Water Harvesting

S. A. Sial

Objectives

- To highlight the role of water harvesting in PIWM.
- To elaborate how water harvesting can help in PIWM.

What is water harvesting? How can a catchment be made more impervious to runoff?

A water harvesting system may be defined as the use of artificial methods to collect and store precipitation until it can be used beneficially. The catchment is made more impervious to runoff than it is in its natural state, and a storage facility is constructed unless the harvested water is to be used immediately.

A catchment can be made more impervious using the following methods.

- Land surface alteration: clearing and smoothing, shaping, compaction.
- Chemical treatment: silicones and sodium salts.
- Soil cementation treatment: mixing of asphalt, cement, resins and polymers with soil.
- Ground cover modification:-butyl-, plastic- and asphalt-exposed membranes, gravel-covered plastic sheeting, reinforced cement-mortar-coated plastics, sheet metal, concrete, reinforced asphalt and asphalt planking (Harwood 1975).

Socioeconomic and ethnic aspects of water harvesting systems

In addition to biophysical considerations, socioeconomic and ethnic aspects are of great importance in the context of sustainability of water harvesting systems. The site for construction of a water harvesting system should be surveyed for social aspects which include availability of construction labour at an appropriate time of the year; availability of local skills needed for construction, operation and maintenance; social acceptability of the project and people's participation. Considerable thought should be given to modifying existing techniques wherever possible rather than trying to introduce altogether new ones, and care should be taken to make the system compatible with existing social patterns.

What are the main water harvesting practices and skills?

- *In situ* water harvesting
- Catchment-based water harvesting systems
- Dugout ponds
- *Tanka* (covered underground tank generally constructed for storage of runoff)
- *Nadi* (small excavated or embanked village ponds)
- *Khadin* (system of growing crops on harvested and stored water by constructing earthen bunds across the slopes of farms in valley bottoms)
- Check dam and percolation tank
- *Ahar* and *bhundi* (similar to *khadin*)
- Rooftop water harvesting or rainwater cistern system
- Fog and ground cloud collection

Main lessons emphasising trends and approaches

Community participation, institutionalisation and policy issues

The delivery of programmes of watershed management with or without water harvesting is replete with diffi-

culties. World-wide, many projects fail primarily due to a lack of people's participation. The consequence is wastage of public funds invested in structures that fail and have to be reconstructed. Unless beneficiaries are committed to operating and maintaining water harvesting programmes by investing their energy and money, soil and water conservation projects cannot perform sustainably.

How to achieve people's participation in water harvesting?

- High priority should be placed on first implementing programmes that generate quick and visible returns such as water harvesting ponds, irrigation systems, income-producing cropping systems, and income generation from common property resources by diversifying into industrial grasses, fuelwood, timber, etc.
- Subsidies and incentives to the community for locally unavailable materials
- Emphasis to be given to the development of capabilities of local farmers
- Training to develop awareness of problems and knowledge and skills of local users
- Regular and frequent visits of experts to observe and discuss community organization and visits of field-based staff to farmers' houses are essential.
- Resolution of social conflicts (Samra et al. 1996).

What are the important policy issues in water harvesting?

Policy issues should be considered by government (central and local) and sectoral departments, farmers and users of the land. Technology demands joint and simultaneous management of arable and non-arable land, whereas laws such as the Forest Act have not incorporated this concept.

Normally soil and water conservation programmes go beyond the boundaries of individual farms and require the investment of funds with or without immediate returns, the maintenance of structures, and the sharing of long-term benefits. Therefore, strong legislative support for the success of such programmes is also needed (Samra et al. 1996).

Rainwater harvesting should be integrated into the programmes of agencies involved with water resources, agriculture, forestry/soil conservation, housing and settlement improvement, and road conservation wherever feasible. Research and pilot studies should be conducted to arrive at technologies for rainwater conservation that are appropriate for the location. Technologies should be disseminated and implemented through community participation and the mobilisation of relevant NGOs and INGOs (Dhungel and Bhattarai 1997).

What are the major constraints and opportunities in water harvesting?

The cost, particularly the initial investment, as well as the skills required are limitations for undertaking water harvesting projects. However it can mean the difference between life and death in some places, making economic aspects of minor importance.

