

Modern concepts in Watershed Management

Integrated Watershed Management Program

INTRODUCTION

A watershed is an area of land and water bounded by a drainage divide, where the surface runoff generated by rainfall collects and flows out to a single outlet (river, lake, dam, stream, pond etc). Generally, two or more catchments form a small watershed, while a group of large watersheds form a river basin. The concept of integrated watershed management is to bring the management of natural resources (land, water, crops and energy etc.) together for sustainable agriculture and improved livelihood of watershed communities. Watershed management relates to the complex interactions among the land use, weather pattern and the resulting changing hydrological characteristics including; evapo-transpiration, runoff, seepage and infiltration. For instance, the typical monsoonal rain dominated weather patterns in this region requires increased water conservation practices ranging from in-situ to large storage dams for reducing flash floods and year-around water availability for various uses. Thus, sustainable watershed management is not only important for the mountainous communities but also for safeguarding the command areas or the main Indus Basin.

Watersheds and their management have elevated importance in the current climate change scenario, because despite negligible contribution to greenhouse gas emissions, Pakistan has been ranked among the top ten countries at risk to climate change. The most visible effects of the changing conditions (weather/anthropogenic/natural) on watersheds are accelerated erosion due to floods, growing tendency of water shortage when needed, frequent droughts and degradation of natural resources. Appropriate watershed management practices may encourage; reduced erosion and sedimentation, good quality water for multiple use (drinking, irrigation, hydropower and eco system services etc.), recharge of groundwater, perennial stream flows, improved life of downstream structures (reservoirs, dams, headwork, canals, hydropower infrastructure etc.), increased storage of rainwater, use of alternate energy for profitable agriculture and increased community resilience to climate change impacts. But lack of knowledge, awareness and resources are the main impediments in its stimulated adoption.

Keeping in view these emerging needs, the PARC has initiated its integrated watershed management activities since early 1980s in different parts of the country. A number of model sites were developed for practical demonstration of promising technologies. For instance, the recently renovated Rawal Watershed Field Station (RWFS) at Satrameel is one of the ideal field sites demonstrating majority of watershed management interventions for hill ecology, while the Thatti GujranFatehJang and Kambrial Field sites demonstrates promising interventions for mini dam command area development. Moreover, livelihood improvement interventions were demonstrated at Arokus and Goragali sites using participatory approach.

PROGRAM OBJECTIVES

- To develop and implement projects on promoting sustainable watersheds in Pakistan;

- To develop best watershed management technologies for improving livelihood and community resilience to climate change;
- To promote site specific best watershed management technologies through capacity building, demonstration, awareness raising and linkages.

PROGRAM ACTIVITIES

- Assessment of water resource potential at sub-watershed level;
- Development of rainwater harvesting technologies;
- Evaluation of erosion control practices;
- Assessment of efficient irrigation methods for watersheds;
- Efficient use of harvested rainwater for high value agriculture;
- Evaluation of groundwater recharging technologies;
- Livelihood improvement through profitable and sustainable agriculture;
- Demonstration of watershed management technologies for adoption;
- Capacity building of professionals, farmers, community workers, NGOs, students and agricultural service providers to stimulate adoption.

The various activities undertaken by the integrated watershed management program in Pakistan through different research and development projects are summarised below:

1: SCIENTIFIC DATABASE DEVELOPMENT

Various research-monitoring installations have been established in different watershed areas to develop hydrological and meteorological database as well as to support research based solutions. Figure 1 shows some of these installations;



Figure 1. Research Monitoring Systems under Watershed Conditions at Satrameel Site

2: SOIL, WATER & ENERGY MANAGEMENT INTERVENTIONS

The soil, water and energy management practices demonstrated at various sites for sustainable watersheds and livelihood improvement under different projects are as under:

(a) RAINWATER HARVESTING AND MANAGEMENT INTERVENTION

Different rainwater harvesting and management technologies (Figure 2) including micro catchments, percolation pits, check dams, farm ponds, rooftop rainwater harvesting, diversion structures, conveyance systems and rod kohi management systems were evaluated and demonstrated at various sites. Similarly, rooftop rainwater harvesting systems were introduced in Arokus and Goragali sites using participatory approach.



Figure 2: Rainwater Harvesting Systems demonstrated at various sites

(b): ROD-KOHI SYSTEMS MANAGEMENT

The rod kohi (Rod means channel and Kohi means mountains) system is the second largest irrigation system after the Indus Basin with the water potential of 19 million acres feet (MAF) and command area of around 17 million acres, which is currently contributing far below its potential level. The rod kohi areas have poor water management at catchment, conveyance and command areas, thus resulting poor crop production. Different improved rod kohi management practices were evaluated and promising technologies were demonstrated throughout the country (D.I. Khan, D.G. Khan, Barkhan, Zhob etc.) as illustrated in Figure 3.



