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"GEOINFORMATICS IN SURFACE WATER MANAGEMENT FOR GROUNDWATER DEVELOPMENT IN SEMIARID TERRAIN OF ARKASA SUB WATERSHED IN PART OF BANKURA AND PURULIYA DISTRICT, WEST BENGAL, INDIA"

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ABSTRACT

Water is a precious asset of humanity. A well managed society is one that knows how to treat its water with care, prudence and respect. Keeping in view this dictum, the present study has been carried out pertaining to Bankura and Puruliya district which falls in the semiarid region and is situated very close to the Chhotanagpur fringe. The present requirement of water for domestic as well as domestic agricultural needs is met mainly by the surface water (rainwater) resources which are increasingly under great stress due to climate change and exponential growth in population. Geoinformatics technology with meteorological data provides a reliable, accurate and updated data base on land and water resources which is also a prerequisite for an integrated approach in identifying most scarcity zone site and potential areas and to identify the suitable sites for rainwater harvesting.

Keywords Semiarid region, Geoinformatics technology, Meteorological data, Rainwater harvesting.

INTRODUCTION

Surface water flow/ sub-surface flow and ground water are not separate resources- they are parts of the same cycle and interchange many times. For example, infiltrated ground water may be available further downstream of a river as surface flow, again surface water flow may in turn infiltrated and join ground water (Bera 2013). Repeated draughts and erratic rainfall have severely affected the livelihood of rural people particularly those living in the dry zones where the water availability is poor. According to land survey 60% of the lands are cultivated and adjoining areas are home to majority of rural poor and marginal farmers. It is found that in most villages households with access to irrigation have only about half the poverty incidence compared to the households without irrigated land. The effect of irrigation facility even among the tribal households is worth mentioning (Roy 2006). The rainwater-harvesting tank can play a very vital role in conservation of water resource. The problem with large tank irrigation structures in India is that these are not well managed. The experiment with the formation of water users' association is not satisfactory at all in the state (Pound Barry et al 2003). Some innovative experiments are going on in different parts of India in the irrigation sector (Jana 2008). One such experiment in West Bengal is Happa where a small tank is being excavated in the private land of the farmer and the farmer can irrigate his own agricultural land from that very tank happa and is managed by the farmer himself.

The main component of happa includes the following: Harvesting rainwater water and using it judiciously, soil conservation, meeting livelihoods needs of people with planting trees, grow crops, rearing animals and transferring resources to the next generation safe and enriched (Palanisami et al 2010).

AIM AND OBJECTIVES

Aim of study is surface water management for groundwater recharge through implementation of Happa.

Objectives are

1. Land categorization (Local regimes).
2. Mapping of drainage system.
3. Extract surface water body from Satellite image.
4. Ecological benefit by implementing Happa.

STUDY AREA

Our study area belongs to the Arkasa in Beko watershed of Dwarakeswar system which is situated in the Chhatna, Indpur and Bankura-I block in Bankura district and Puncha, Hura and Kashipr in Puruliya district of West Bengal. The study area geographically located in 22^0 57' to23^0 31' 38.68″ N and 86^0 31' 03.68″ to 87^0 02' 45.18″ East (Fig. 1). Based on the socio-economic survey it is observed that about 54% of households in the block live below poverty line. There is specific geographical concentration of backwardness in these regions of the district. Only 30% of the agricultural land is irrigated in the block (Government of West Bengal 2007). The backwardness can be explained through the lack of access to natural resources like water. The land types in these districts are of three categories: (i) Fallow Uplands (called Tanr land): These are at the top of the terrain with very thin topsoil and very low water-holding capacity. (ii) Medium uplands (called Baid land): In these types of lands soils are sandy and sandy loam and shallow with low organic matter and low moisture holding capacity. (iii) Low Lands (called Kanali / Sol land): These lands are more loamy than Baid and are most advantageously located in terms of water availability and these lands get additional water from seepage from upper catchment. In these regions 50% - 60% land is medium upland, 20%-30% is up land and 30% is low land. The water holding capacity of the barren upland is very low. There is high need for irrigation water in tanr and baid lands as these possess inferior soil and low moisture. Season- wise paddy is classified into three types – Aus, Aman and Boro. Aman is the main paddy here which is grown in the Khariff season. In the state, September is flowering stage of aman paddy. If there is dry spell, then production of paddy in medium upland is badly affected. The moisture conservation of the soil is very important.