Water harvesting will never be used in some areas because other water sources are more economical, or because annual precipitation is very low. Since water harvesting depends on natural rainfall, it is no more reliable than the weather. Without adequate storage facilities the system will fail in drought years. In locations with an average annual rainfall of less than 50-80 mm, water harvesting will probably never be economically feasible. Lack of rainfall data, especially intensity and variation information, in many areas makes it difficult to design a water harvesting system. Annual precipitation in excess of 280 mm is generally required to assure successful vegetation management. Potential for increasing runoff yield increases as annual precipitation increases (Dawud 1975). Less than 30 per cent of the runoff may be collected in dugouts to avoid hydrological imbalances (Sardar Riaz n.d.).

Benefits that may accrue from water harvesting systems

- Protection to eroding uplands
- Protection to downstream fertile lands from silt flow, floods and sand casting
- Land development in the command area of structure
- Flood moderation and drought alleviation
- Irrigation in winter and summer seasons
- Improved cropping pattern and increased production
- Increased biomass production from degraded or waste common lands

- Improved environment
- Generation of casual and regular employment

Advantages/ disadvantages

Surprisingly, the livestock or wildlife carrying capacity of many arid rangelands is limited more by water than by field limitations. Improvement and proper management of drinking water supplies increase the value of grazing lands and allow available feed to be better utilised (Martin and Ward 1970). Conventional methods of providing additional water to many arid areas, such as importation, require large amounts of energy. Water harvesting for both drinking water and crop production, however, requires only minimal energy inputs, most of which are associated with material production and construction (Morn and Mattock 1975). Overharvesting could result in destruction of water canals and other water bodies due to reduced surface water runoff.

Future directions

Research

A survey of natural watershed/catchment areas should be made in high, medium and low rainfall areas.

Pilot projects may be developed in watershed areas for developing and demonstrating rainwater harvesting techniques and soil moisture conservation practices that can serve as models for farmers from similar areas.

The feasibility of decreasing infiltration rates and increasing runoff on catchment slopes for greater water yields with less erosion can be studied by removal of vegetation cover, compaction, use of sealants or water repellent materials on the runoff area.

Research on selection of crops, cropping patterns, and production technology for runoff agriculture under various farming systems may be developed (Sardar Riaz, n.d.).

Integrated location-specific packages for rainwater harvesting should be developed to provide water for domestic livestock or agricultural purposes.

Site-specific hydraulic and structural configurations need to be evolved and standardised for different water harvesting structures.

Monitoring and data collection for creating a database, self evaluation of the system, improving design indices and assessing watershed responses.

Training

Technical assistance for designing shapes and types of catchments and suitable catchments for cultivated area ratios to allow maximum runoff on the catchment slopes and harvesting in the lower reaches for sustained crop production should be given.

Farmers, especially in medium and low rainfall areas, should be advised about *in situ* water harvesting techniques based on the principle of maximising infiltration rates and minimising runoff.

As the supply of water for household use is traditionally the responsibility of women, they should be trained in rainwater collection from rooftops/treated catchments and storage in tanks.

Training of technical manpower from government and non-governmental organizations engaged in such programmes is necessary to ensure proper implementation.

Policy

National and local water harvesting programmes should be formed to identify the resource base, components of work, selection and development of research cum demonstration sites. These sites should be used for obtaining necessary data and training of technicians, government officials and farmers in the programme.

