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WORLD BANK GROUP

Securing IRRIGATION In Rainfed Areas

Strategies and Experiences of the *West Bengal Accelerated Development of Minor Irrigation Project*¹

INTRODUCTION

The World Bank supported *West Bengal Accelerated Development of Minor Irrigation Project* assumes a centre-stage position in the current context of bringing water to every farm (*Har Khet ko Pani*) under the recently launched *Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)*. With an objective to “enhance agricultural production of small and marginal farmers of the project area in West Bengal through development of minor irrigation infrastructure and agriculture support system”, the Project was launched in 2012, partnering the Department of Water Resources Investigation and Development, Government of West Bengal. To achieve its outcomes, the Project focuses on strengthening community-based organizations, especially water users’ associations with a strong focus on gender aspects, irrigation systems development and improvement, agriculture, horticulture and fisheries development.

FOCUSSING ON IMPROVED OUTCOMES

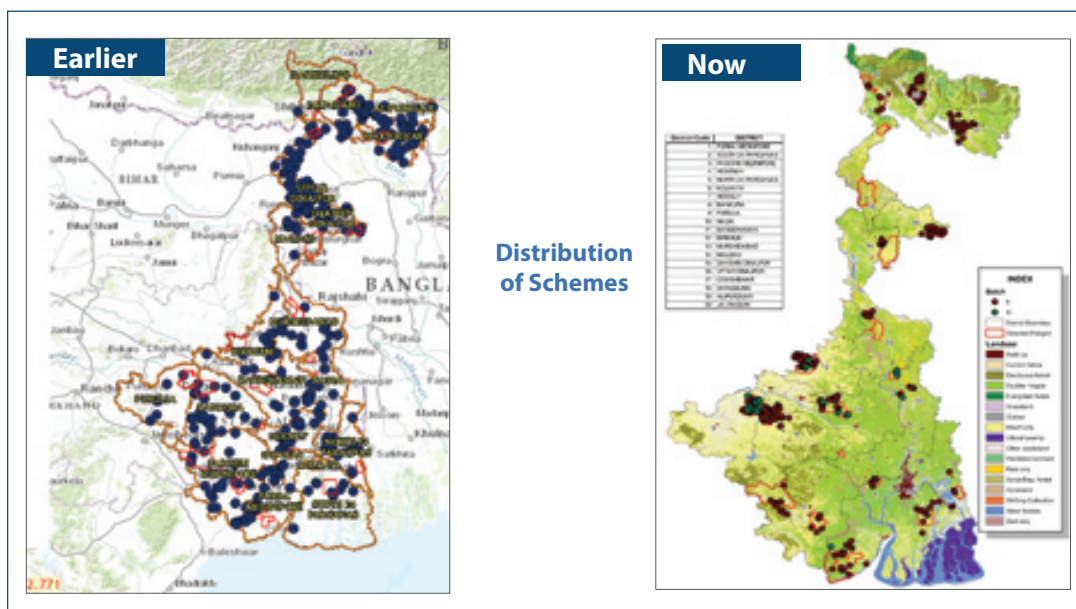
Initially planned to cover 18 districts in the state of West Bengal in comparatively water rich regions, the project realised that the potential for improvements in agricultural productivity, while targeting the poorest, lay in the single-cropped, rain-fed areas. The four districts of Bankura, Purulia, Birbhum and West Midnapur which

cumulatively cover about 46.8 percent of the total rain-fed area of the state, were identified for project investments. To address the new thinking, the selection criteria, design and types of schemes were redefined. This was backed up with appropriate planning, supervision and monitoring inputs using both technology and community support. The shift from groundwater to surface water and from river lift irrigation to dugwells demonstrate a more environmentally sustainable and poverty focused approach.