Figure 3: Rod Kohi Management Systems Demonstrated at various sites

(c): EROSION CONTROL INTERVENTIONS

Various practices (Figure 4) for controlling rill, gully and stream bank erosion using both biological (land cover through grasses, vegetation, shrubs, bushes, forest trees, fruit plants) and engineering measures (gabion netted retaining walls, check dams, hill side ditches, energy dissipaters, micro catchments, sediment traps, terraces) were demonstrated. At Rawal Watershed Field Station in Satrameel forest plants species with deep roots, nitrogen fixing, quickly growing

and easily adapted to local environment, both palatable and non-palatable were introduced. The successful tree plantation tested includes Iple Iple, Eucalyptus, Bottle Brush, Kachnar etc. Moreover, existing forest and shrub covers of Kaho, Pullai, Granda and Wild Olives etc were also conserved. Permanent raised bed farming system has been introduced for reducing machinery cost and improving the resistance of cultivated land to erosion. Mulching for conserving soil moisture, reducing weeds infestation around fruit plants and inside tunnels has also been demonstrated. These biological covers are effective in reducing soil erosion, recharging groundwater, balancing soil nutrients and controlling runoff fluxes. Percolation pits for collecting runoff water, controlling seasonal waterlogging and recharging groundwater has also been demonstrated at Satrameel site.



Figure 4: Erosion control demonstrations at Rawal Watershed Field Station Satrameel

(d) IRRIGATION MANAGEMENT INTERVENTIONS

Different efficient irrigation methods (Figure 5) including rain gun sprinkler, drip irrigation for fruit plants, drip irrigation for vegetables under tunnel, low head bucket drip irrigation, bubbler irrigation, micro sprinkler (surface and overhead) irrigation, furrow bed irrigation, integrated drip lines and drip tape has been demonstrated at various demonstration sites.

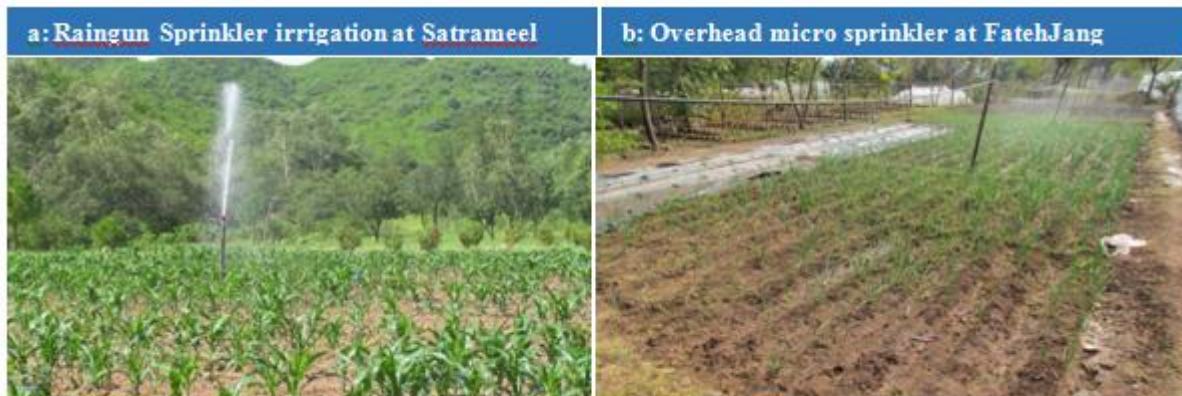


Figure 5: High efficient irrigation systems demonstration at various sites

(e) : ENERGY MANAGEMENT INTERVENTIONS

Energy is the main constraint in promoting sustainable agriculture in majority of rain fed areas of Pakistan. Keeping in view availability and cost constraints, a 5 hp solar driven irrigation systems were demonstrated at Thatti Gujran (Fateh Jang) and Kambrial for mini dam command area (20 acres) development and a 3 hp solar powered irrigation system for dugwell command area (5 acres) development at Satrameel (Figure 6). These model sites of have attained widespread recognition and adoption from government and local communities.



Figure 6: Solar powered pumping systems demonstrated at various sites

3: LIVELIHOOD IMPROEMENT INTERVENTIONS

Different income generating and livelihood improvement interventions (Figure 7) including nursery raising for fruit plants, growing off season vegetables under tunnels, single solar panel pumping system for kitchen gardening, vegetable growing for self consumption, honey bee keeping, aquaculture and fish farming has been demonstrated at various sites.



Figure 7: Income generating and livelihood improvement interventions demonstrated

4: DISEMINATION AND CAPACITY BUILDING ACTIVITIES

This program is actively involved in capacity building of professionals, farmers, agricultural service providers, NGOs, students, community workers and all other stake holders with special emphasis on female participation. Capacity building of 120 professionals during 2016, 146 during 2017, 696 farmers during 2016 and 829 during 2017 were conducted by this program under various national and international projects. Professional training programs involving class room lectures on various soil and water conservation practices, high efficiency irrigation systems design, installation, operation and evaluation, solar driven pumping system design, irrigation scheduling and management, field practical on assembling solar pumping components, trouble shooting of high efficiency irrigation systems, tunnel farming and raising high value agriculture etc have been conducted. Dissemination of knowledge and awareness raising of technologies through written materials (brochures, leaflets, reports, manuals, papers etc), short videos, TV & radio talks, discussions, delegation visits, chance visitors and farmer days is a regular activity of the program (Figure 8).



Figure 8: Technologies demonstrations & capacity development at various field sites