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WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

Conjunctive water use, Maharashtra, India

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THE RESEARCH PROJECT, *Conjunctive Use of Water Resources in Deccan Trap, India,* involved BAIF Development Research Foundation and University of Windsor Earth Sciences. They worked in partnership with the tribal and rural people of Akole *Taluka,* Ahmednagar District, Maharashtra. Participatory management and evaluation were key elements of the project. The goal was to improve management of water resources in Akole *Taluka*. The purpose was to design a management strategy for a year-round water supply, with a focus on domestic needs. The authors were the Canadian and Indian project leaders. The funding agency was the International Development Research Centre, Ottawa. Simpson and Sohani (1998) gave a summary of the project, with an emphasis on the sustainability of its results. The present account deals with some aspects of project research.

Background

Akole *Taluka* is on the eastern flank of the Western Ghats mountain range. A rugged terrain in the west gives way to relatively flat land at lower elevations to the east and south. The *taluka* receives monsoon rains from June to September, in amounts ranging from 600 to 2,000 mm. July is the wettest month. In the post-monsoon period (October - January), sporadic showers sometimes occur. Rain is generally absent from the pre-monsoon months (February-May), when temperatures commonly climb to the forties Centigrade.

Project activities were concentrated mainly in and around the villages of Ambevangan, Manhere, and Titvi, located in the west-central part of the *taluka*, which is drained by mainly ephemeral streams, flowing into the Pravara River in the months following the monsoon. The project area is part of the Deccan Trap plateau, where the bedrock is composed of relatively flat-lying basalt lavas over some 500,000 sq. km. of western and central India (Beane *et al.*, 1989*)*. In the project area, surface and near-surface Earth materials in general exhibit poor aquifer potential, comprising a soil cover, up to about 2 m thick in the deeper valleys, resting on weathered bedrock of variable thickness, which gives way to the impermeable basalt beneath.

The main crops of the *kharif* growing season (June-September) are rice, groundnuts, *ragi,* and local grass. In the *rabi* season (October-January), the main crops are wheat and *gram,* but quality depends very much on the availability of soil moisture. At the start of the project, water supplies dwindled gradually after the monsoon rains, so that during the pre-monsoon period the women and older children had to walk increasing distances, in search of water for domestic use. The men were forced to work as unskilled labourers away from home for extended periods of time. Many of the villagers had dermatitis and gastro-intestinal disorders, related to the scarcity of water.

Water for Akole *Taluka*

Technologies to reduce the movement of water out of the area as surface runoff formed an important part of the management strategy for a year-round water supply in Akole *Taluka*. The techniques considered were those employed in other dryland regions of India and abroad. They included technologies more than four millennia old, such as those employed by the Naboteans and their predecessors in the Negev Desert (Nessler, 1980). As well, attention was paid to the land-use practices and religious beliefs of the tribal and rural people. The villagers contributed their indigenous knowledge on terrain features and also botanical indicators of shallow ground water, which are revered locally.

The technologies introduced are cheap, small-scale, easily replicated and compatible with existing land-use practices. They are various approaches to water harvesting and spreading, augmented with techniques of soil conservation and revegetation. Terracing of the hillsides was expanded in a few places. Ridges and trenches were configured to divert surface runoff underground. Artificial recharge, deepening of dug wells and workovers on bore wells improved well yields. Check dams were constructed to trap monsoon rains and spring and seepage waters in reservoirs, occupying the valleys of ephemeral streams. Some spring discharges were collected in tanks. The rain, falling on the roofs of houses, was diverted to collection tanks, by means of eaves troughs and pipes. The project research assisted the selection and siting of appropriate technologies. In general, the research activities were aimed at understanding the fluid-flow characteristics of the shallow Earth materials and the relationship between surface and ground water.

Project research

Measurements of field-saturated hydraulic conductivity, porosity, bulk density, soil moisture tension, and surface infiltration rates were used in assessments of the aquifer potential of the soils. The tests confirmed the common occurrence of a thin surface veneer of clay and silt, above more permeable soils. These data were employed in the siting and determination of the spacing of recharge pits and trenches. Observations of rivulet discharge in some paddy fields after heavy rainfall indicated that the weathered bedrock was capable of storing and also releasing significant amounts of water.