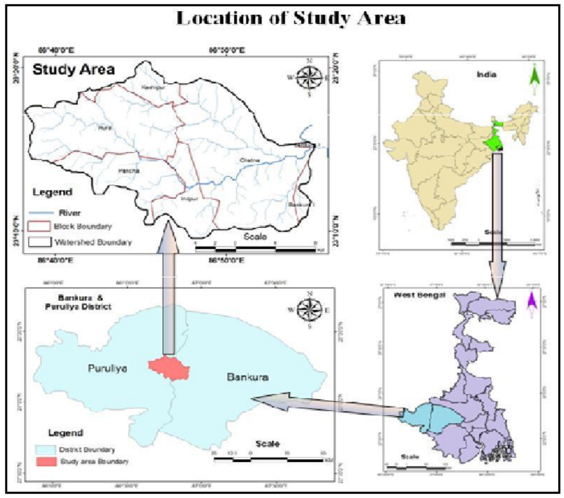

Fig. 1 Location of the study area

SURFACE WATER

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, river or canal, a transitional water or a Pond (Bandh), a Percolation Tank, Check Dam or a stretch of coastal water The application of the definition requires the sub-division of surface water are as flows:

Drainage: The river originates from western upland of chhotonagpur plateau region to and flow almost parallel to each other carrying seasonal flow of water & meets Damodar River. The river Dwarakeswar drain from northwest to southeast of the study area. The study area drainage pattern in dendrite drainage pattern, here sub stream meet with mainstream at right angle. We see 2nd order sub watershed in the study area (Fig.2). The total areas of river watershed 341.14 Km2. Kansachara Nadi & Arkasa Nala are the prominent left hand tributaries of the Dwarakeswar river.

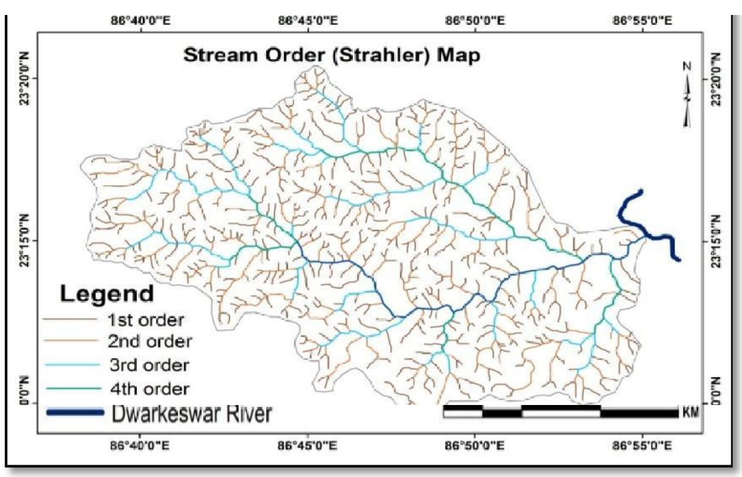

Fig. 2 Second order sub water shed in study area

Other Surface water body

Drainage of the study area is under rain fed regime. Therefore very little normal flow of 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. The different types of surface water management plan has 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. 3). One of the surface water management plan happa is used here for domestic and irrigation purpose. 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.

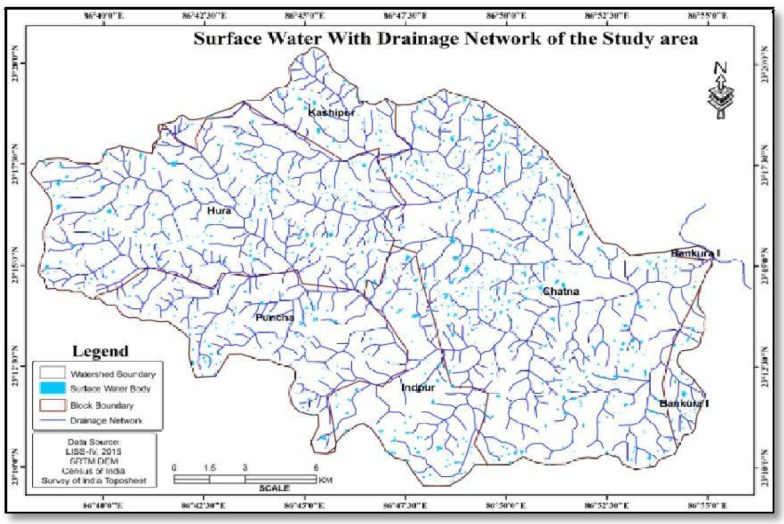

Fig. 3 Surface water bodies in the study area

IMPORTANCE AND CONSTRUCTION OF HAPPA

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 slope of 1:1 such that both livestock and human can access the water of happa easily. A happa is constructed by the side of agricultural field of a farmer with 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 which requires 299 mandays. With existing NREGS wage rate of Rs. 100/- day the average construction cost with the above specifications is about Rs. 29,900. 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 agricultural plot of the farmer (Jana 2008). The construction cost of the happa is presently being financed from NREGS and all the operational expenditure is being incurred by the farmer for maintaining the happa. This model has become successful in some dry zones of West Bengal. It may be mentioned that there are two major cropping seasons in India, namely, Kharif and Rabi. The Kharif season is during the south-west monsoon (July-October). During this season, agricultural activities take place both in rain-fed areas and irrigated areas. The Rabi season is during the winter months (October to June), when agricultural activities take place only in the irrigated areas. Khariff crop includes Aman paddy, maize, pulses etc. Rabi crop includes wheat, barley, oilseeds etc. Construction of water harvesting structures like happa have created a strong impact on their livelihood through generation of additional incomes in some dry areas because of the following reasons: (i) Farmers could provide life saving irrigation to paddy crop during this khariff season, (ii) They could grow vegetables around the bund of happas etc. It should be pointed out that in most of the dry zones the cropping intensity is poor. One extra crop will have perceptible impact on their standard of living (Narayanmoorthy et al 2005).