Planning

The Project had to address a number of challenges. These include thinly distributed schemes across the district that were difficult to aggregate for optimal results, difficult to monitor, based on the use of groundwater, and with no pre-set criteria for selection, difficult to refuse. With the reformulated Project strategy, the prioritisation parameters laid emphasis on rain-fed, single-cropped areas with a higher potential for surface irrigation, having large tribal populations, and where at least 80 percent of beneficiaries would be small and marginal farmers. Detailed guidelines were prepared to ensure that the benefits reached those poor farmers without any access to irrigation and who are often unaware of the project. To simplify and expedite the process of future selection, the guidelines recommended prioritization of single-cropped areas. The initial guidance

¹ This document is prepared based primarily on the presentation made at the Technical Workshop on *The Role of Hydrology and Decision Support Systems for the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) - Applications and Experiences from India* held in New Delhi from 29-30 September 2015 and supported through the South Asia Water Initiative.



Distribution of Schemes

was to focus on *Kharif* areas only. Later, taking into account the needs of various agro-climatic zones of the state, the selection criteria and interventions were customized to address the specific requirements of diverse zones.

Selection Criteria

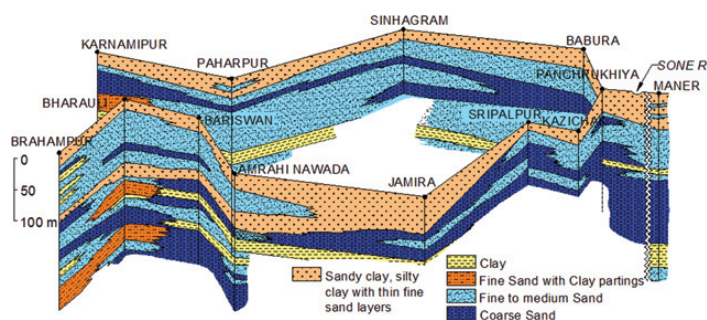
Based on their socio-economic rank, proportion of unirrigated land and hydrologic conditions, focus areas “Polygons” that accommodate the hydrologic and village boundary are identified in each district. Irrigation schemes are taken up for implementation in a phased manner. The aim is to implement schemes in contiguous area to the extent possible, and eventually have coverage at watershed or sub-basin scale. The approach demonstrates an unique amalgamation of socio-economic, natural resource, productivity and investment considerations when planning interventions at field level.

Scheme Design

Keeping in mind that water users’ associations would operate and maintain these schemes, the design and size of the schemes were kept as simple and small as possible to enable decentralized operations and low cost maintenance with local technical help. The designs of schemes are customized following repeated consultations with farmers in order to ensure acceptance by the community while keeping in mind that the proposed schemes would be socially, environmentally and technically viable. Earlier, only fixed designs were considered.

Types of Schemes

The project undertakes analysis of hydrology and water budget at watershed and village levels to identify the most feasible type of scheme. For completed schemes, water availability and quality are monitored regularly. Water level gauging stations are installed in streams where check dams and lift irrigation schemes are proposed and the concerned WUA is expected to monitor it. In order to avoid failures and ensure maximum potential yield, the groundwater schemes are designed based on appropriate geo-physical investigations. Pumping tests have been incorporated in the drilling contract so as to determine the most suitable pumps for the aquifers tapped.

