



# Land-Water Linkages in Rural Watersheds Electronic Workshop 18 September – 27 October 2000

## Case Study 12

### **Watershed development – or should it be watershed management?**

C. Batchelor, Water Resources Management Ltd.  
Tavistock, Devon PL19 0NQ, UK  
email: [wrmltd@aol.com](mailto:wrmltd@aol.com)

M. Rama Mohan Rao, Soil Conservation Institute  
Karnataka, India  
email: [soilcons@blr.vsnl.net.in](mailto:soilcons@blr.vsnl.net.in)

K. Mukheree, Karnataka Watershed Development Soc.  
Bangalore 560 038, India  
email: [kawad@bgl.vsnl.net.in](mailto:kawad@bgl.vsnl.net.in)

A full report on this work can be downloaded via the following link:  
<http://www.driveway.com/share?sid=csba484b.799e5&name=for+guests>.  
The file (listed as Report 17) is in compressed \*.pdf format and it can be viewed  
and printed using ACROBAT Reader.

## **BACKGROUND AND OBJECTIVES**

The Karnataka Watershed Development Project (KAWAD) is located in the northern districts of Karnataka State, India. This is an area characterised by limited water resources for which there is increasing competition. In addition to piloting different institutional approaches to watershed development, KAWAD aims to improve the livelihoods of the inhabitants of three selected watersheds (total area of around 45,000 ha). The water resources audit study reported here aimed to assess the status of land and water resources in the project watersheds and to provide a framework for more productive, sustainable and/or equitable use of water resources.

## **METHODOLOGY**

In India, large amounts of physical, institutional and socio-economic data have been and are being collected in rural areas. Unfortunately, these data are not always easily accessible and their quality is usually quite variable. A major feature of the study was the consolidation of data from a wide range of sources onto a GIS database. Some groundtruthing was carried out during the collection process and further quality control checks were carried out once the database was set up. Analysis focused on using water balance techniques to assess current patterns of water use by irrigated and rainfed agriculture at a range of scales and current and future demands for water by, in particular, the human and livestock populations of the watersheds.

## **PHYSICAL CHARACTERISTICS OF THE WATERSHEDS**

Two of the project watersheds, namely Chinnahagari and Upparahalla, are located in a predominantly red soil (alfisol) area that is underlain by granites and gneisses. The other watershed, Doddahalla, is located in a black soil (vertisol) area that is underlain by Deccan basalts. Mean annual rainfall is approximately 472, 576 and 573 mm in the Chinnahagari, Upparahalla and Doddahalla respectively. However, there is considerable inter- and intra-annual rainfall variability and droughts and years of relatively high rainfall are not uncommon. The main land use in all three watersheds is rainfed arable cropping. At 25%, Doddahalla has the largest percentage area under irrigated cropping. In comparison, Chinnahagari and Upparahalla have only have 6% and 3% of the land area under irrigation.

## **MAIN FINDINGS**

In all three watersheds, there has been a dramatic increase in groundwater extraction for irrigation during the last ten years. This has been driven by the relatively higher profitability of irrigated agriculture when compared to rainfed agriculture, grants or cheap loans for well construction and government policies such as free electricity for pumping groundwater. Although there may be some small areas of unexploited aquifer in Chinnahagari and Upparahalla, all the evidence points to the conclusion that current levels of groundwater extraction are approximate to annual recharge. Over large areas, wells are pumped for irrigation each year until they fail.

As a direct consequence of increased groundwater extraction, groundwater levels have fallen and, in Chinnahagari and Upparahalla, shallow wells have failed as borewells have been constructed and as extraction from the deep aquifer has become the norm. Falling groundwater levels have led to changes in the surface hydrology of the project watersheds. Springs and seepage zones have dried and now only flow or become saturated after exceptionally wet periods. Flow in ephemeral streams is less prolonged after large rainfall events and, as a consequence, flows into tanks are reduced. Even though local perception is that cutting down trees is the main cause of the reduction in tank inflows, it is clearly falling groundwater levels

that have had the greatest impact along with, in some areas, the unregulated construction of check dams and diversion weirs in the tank catchment areas.

In the project area, river gauging data show that annual surface runoff at the large watershed scale is somewhat lower than is often reported or than accepted wisdom would suggest. Although there is large inter-annual variation, average runoff as a percentage of rainfall is around 6% and 2% for the Doddahalla and Chinnahagari Rivers respectively. Although runoff for individual or sequences of rainfall events is often higher (as is runoff at the plot and field scale), this finding shows that there are not large volumes of additional surface water that can be harvested in the project watersheds. The low values of runoff are not surprising given the physical characteristics of the region, the groundwater depletion (and, hence, the greatly reduced base flow) and the large number of check dams, nala bunds and contour bunds constructed prior to the project. It should be noted also that tanks in the area now only spill when the rainfall pattern is particularly conducive to the generation of runoff (approximately once in every 5-10 year period).