IMPACTS OF THE IRRIGATION EXPERIMENT WITH HAPPA

The environmental and economic impacts of Happa (Fig. 4) in the regions are reported to be very encouraging. Changes in the irrigated area have always positive impact on rural livelihood, particularly in these reasons where the opportunities for alternative livelihood are very little (Shah 2003). Economic benefits of happa include the following:

Fig. 4 Mud excavated rain water harvesting structure known as Happa

- The household surveys have reported that the yield and cropping intensity of land has increased because of the construction of happa. Farmers could provide life saving irrigation to paddy crop during this kharif season. This has resulted in the improvement of yield. It has been reported that the yield of Aman paddy has increased from 3.5 tonnes to 4.5 tonnes per acre in poor rainfall year (Pradan 2008).
- They could grow vegetables around the bund of happas and diversify their cropping pattern.
- There is opportunity of generation of wage employment during the construction of Happa. The average number of person days generated for construction of one happa is about 300.
- Involvement of local people in the planning and implementation of programme has led to developing more ownership of the programme (Sivasubramaniyan 2006).
- The annual average fishery income per happa is calculated as Rs. 1,152.
- Land value of land has increased because of the irrigation facility through happa. The happas are also meeting the water needs of livestock.

Ecological benefits

Our surveyed happas have been constructed within 2013 and 2014. So the full impacts of ecological benefits are yet to be calculated. The soil and moisture conservation of the watershed area has improved in the village. Because of the enhanced moisture retention, microbial activities and biomass deposition have increased (Fig. 5a and 5b). As a result local micro environment has improved. The construction of happa has checked soil erosion and run-off and improves land quality.

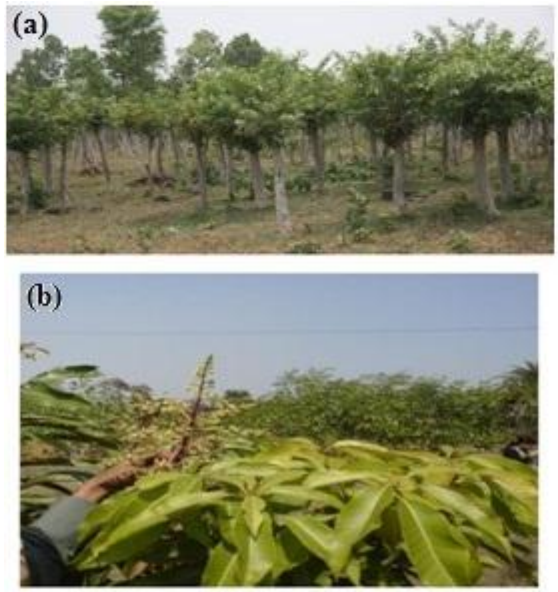

Fig. 5(a) Sericulture, (b) Horticulture

CONCLUSION

The small irrigation program like happa has 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. The success and up scaling of the programme depends very much on the system of planning, application, execution, monitoring and fund-flow. As we have noted from the field survey, there should be more emphasis on crop diversification. Paddy cultivation is more risky compared to crops like maize and vegetables because in case of low rainfall paddy crop may suffer heavily. Our survey results reveal that 100% households have given their opinion that they fail to utilize the land because of the lack of water. There is huge demand for irrigation facility in these areas. To make it success technological interventions are required in terms of new production techniques like sericulture (Fig.5a), horticulture (Fig.5b) and new irrigation techniques like sprinkler irrigation techniques for conserving water and also organic farming method. It must be pointed out that average annual rainfall in the district of Bankura, West Bengal is about 1400 mm. So, there is huge scope of enhancing irrigation, if the runoff water is systematically and properly tapped. Another big advantage of this model is that number of beneficiaries per unit expenditure spent is much higher in happa than the bigger irrigation model. As the happa is private property of the individual farmer, farmers have the incentive to maintain the structure and being low cost it is also affordable to them. The strong feature of the happa model is that it is both replicable and sustainable. There is enough scope of uplifting of the livelihood of the marginalized sections of the rural community through this programme. More innovations are required in this programme and can be integrated with other watershed activities so that water can be more efficiently utilized. Also there is a need to think how small farmers and farmers with scattered land and also landless farmers can avail the benefits of the progrmme. There should be more emphasis on capacity building at the local level and the development of institutional arrangement. The success and upscaling of the programme depends very much on the system of planning, application, execution, monitoring and fund-flow.

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