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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.

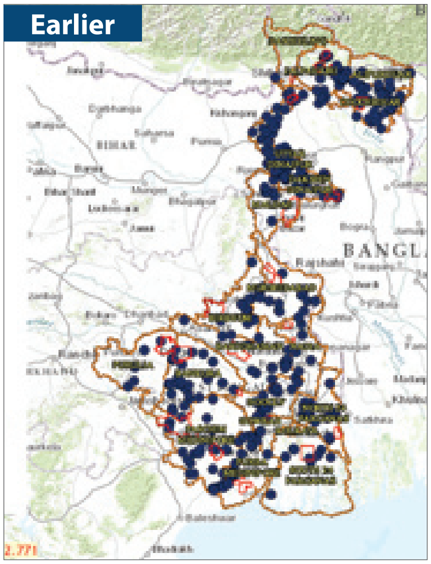
FOCUSSING ON IMPROVED OUTCOMES

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 focussed approach.

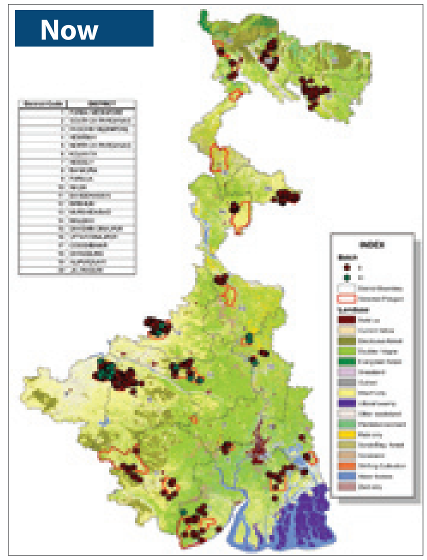
Planning

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

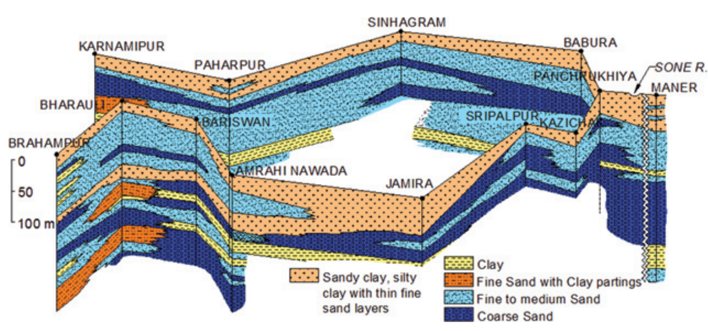
Based on their socio-economic rank, proportion of unirrigated land and hydrologic conditions, focus areas "Polygons" that accommodate the hydrologic and village boundary are identified in each district. Irrigation schemes are taken up for implementation in a phased manner. The aim is to implement schemes 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.

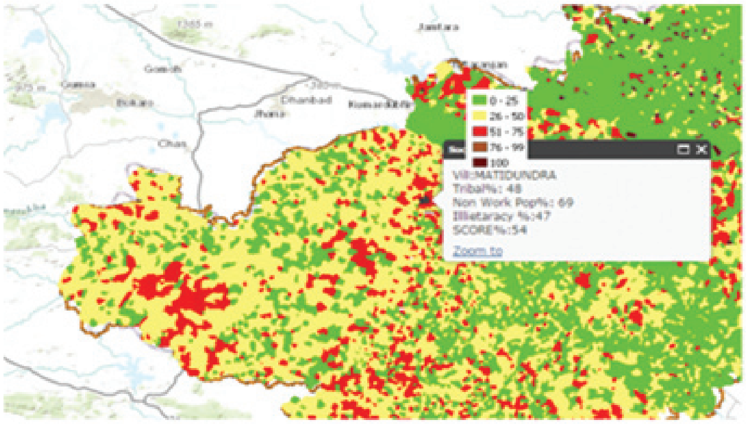


Aquifer in Ganga Basin (dark blue is the highest water yielding aquifer)

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



- *Scoring is calculated against each village on the basis of socio-economic parameters to fix priority.*
- *Attempt is made to take works to high scored villages.*

Critical socio-economic parameters like tribal area, literacy, % working population are considered