Doddahalla's annual groundwater recharge and, hence, availability is estimated to be 21% of annual average rainfall. It appears that one positive consequence of groundwater depletion in this watershed has been an increase in groundwater recharge. This is because groundwater levels no longer approach the ground surface at the end of the rainy season and, therefore, rainfall infiltration is not rejected due to lack of available storage. Average recharge estimates for Upparahalla and Chinnahagari are around 6% and 8% of annual rainfall. Estimates of groundwater use on a village-by-village basis, show that extraction is far from uniform. Levels of groundwater extraction in some villages are more than 2.5 times higher than average recharge values. Although there is certain to be some real variability in recharge, in many cases, this situation is only sustainable if water is flowing into these village areas from neighbouring areas. This finding has important implications for the implementation of the project. If the project promotes soil and water conservation activities that reduce these flows, there will be winners in one village but only at the expense of losers in another.

Current extraction of groundwater for domestic and livestock purposes is estimated at around 3%, 10% and 12% of average annual recharge in Dodda Halla, Uppara Halla and Chinna Hagari respectively. By 2030 these figures are likely to double and, for future demands to be met, there will have to be a reduction in groundwater use for irrigation at least in the areas around villages. In some villages, there are already problems of water shortage in the summer season. In these cases, it is the poor, particularly women and children, who suffer the most. Even more worrying is the prospect of a major groundwater drought in the region. Levels of groundwater extraction are such that, in many areas, there is no longer a groundwater "buffer" that can be used as a source of supply during periods of meteorological drought when no recharge will take place.

## **CONCLUSIONS SPECIFIC TO THE KAWAD PROJECT**

The results of the study show clearly that the focus of KAWAD should be on water resource management as opposed to water resource development. Water resources in the watersheds are close to being fully developed and, in general, constructing check dams or new wells will only change the pattern of water abstraction and use (i.e. such activities will not make additional water resources available). Although the study findings suggest a rather gloomy state of affairs, one positive conclusion is that there are a large number of water management options (over 40 were identified) that could be promoted by the project. All these options have the potential to increase the productivity of water use and/or to improve equitable access to water resources. The fundamental need is to consider the tradeoffs associated with changing patterns of water use and to select options that maximise the social and economic value of water in any given setting

at the watershed scale. In most cases, this means giving drinking supplies the highest priority and then allocating water to uses that have the next highest social and economic value.

## **GENERAL CONCLUSIONS**

This study has shown that consolidating, groundtruthing and analysing existing information using GIS software provides important insights into the status of water resources in an area and the potential for making better use of these resources at a range of scales. The study has also shown that such water resource auditing is a good starting point for identifying options that match the physical characteristics of an area.

Results from this study and analysis of information from watershed development projects in other dryland areas of India indicate that positive aspects of the ongoing watershed development programme include:

- Increases in net agricultural production on arable and non-arable lands;
- Development of village-level institutions;
- Substantial improvements in the livelihoods of some social groupings;
- Implementation of an approach that has widespread political and public support.

The less positive aspects of the programme in dryland areas include:

- Certain groups capture water resources often at the expense of the poor;
- New village-level institutions are usually outside government and, consequently, they often they have minimal political or legislative support for any actions or decisions that they might take;
- Protecting drinking water supplies is not seen as an integral part of watershed development;
- Emphasis is on development of water resources (i.e. on increasing water supplies by constructing check dams, rehabilitating tanks etc.) and not on management of water resources (i.e. on managing demand and on maximising the social and economic value of water).
- As planning takes place at the village-level, a whole range of wider issues are ignored (e.g. upstream-downstream equity, inter-village equity, flood protection, drought preparedness, pollution of water courses, biodiversity and protection of rare habitats etc.)
- Watershed development publicity or propaganda (e.g. wall paintings, street plays etc.) is often misleading in that suggests that there are quick fixes to water-related problems in semi-arid areas.

## **GENERAL RECOMMENDATIONS**

The watershed development programme in India has proved to be very successful on many counts, however, there is scope for improvement, particularly in dryland areas. The modifications that are needed include:

- Planning and water resource management should take place at basin and watershed levels as well as at the village level. Village-level ownership and decision-making are fundamentally important but village-level decisions should be made within a wider planning framework;
- Emphasis should be on long-term management of resources at all levels even though this may not be attractive to bureaucrats and politicians who want a quick fix or another glittering initiative;
- Fundamental rights to drinking water need to be protected such that demand is met throughout the year and during years of good and bad rainfall;
- Watershed development guidelines and funding procedures need to be changed so that a much wider range of activities and interventions are promoted;

- Incentives and disincentives are needed that encourage individuals and groups to make more equitable, efficient and productive use of water;
- Legislative support needs to be given to community action;
- Steps need to be taken to reduce the frequency and impact of corrupt practices on all resource management practices;
- Finally, resource audits should be used as a starting point for all watershed development and livelihood projects. It is a tragedy that so much effort goes into collecting resource-related information that is not made available to potential users or even demanded by potential users and as a consequence, financial and human resources are often wasted.

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