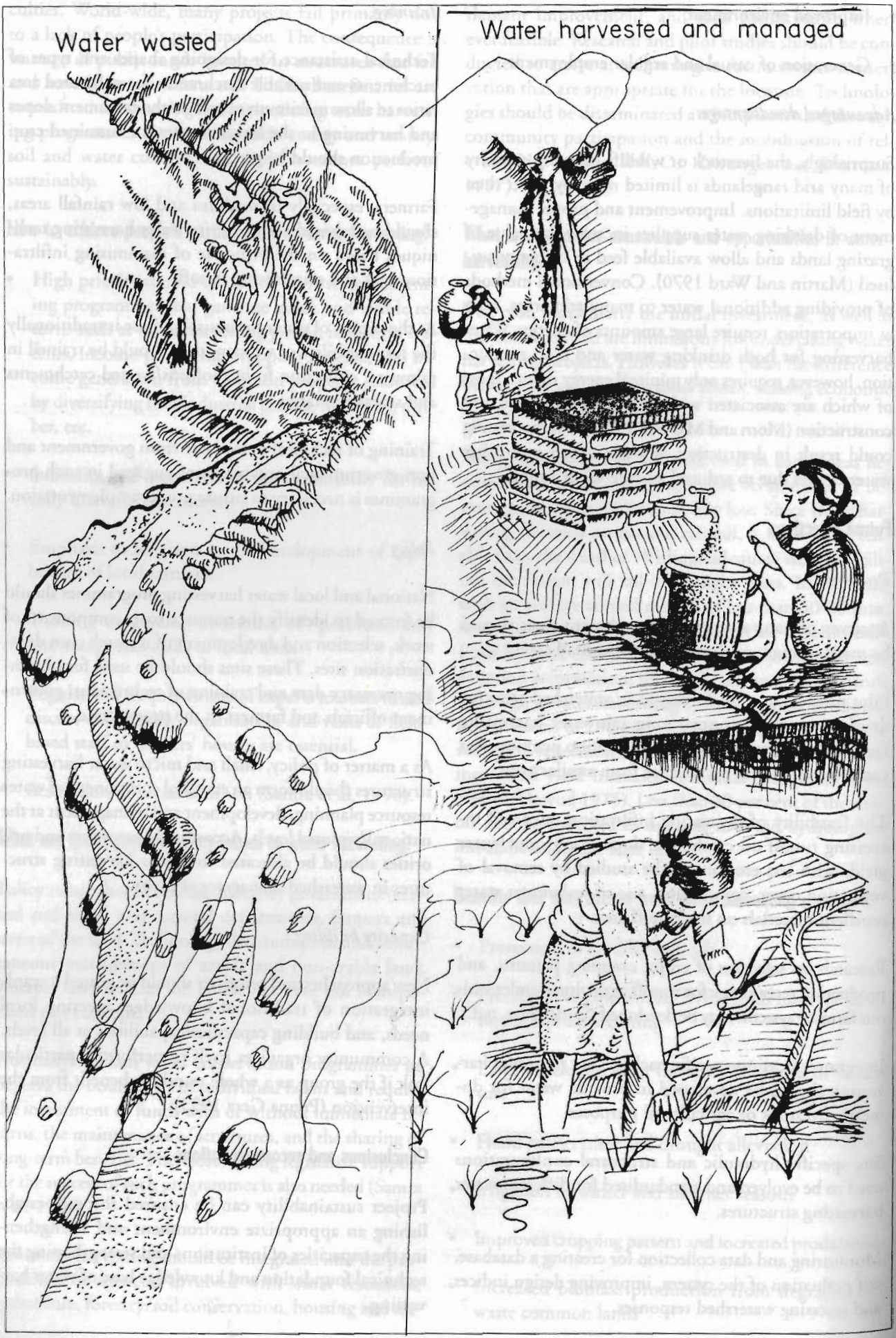
As a matter of policy, small and micro water harvesting structures should form an essential component of water resource planning, development and management at the national/regional levels. Accordingly, resources and priorities should be allocated for water harvesting structures in watershed management plans.

Capacity building

New approaches and priorities should be geared towards integration of traditional knowledge, meeting local needs, and building capacities/capabilities at all levels. A community organizes itself to perform a particular task if the group as a whole stands to benefit from the intervention (Prema Gera 1993).

Conclusions and recommendations

Project sustainability can be ensured through establishing an appropriate environment and strengthening the capacities of institutions and strengthening the technical foundation and knowledge base of water harvesting.


Water wasted
Water harvested and managed

Sustainability can also be improved through collaborative (community) pilot water harvesting schemes that have a positive impact on socioeconomic conditions of local people and by protection of quality of harvested water from pollution.

More effective partnerships among government, private sector and community-based organizations are needed to promote and facilitate conditions in which people can actively create their own development responses.

There is a need for better understanding of the technical, organizational and managerial aspects of local water harvesting systems (LWHS) in micro watersheds.

Exploration of the feasibility of establishing water users' associations as the institutional mechanism for sustainable use of local water resources based upon the experience of LWH bodies.

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