Watershed management training, Maharashtra, India

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THE RESEARCH PROJECT, *Conjunctive Use of Water Resources in Deccan Trap, India*, ran from April 1, 1992, to May 31, 1996. BAIF Development Research Foundation, Pune, India, and University of Windsor Earth Sciences, Windsor, Ontario, Canada, worked with the tribal and rural people of Akole *Taluka*, Ahmednagar District, Maharashtra State. The goal was to improve the management of water resources by the people. The purpose was to design a management strategy for year-round availability of a domestic water supply. Participatory management was an essential component of the project. Demonstration sites of water harvesting and spreading for conjunctive use satisfied the domestic water needs of the people within the project term (Sohani, Simpson, et al., 1998). The project outcomes are sustainable.

Hartvelt and Okun (1991) and Oyebande (1995) emphasized the importance of education and training in capacity building[1] for the management of water resources. The objective of the present account is to describe how these major components of human resource development contributed to the success of the project in Akole *Taluka* and also has provided a basis for continued cooperation of BAIF and the University of Windsor, up to the present day. The authors were the Canadian (FS) and Indian (GS) project leaders.

Training model

The collaboration between BAIF, the University of Windsor and the rural poor of three villages is the basis of a model for international education and training, with a focus on watershed management.

The model comprises three distinct, though overlapping stages of development. (Table 1 overleaf)

The first stage was international development research (1992-96) in rural Maharashtra, India, to solve a problem of water-resource management. Human resource development included training in some of the field techniques of hydrology and hydrogeology for programme and BAIF field personnel and basic education (environmental education in village schools, vocational training for implementation of water-conservation technologies and also training in health and sanitation) for the village partners. Village role models played an important part in the wider dissemination of the messages from vocational training. This also assisted the transfer of project technologies to the surrounding area. The villagers were encouraged to form watershed committees and women's groups, which assisted communication.

The second stage (1996-present) slightly overlaps with the first. It comprises human resource development for increased numbers of programme personnel. These individuals, for the most part, did not participate in the development research project. This stage involves training that takes as its basis the main lessons, learned during the course of the research. These pertain to the technologies, implemented during the project. But they integrate cutting-edge Science, ancient Indian hydrology, indigenous technical knowledge, and water-related aspects of local, religious beliefs. The project personnel work in seven of the states of India. They represent a total constituency of more than a million families.

The third stage (1998-present) overlaps with the second. It has to do with incorporation of the information, derived from the first two stages, into existing, undergraduate courses in Earth Sciences at the University of Windsor. During these times of increasing concern about global climatic change, this has very practical value for Canada. This stage also includes dissemination of the project results in popular articles, as well as in peer-reviewed papers, for the most part presented at international symposia, attended by development practitioners. Journalists wrote many of the popular articles. The funding agency, the International Development Research Centre, Ottawa, led the way in the dissemination of project results.

Project outline

The project involved the integration of modern Science (analysis of imagery from Earth satellites in orbit, use of global positioning systems, geographic information systems, and field and laboratory techniques in hydrology and hydrogeology) with ancient Indian hydrology (for example, entries in the *Brahat Samhita* of Varaha Mihira, Sixth Century), water-related aspects of local religious beliefs, and indigenous technical knowledge. Simpson and Sohani (2000) described the main thrusts in project research. The fluid-flow characteristics of shallow Earth materials were investigated, as a basis for the selection and siting of appropriate technologies for water harvesting and spreading in support of conjunctive use[2].

The project technologies are compatible with local land-use practice.

Masonry check dams, gabion structures, and gabion structures with impervious, ferrocement barriers were constructed across the valleys of ephemeral streams at different locations to impound water in reservoirs on the up-slope side[3]. Gabion structures were held together by galvanized

Table 1. Model of International Education and Training in Watershed Management

1) Human resource development to facilitate project research

- training of NGO's programme and field personnel (hydrology, hydrogeology);
- basic education for village partners (vocational training on implementation of technologies, training in hygiene and sanitation, environmental education in schools, introduction of ITK from other regions); and
- ITK transfer, village traditions in action (notably folk and cultural approaches to group communication).

2) Human resource development for technology transfer

- training for NGO's programme/field personnel from other projects over wider area (project results, lessons learned);
- technology transfer beyond project area (exposure visits for villagers from adjacent areas); and
- ITK input from rural people, spurs to creativity from brainstorming sessions in workshops.