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

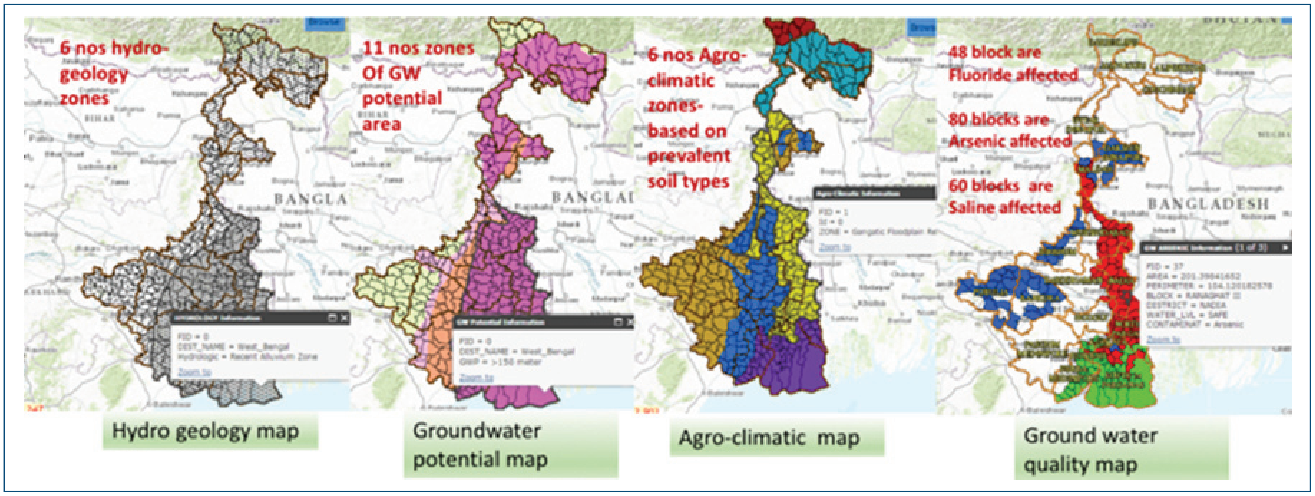
Characteristics of Watershed
- Watershed area
- Shape of watershed
- Elevation
- Slope of the area
- Length of slope and length of valley
- Lag time to the vally and to the outlet
- Land use
- Vegetation type and cover

- **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) or
=f(CN)

Peak Run-off Discharge
=f(C,i,A)
or
Unit Hydrograph

Use of various thematic maps



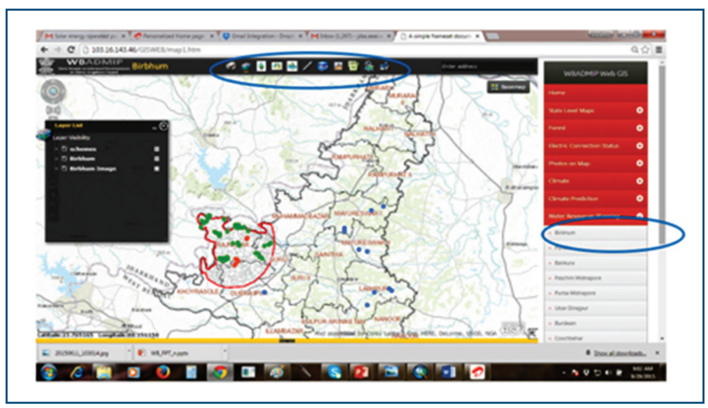
Web-based hydrological information

- 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.

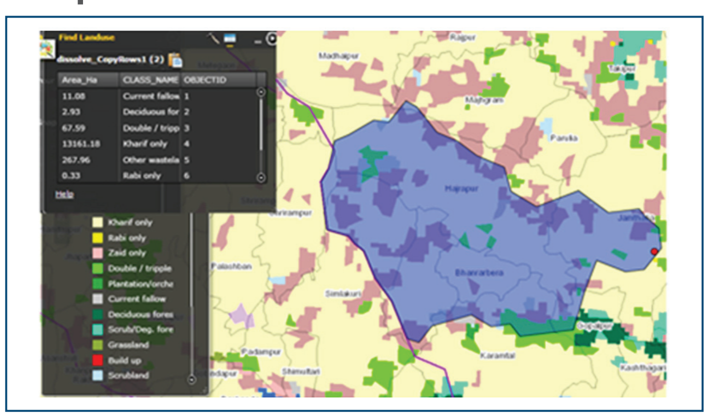
LANDSAT 8 data is used to continuously update the information on land use, cropping patterns and identify unirrigated areas. Thematic maps of the state pertaining to hydro-geology, groundwater potential, agro-climatic regions, groundwater quality, watershed and sub-watershed, forest and critical groundwater, 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