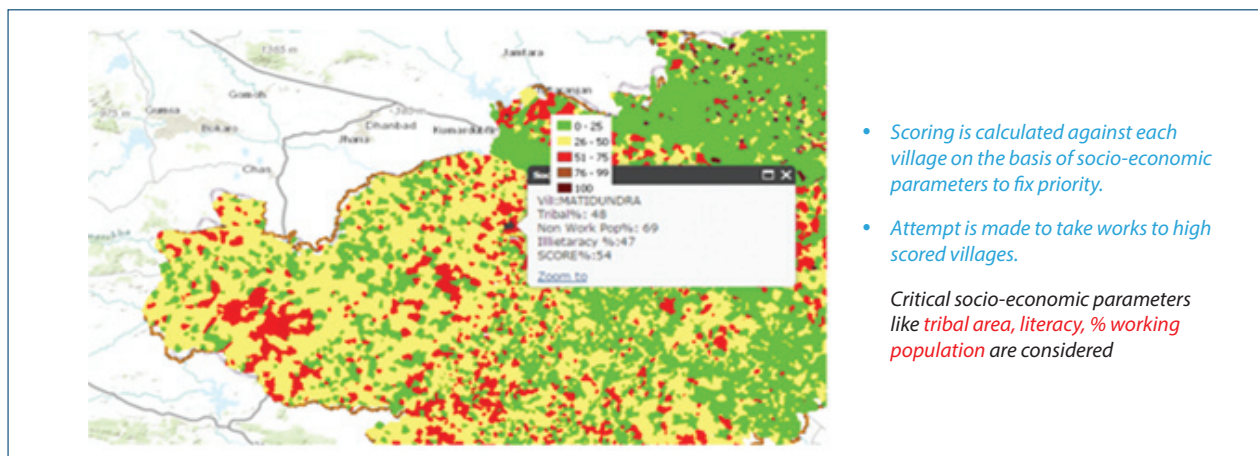


Aquifer in Ganga Basin (dark blue is the highest water yielding aquifer)

Planning formats

To minimize failures, the project has moved from the template driven Detailed Project Report (DPR) which often ignored sites specific suitability of schemes to a more comprehensive Scheme Development and Management

Assessment of social needs



Plan (SDMP) that lays out customized decisions after considering farmer's needs, social, technical and environmental feasibility.

Use of Web-based Tools

The project follows a watershed approach. Investment decisions were grounded in the hypothesis that appropriate scientific investigation and analysis when matched with community level information would enable identification of areas with a high potential for irrigation water availability within a rain-fed context. Fairly accurate information relating to land, rainfall, soil type, existing coverage of agriculture, runoff, etc. are critical

for the analysis supporting the identification of scheme locations and design of structures. Past experiences with uninformed planning, had often resulted in the wastage of resources and community disappointment.

Access to hydrological information through GIS-based tools for planning and design of structures played an important role in the overall success of the project. Data taken into consideration include those for rainfall, evapotranspiration, watershed characteristics, infiltration capacity of soil and stream characteristics, aquifer properties, lithology, water quality, water level fluctuation, seawater interface, etc.

Hydrological information of interest

Surface Water Hydrology

Rainfall Data

- ❖ Historical
- ❖ Real time or near real time
- ❖ Futuristic

Evapo-transpiration Data

- ❖ Historical
- ❖ Real time or near real time

Characteristics of Watershed

- ❖ Watershed area
- ❖ Shape of watershed
- ❖ Elevation
- ❖ Slope of the area
- ❖ Length of slope and length of valley
- ❖ Lag time to the vally and to the outlet
- ❖ Land use
- ❖ Vegetation type and cover

❖ Infiltration Capacity of Soil

- ❖ Soil texture
- ❖ Soil moisture

❖ Characteristics of the Stream

- ❖ Dimension
- ❖ Flow length
- ❖ Slope
- ❖ Discharge capacity
- ❖ Base flow (+/-)