The work of Subbarao and Hooper (1988) provided a basis for a reconnaissance geological map. Straight-line ground features (lineaments), mapped from interpretations of imagery from Earth satellites in orbit, were overlain on it. Other linear ground features were added from the previous work of Powar (1981) and Deshmukh and Sehgal (1988). The lineaments commonly define the surface traces of vertical fractures in the bedrock. These breaks in the lateral continuity of the basalt lavas frequently mark the courses of short-lived streams. Fracture systems also serve as conduits for the migration of ground water. On hillsides, they commonly coincide with springs and seepages.

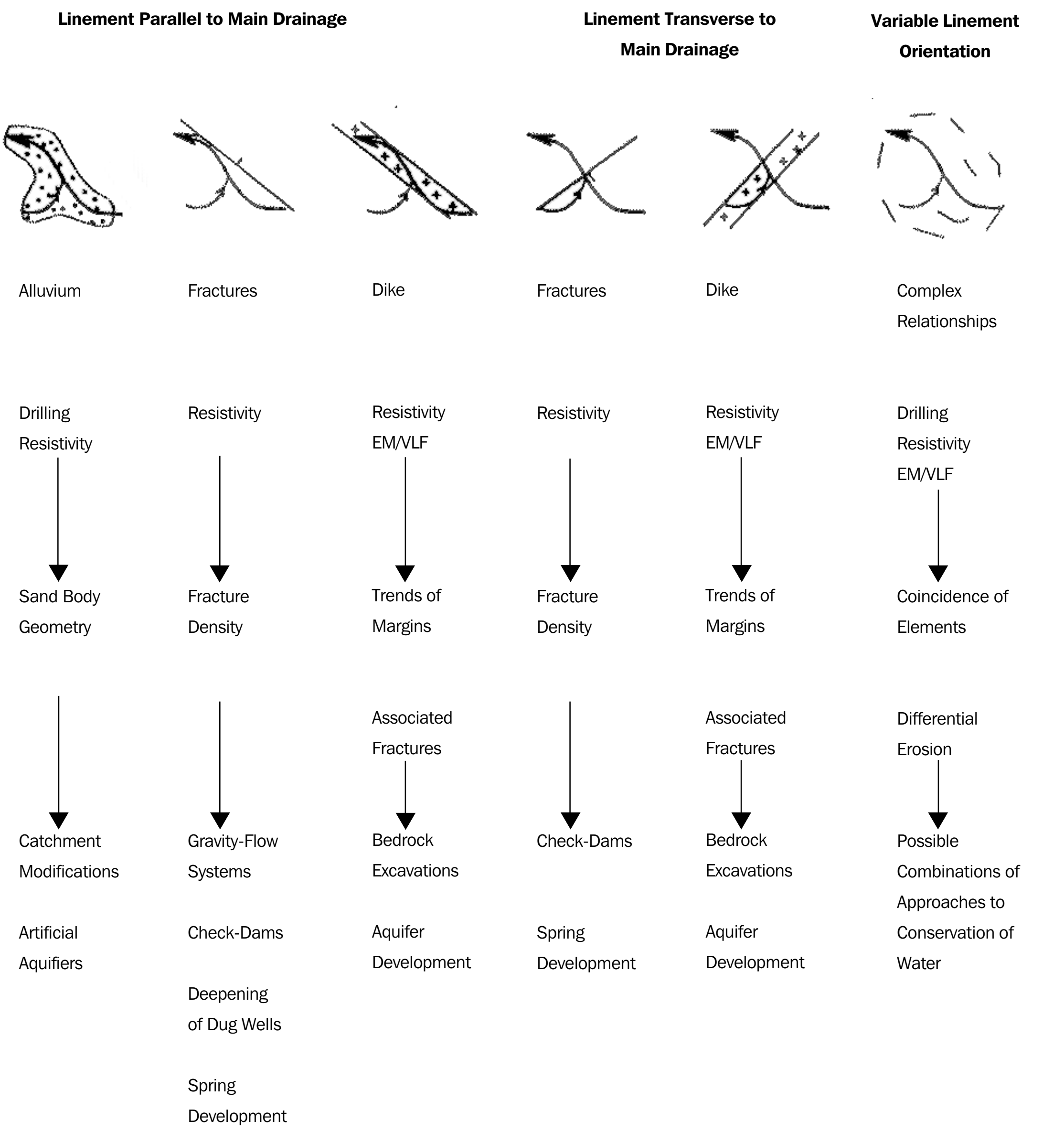

Figure 1: Lineaments, surface drainage and water conservation in Akole *Taluka*, Maharashtra State, India

Figure 1 summarises alternative interpretations of linear ground features in the area and presents a series of corresponding approaches to water conservation. These formed an important part of the project's water-resource management strategy. This approach to water-resource management has potential for application across the Deccan Trap plateau, on the basis of similarities in geology. Accordingly, the approaches to geophysical exploration, likely to yield the best results, are noted with the main factors, contributing to the localisation of surface and ground water. Several of the pre-existing dug wells, deepened during the project term (Fig. 2), were sited on vertical fractures in the bedrock.

Analyses for the environmental isotopes, oxygen-18 and deuterium were made on water samples from dug wells and surface waters. These data, combined with field measurements of electrical conductivity, gave an approximate indication of the nature and location of ground-water recharge. The isotopic signatures of the well waters resembled those of the surface waters. It was concluded that they had undergone evaporation, consistent with a shallow mode of occurrence. This was taken to indicate that recharge of the well waters had occurred through the weathered bedrock and fractures in the underlying lavas during the previous monsoon.

Outcomes

The project achieved its purpose, by providing the tribal and rural people of the partner villages with a management strategy for a year-round water supply. The technologies, introduced at demonstration sites, resulted in an increase to water availability of about 750 l/d per capita during the driest part of the year. In 1966, about 300 ha of wasteland were brought under cultivation during the rainy season. During the same year, increases to soil moisture permitted the villagers to harvest a second (*rabi*) crop from 75 ha of land. Soil erosion has been greatly reduced.