3) International education and technology transfer

- incorporation of information from stages (1) and (2) into university courses (environmental impact assessment, decision analysis and auditing);
- technology transfer worldwide (popular articles, Web documents, conference papers, best practices competitions); and
- feedback and idea generation.

iron chain-link. Shallow bedrock provided the foundation. An underground stone dam also was constructed to localize the occurrence of ground water, which is accessed through a dug well.

Barriers, including some gabions and masonry gully plugs, also were constructed at right angles to the slope to reduce runoff velocity and trap eroded soil[4]. Hedges also were planted at right angles to the slope on selected hillsides. Local vegetation was augmented through additional planting in areas of wasteland. These strategies of revegetation also had the effect of reducing soil erosion.

Roof water harvesting was introduced into the villages as a partial response to the priority, placed by the people on a domestic water supply. The houses in the villages are of stone and mud and have tiled roofs, which form effective catchments. Gutters of galvanized iron were added and connected to ferrocement storage tanks, by means of PVC pipe.

Infiltration (recharge) pits, in the vicinity of dug wells, contributed to the artificial recharge of ground water and had the effect of improving water yields. Existing bore wells were given extensive workovers (repairs) to improve their yields.

The down-slope motion of and erosive power of runoff waters were reduced through the expansion of the systems of terraces, excavated on the hillsides and more steeply inclined valley bottoms. Surface runoff was diverted underground, as a result of improved infiltration at particular terrace levels, related to the construction of terrace-margin bunds[5] and systems of contour trenches[6]. Infiltration pits and trenches and farm ponds[7] complete the inventory of water-spreading technologies, used in the project.

Human resource development

Human resource development with an Earth Sciences focus played a vital role in project activities. It was part of a multidisciplinary effort that also included attention to public health and socio-economic issues. Vocational training was provided for villagers in the implementation and maintenance of technologies for water harvesting and spreading.

About 25 village youths were trained in ferrocement technology and masonry construction. In each village, 10 to 15 people were trained to construct gabions and 8 to 10 individuals were instructed on how to construct terraces and trench and bund systems, with reference to contours of elevation above mean sea level. Nursery and plant grafting techniques were shown to five youths in each village. In general, all interested parties were shown on an individual basis the installation of roof water harvesting systems, maintenance and repair of hand pumps, cleaning of dug wells, construction of check dams, and various measures for the conservation of soil and water.

Village families were given basic instruction in hygiene and sanitation. Interested families were given assistance in the construction of pit latrines. Environmental lessons, introduced into village primary schools, were taken home by the children and passed on to their parents.

Organized groups and individuals in the villages assisted in delivery of the project's messages of water conservation and related aspects of public health to the communities.

These included village watershed committees, women's groups, teachers at the village primary schools, and individual farmers. Villagers, with benefits to show from their early involvement in project activities, served as enthusiastic role models, both for others in their own villages and for interested individuals from the surrounding area.

Public meetings, with attention to traditional formalities, were effective venues for communication of an environmental message to a wider audience. These gatherings also provided the Canadian and Indian project teams with useful insights into local knowledge systems.

Professional retraining in some of the field techniques of hydrology and hydrogeology took place "on the job" for BAIF programme personnel and field staff. Programme personnel attended conferences and workshops on project-related themes, both in India and abroad. In addition, workshops on water-resource management and techniques of soil conservation were made available to BAIF personnel, both in the classroom and in the field by members of the Canadian and Indian project teams.

Workshops

Lessons learned from the research results and project outcomes have been incorporated into training courses on related approaches to water resource management. These were presented to groups of BAIF programme personnel, working on development projects in other parts of India. The multidisciplinary courses are offered in a workshop format.

The workshops typically consist of both field and classroom components. The field part involves observation and constructive comment on current, local initiatives in watershed development. The classroom part includes an account of the integration of research and indigenous knowledge, as well as the resulting technologies for water conservation, in Akole *Taluka*. Each workshop ends with a brainstorming session on the socio-economic impact of land degradation, in which participants share their experiences from different development projects. Both the individual training workshops and the overall process of human resource development are enhanced by these contributions of the participants.

The research results are presented in modules, which are integrated with the appropriate parts of undergraduate courses, titled *Geology and the Environment* and *Environmental Decision Analysis*, respectively, presented at the University of Windsor by the first author. The courses place emphasis on the need for harmony in human interaction with Earth processes and therefore are relevant to all climatic settings around the world. The courses were first integrated with project information for the end-of-project workshop in Pune, in February 1996.