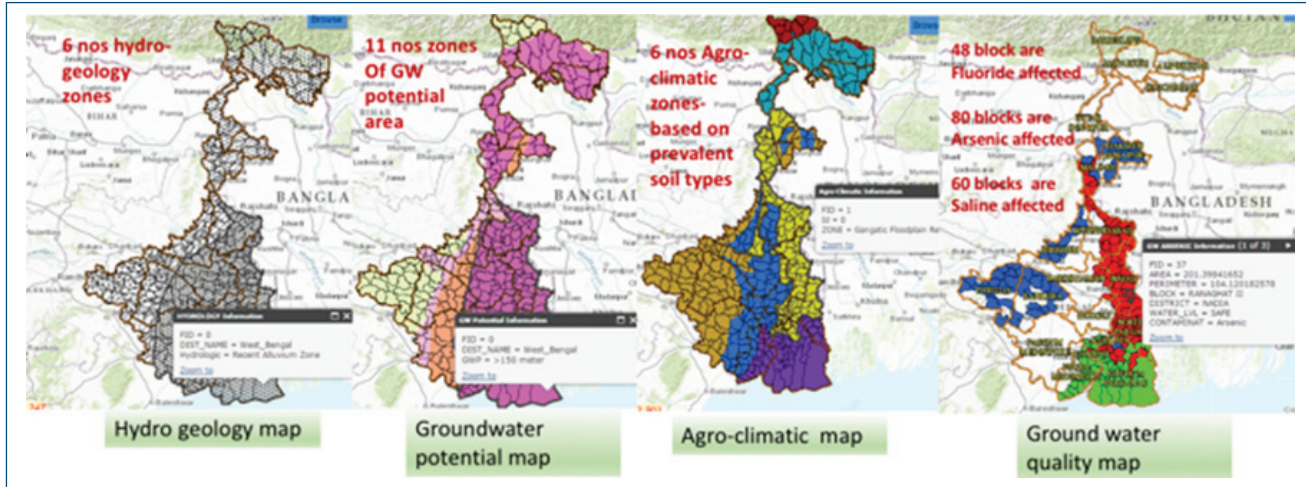
Run-off Volume

$$=f(C) \text{ or } =f(CN)$$

Peak Run-off Discharge

$$=f(C,i,A) \text{ or } \text{Unit Hydrograph}$$

Use of various thematic maps



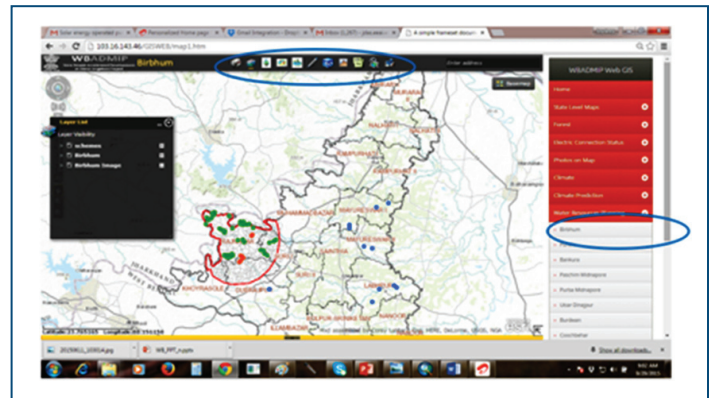
Web-based hydrological information

- Digital terrain model for automated calculation of watershed and hydraulically effective terrain parameters.
- Remote sensing data for the survey of current land use.
- Digital maps of soil, hydro-geology and climate.
- Near real time as well as historical climatic data like evapo-transpiration, rainfall, soil-moisture and surface run-off.
- Models and tools for generation of various hydrologic parameters.
- Regionalized hydrological information.
- Visualization of spatial data.
- Surface water and ground water resources maps.
- Spatial distribution of various hydrological parameters like slope, contour, run-off coefficient, drainage length, stream orders, etc.

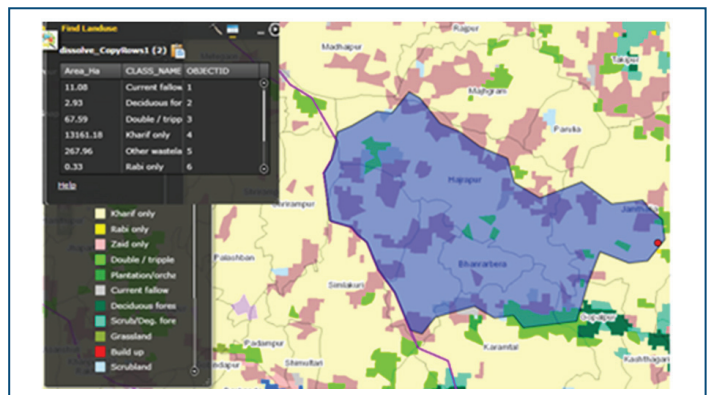
LANDSAT 8 data is used to continuously update the information on land use, cropping patterns and identify unirrigated areas. Thematic maps of the state pertaining to hydro-geology, groundwater potential, agro-climatic regions, groundwater quality, watershed and sub-watershed, forest and critical groundwater, are among those routinely collected from relevant line departments and specialized institutions such as ISRO and used for analysis of further potential. Access to data through a user friendly interface often guides decisions on suitable interventions at field level, as well as for the validation of data from the ground. For eg. hydrogeological and groundwater quality data can enable a decision on the feasibility of a groundwater-based scheme.