Village women no longer spend the greater part of each day, searching for and carrying water. Instead, they now are able to work longer hours each day in the fields. The men are able to put their new skills to work for higher pay, should they choose to seek employment outside of the villages. Increasing numbers of villagers sell produce at the local markets. New, agricultural enterprises, planned by the people, include the introduction of commercial crops, such as tomatoes. Expanded uses for the excess water, such as irrigation, are being planned. Livestock numbers are decreasing, although the quality of livestock shows improvement, as more land goes into agricultural use.

There are significant improvements to village morale, evidenced by attention to personal appearance, more outgoing attitudes, improved upkeep of dwellings, and new housing starts. The incidence of health problems, related to water shortage, shows a dramatic reduction. The villagers now see connections between reduced water quality, sickness, lost time in the fields, declining productivity, and lower financial returns. Accordingly, they sought instruction from the project partners on the periodic cleaning of dug wells. They have taken charge of maintenance of the demonstration sites and the monitoring of water quality. The women strain well water through several layers of *sari* material to remove suspended solids. The use of pit latrines still shows a steady increase.

Figure 2: Dug well and vertical fractures in bedrock, near Manhere, in Akole *Taluka*, Maharashtra State, India

The project not only yielded a management strategy for a year-round water supply in the three partner villages. The effectiveness of the water-harvesting and -spreading technologies that form an integral part of the strategy was demonstrated at a number of sites in the villages and outlying areas. The demonstration sites satisfied the water needs of the people throughout the year. Visits to the sites before the onset of the monsoon in both 1997 and 1998 and also during the monsoon in 1999 showed that the project results are sustainable.

The success of the project created an enabling environment for similar activities in the surrounding area. The transfer of technologies across a wider area of Akole *Taluka* was made possible by support to BAIF Development Research Foundation from the National Bank for Agriculture and Rural Development, under the Indo-German Watershed Development Programme.

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