The next workshop was held in Pune and Akole *Taluka*, in June 1997. The village role models, other members of the watershed committees, and BAIF field staff made valuable contributions to the field component. Subsequent workshops took place in Sanosara, near Bhavnagar, Gujarat (June 1998), Tiptur, Karnataka (July-August 1999), and Bundi, Rajasthan (December 2000). The 1997 and 1999 workshops included presentations by BAIF project personnel on measurement and analysis of rainfall, soil properties, land capability classification, and health aspects of watershed development. Local people also contributed to the field components. To date, about 130 individuals have taken part in the workshops.

Co-operative education

The project led directly to the first co-operative education placement of a University of Windsor student with BAIF for a work term, during the period January-April 2001. This was made possible by an award of funding to the University and BAIF in the framework of the Canadian International Development Agency's *Learning Through Service Program,* administered by the Association of Universities and Colleges of Canada. The female undergraduate was in the second year of study, in the Honours Geology degree programme at Windsor.

Notes

[1]According to Hartvelt and Okun (*op. cit.*), the foundation of capacity building for the sustainable development of water resources is institutional strengthening and the development of human resources. It is noteworthy that they include creation of a favourable policy environ ment, water resource assessment, planning, management, programme and project formulation, implementation and evaluation under institutional strengthening.

[2]In this account, water harvesting is taken to mean the use of technologies for the capture at and near ground level and eventual extraction of fresh water, obtained from a particular catchment area. The catchment may be natural or artificial. Technologies for water spreading involve the diversion of water underground, to occupy the interconnected pore systems of relatively shallow Earth materials. Conjunctive use of water resources involves taking fresh water from multiple sources.

[3]These are different kinds of artificial barrier, constructed parallel to the local trends of contours of elevation above mean sea level. Gabions consist of rock fragments in stacked bundles. Chicken wire or nets of organic fibres bind each bundle. Some gabion structures were built around impervious barriers of ferrocement.

[4]Gully plugs are low walls of masonry, constructed parallel to contours of elevation above mean sea level. They are built on hillsides, so that several of them occupy different levels at each site of incipient gully formation. They have the effect of arresting gully erosion. Runoff, impounded on the up-slope sides, infiltrates into the slope materials.

[5]Bunds are low ridges of soil, constructed at right angles to the direction of slope of a hillside. Terrace-

margin bunds are located along the down-slope edges of terraces. The purpose of doing this is to arrest the down-slope flow of surface runoff at particular terrace levels. The impounded waters infiltrate into the terrace materials. A common approach is to break the continuity of a terrace-margin bund with a stone-lined opening, termed a spillway. The lining of stones extends as an apron down to the terrace below, to minimize the risk of erosion.The farmer fills the spillway with sand bags, when he wishes to facilitate impoundment of runoff and infiltration at a particular terrace level. He eventually may choose to permit flow down to the next terrace level below, by removing the sand bags.

[6]Infiltration of runoff at different terrace levels was also enhanced by the excavation of systems of relatively shallow trenches, arranged in lines, parallel to the con tours of elevation. These trench systems commonly were excavated on the up-slope sides of terrace-margin bunds, although by no means were they restricted to such a location. Trenches and less elongated infiltration pits also were dug on the steeper hill slopes, to promote infiltration down to the Earth materials of the adjacent valley floor.

[7]Farm ponds are deeper (1-2 m) excavations, generally rectangular in plan. The long dimension of the pond is parallel to the local trends of contours of elevation. The walls of the pond may be terraced and planted, so as to gain maximum benefit from the successive, declining levels of water in the pond after the monsoon. For example, medicinal plants are commonly grown at such locations. The excavated soil is built into a ridge, at right angles to the direction of slope, parallel to the long dimension of the pond, and flanking the down-slope side. The soil ridge commonly has a vegetation cover.

References

HARTVELT, F., and OKUN, D.A., 1991. Capacity building for water resources management. *Water International*, vol. 16, p. 176-183.

OYEBANDE, L., 1995. Capacity building, manpower development, technological trends, training and material for water resources assessment. Keynote Paper on Theme 4. *Conference on Water Resources, Policy and Assessment*, 20-25 March, 1995, Addis Ababa, Ethiopia, 39 pp.

SIMPSON, F., and SOHANI, G., 2000. Conjunctive water use, Maharashtra, India. *Water, Sanitation and Hygiene: Challenges for the Millennium*. Preprints, Twenty-sixth WEDC Conference, November 5-9, 2000, Dhaka, Bangladesh, p. 330-333.

SOHANI, G.G., SIMPSON, F., *et al.*, 1998. *Conjunctive Use of Water Resources in Deccan Trap, India*. Pune, BAIF Development Research Foundation, 133 pp.

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