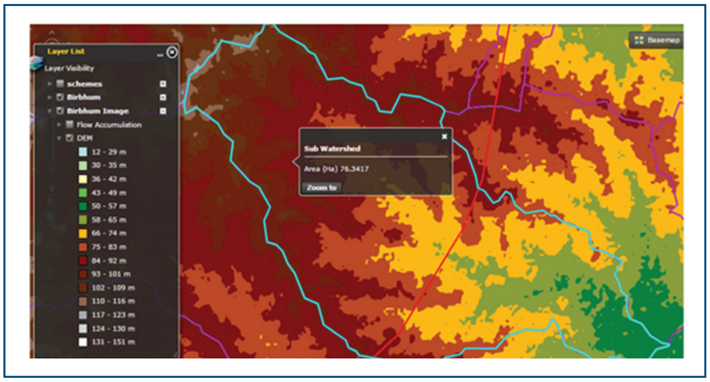
Composition of land use and cover



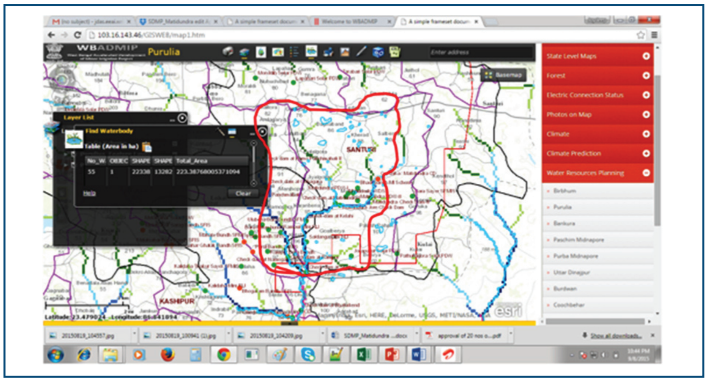
working model for quick assessment of run-off and the water resources planning tool.

Automated generation of catchment area characteristics and hydraulically effective terrain parameters of project locations, assist in the design of structures. Other tools and resources include the water resources planning tool, composition of land-use and land cover, digital terrain model, information on water bodies and near real-time water resources parameters through interactive tools with help from the IMD site. This leads to the assessment of surface water availability at the watershed level as well as in specific villages.

Digital terrain model

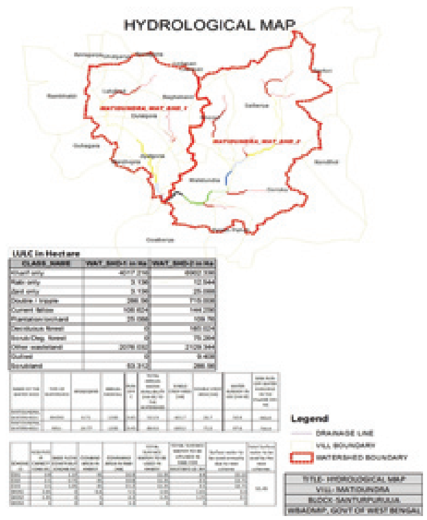


Information on water bodies



In Above Sub-watershed, the area of water body is 223 ha and total water body is 55

Assessing surface water availability at watershed level and village level



Parameter	Unit	Value	
		Watershed	Matidundra
Rainfall	mm	1322	1322
Runoff	mm	543	
Catchment area	Ha	2352	186
Runoff	Ham	1279	75
Existing Storage	Ham		5
Proposed storage	Ha m		40
Groundwater potential	Ha m		
Existing development			
Proposed Groundwater development			

Community Connect and Field Verification

The RS - GIS information is validated and supplemented with primary data from the community. Planning is done alongwith villagers using satellite maps and expert inputs. This approach helps in orienting the villagers while developing a realistic plan. Critical geo-hydrological information is collected and detailed engineering surveys are undertaken. Water quality assessments and lithological co-relation need to be undertaken in certain districts. The groundwater potential is assessed and selection of suitable locations for surface water schemes within a watershed is undertaken using GIS tools.