Once a broad consensus on feasibility and the type of intervention/s is arrived at, the next steps are the development of hydrological models and the estimation of parameters that assist in actual location and design of structures. The Project has developed a number of models and tools to assist these processes. These include tools for automated watershed delineation and its properties,

Water resources planning tool



Composition of land use and cover





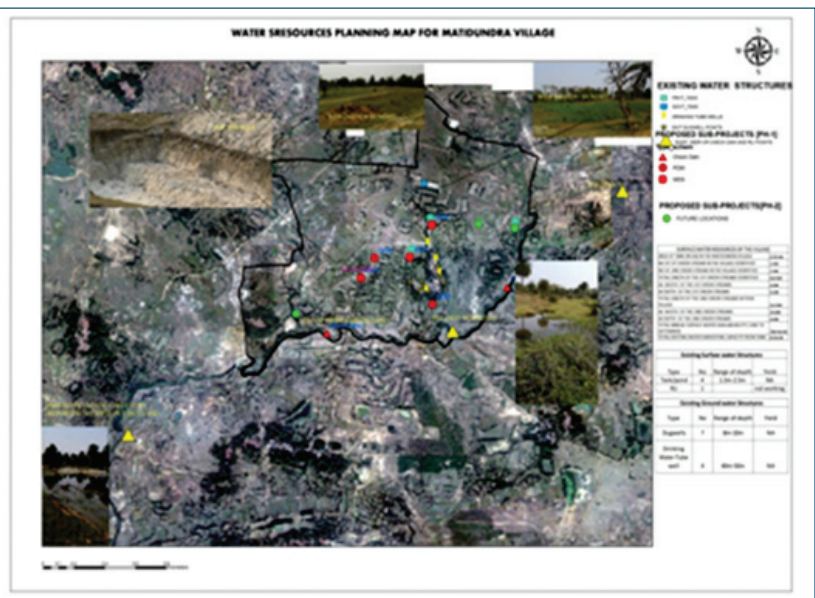
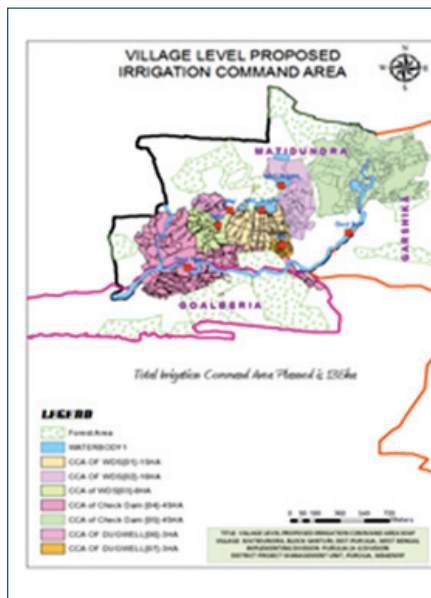
Planning with villagers using satellite maps



Detailed engineering surveys of the project area



Village level planning map



Google earth and GPS-based photos for location of structures

Check dams are avoided in turning rivers



Kanmara V SFMIS

Lift irrigation schemes are now proposed only after verifying the flow in rivers



Impacts and learnings of an ongoing Project

- ❖ Compulsory inclusion of a chapter on hydrology in the Scheme Development and Management Plan.
- ❖ Use of web-based tools for planning, supervision and monitoring of different project parameters ensures high levels of accuracy, resource efficiency and transparency.
- ❖ Introduction of village-level planning maps using scientific information corroborated by community perceptions for technical feasibility and community ownership.
- ❖ The state government allocating INR 500 crores for development of water resources in semi-arid areas of the state. Earlier, the focus was always on irrigated areas.
- ❖ Targeting the poor, ensuring efficient use of resources and delivering environmentally sustainable production solutions can work conjunctively and successfully with focused planning supported through the use of right information and tools.



The Watershed Development Component of the PMKSY (erstwhile Integrated Watershed Management Programme-IWMP) is being implemented across rain-fed areas covering 28 states of India, following the *Common Guidelines for Watershed Management Projects (2008, revised 2011)*. The Programme in essence follows an area development approach for treatment with topography playing a major role in the planning and design of land and water related interventions. With the current focus on ensuring water availability to every farm, the experiences and evolving lessons from the WB-ADMI Project can provide the water-related specificity to an overall integrated area treatment approach within the PMKSY.