slope of 1:1 such that both livestock and human can access the water of happa easily. One of the surface water management techniques named Happa is shown in Fig. 4.

The maximum closed bound surface area of water is 45210.102 sq. m whereas smallest is about 236.326 sq. m and average is about 1200 sq. m. A happa is constructed by the side of the agricultural field of a farmer with an average length of 45 ft, breadth of 50 ft and depth of 12 ft. The total earth extraction of this happa is 17,360 cubic feet. The average command area of a happa is about 0.6 acre. The model is also called 5% model because it occupies 5% of the area of the agricultural plot of the farmer. This model has become successful in some dry zones of West Bengal.

**Fig. 4: Field Photographs of Happa**

### Nala bunds/ Check dam

The nala bunds structures constructed across nalas (Streams) for checking velocity of runoff. It is important as it is reducing the gradient of water flow and soil erosion and increasing water percolation and improving soil moisture regime (Bera 2013). The nala bunds are recommended on first order drainage at a suitable distance on all over the drainage, on the other hand, check dam constructed on the minimum area is 25 hector also in 1st to 3rd stream order. Fig. 5 is showing the Nala bunds/ Check dam.

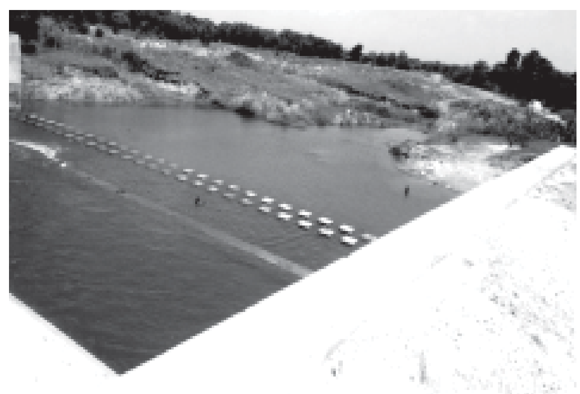

**Fig. 5: Field Photographs of Check Dam**

### Ground Water Management

Ground Water management plan can be done through the identifying potential zone for future prospect. The overlay analysis allows a linear combination of weights of each thematic map with the individual capability value with respect to ground water potential (Bandyopadhyay et al. 2014). Various terrain parameters like Slope, Drainage Density, Soil characteristics, and Land use are prime control on movement of surface and sub- surface water and occurrence of perspective ground water reserves in the region. Fig. 6 is showing the ground water potential condition of the study area. The ground water level is more than 100 meters from sea level and even more than 200 meters also at some places. From the study, it is observed (Fig. 6) that Hura and Kasipur block is under high scarcity (Bandyopadhyay et al. 2014). Chatna, Indpur have good water potentiality because of low slope, high drainage density, infiltrated soil, porous lithology. On the other hand, Hura, Indpur have low water potentiality because of high slope, low drainage density, hard lithology, non porous soil et

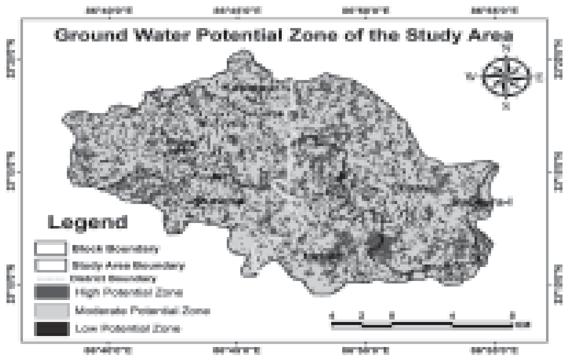


**Fig. 6**

## CONCLUSION

The small irrigation program like Happa has a strong impact on the livelihood security of the rural people. It has improved the productivity, intensity and diversity of crops. The diversification of production of farmers from a single Khariff crop of paddy into other crops like vegetable production and fishery has reduced their vulnerability to climate shock they faced earlier before the construction of Happa. Therefore only the surface water management plan is essential for challenges the water threats and future prospects.

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