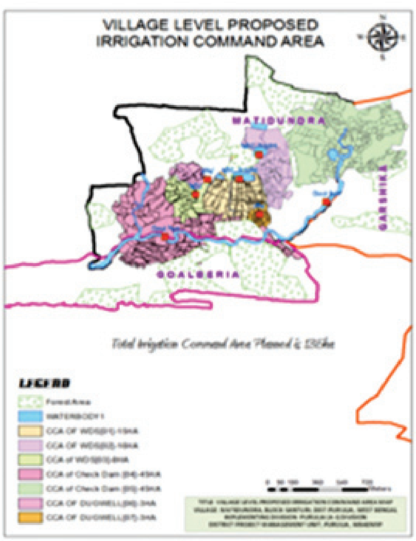
Monitoring and Supervision

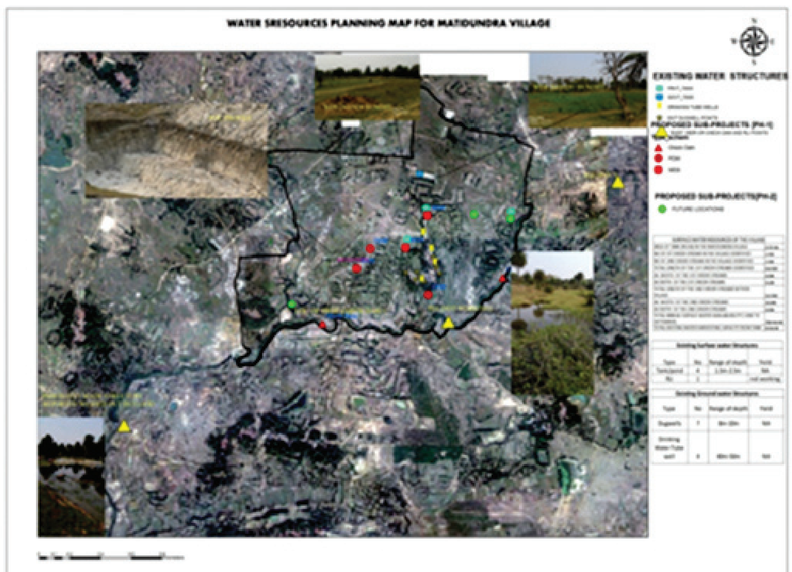
Web-based tools have provided key support in the supervision and monitoring of various project interventions including site selection and choice of structures, tracking of physical progress as well as agricultural outcomes.

Planning with villagers using satellite maps

Detailed engineering surveys of the project area

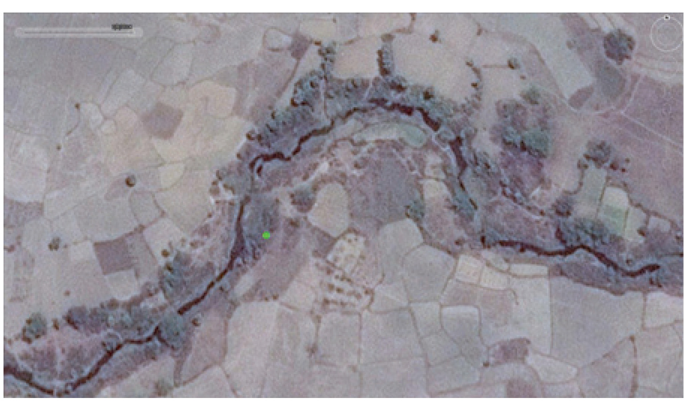
Village level planning map





Google earth and GPS-based photos for location of structures

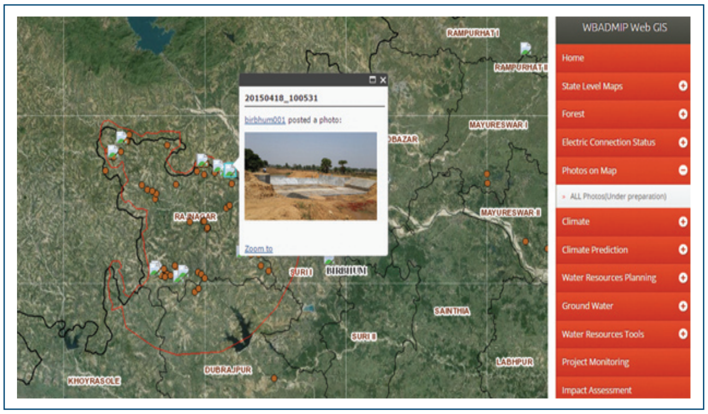
Check dams are avoided in turning rivers



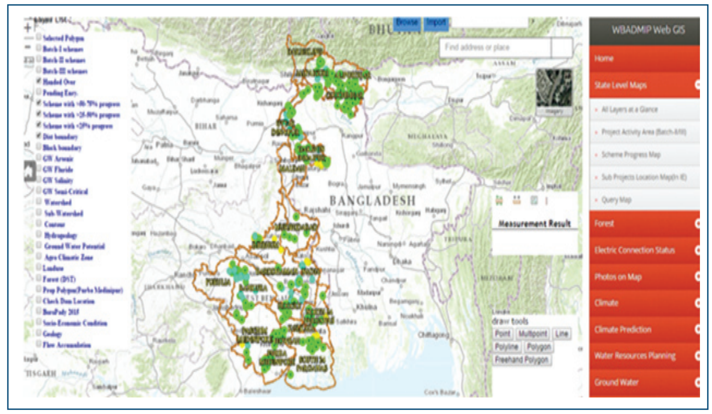
Kanmara V SFMIS

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

Monitoring of scheme progress with photos



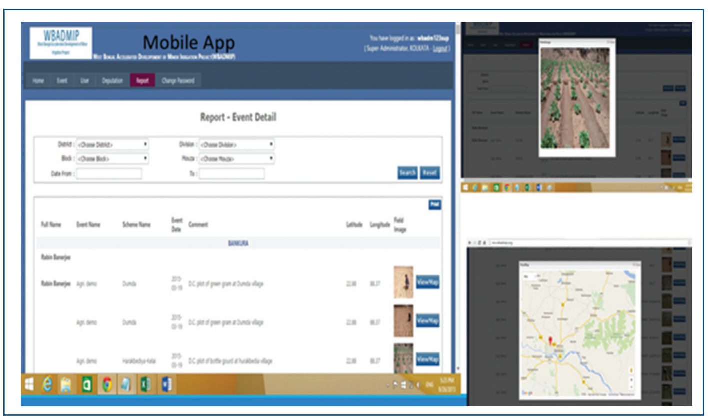
GIS-MIS integrated scheme monitoring and progress tracking



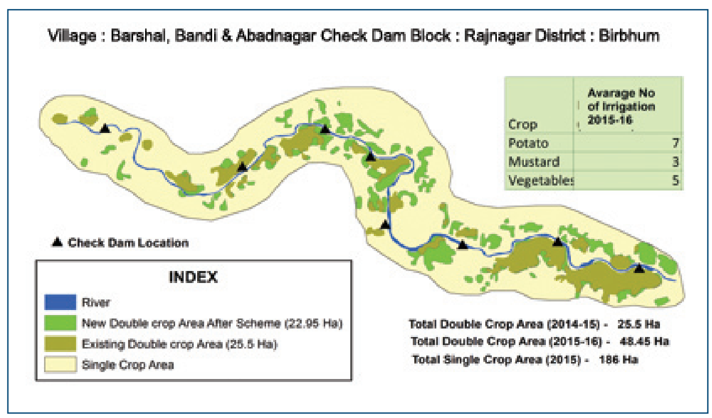
Production and Livelihoods Support

Diversification and enhancing productivity in agriculture, horticulture and fisheries were achieved through improved water availability, dissemination and adoption of better production and water management technologies and efficient farm advisory services. Increases in cropping intensity range from 30 percent to 100 percent. Paddy production recorded a phenomenal increase of nearly 500 percent in some areas.

Mobile app for monitoring



Change in crop production



Institutional Strengthening

Water Users' Associations have been formed across most project villages and registered under the West Bengal Societies Act. A large number of women have assumed decision making positions in the WUAs. The WUAs have assumed management, operation and maintenance responsibilities of commissioned water supply schemes and some have started collecting water charges to meet the operation and maintenance expenses. A number of water meters have been installed and water regulation registers are available. WUA members are typically closely involved in supervision of the construction works. Checklists have been provided to WUAs to ensure quality control of works. The formal proposal (SDMP) is signed and submitted by the WUA and contractor payments are linked with OK cards given by the concerned WUAs.

Conclusions

Figures indicate that over 95 percent of the remotely identified scheme locations were found feasible after field verification, thus reducing valuable time and effort. All schemes constructed are operational and no failures have been reported due to wrong site selection. Efforts that the project put into strategic planning emphasize the fact that well thought out and focused planning with the right tools and information can go a long way in achieving the overall objectives of most natural resources-based development initiatives of environmental sustainability targeting the poorest through enriched asset bases for improved production and livelihood outcomes.

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.

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