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 traditional watershed management practices cannot cope with the rapidly emerging climate change risks. Sustainable watershed management practices may enhance the resilience of natural resources to climate change induced risks (floods/droughts) but lack of knowledge, skills, resources and awareness in Pakistan are the main impediments.

Addressing these issues, the CEWRI, NARC in collaboration with three research and development organizations each from Nepal and Sri Lanka has initiated a capacity development project under the financial support of Asia Pacific Networks for Global Change Research (APN gcr). A training workshop will be conducted in each collaborating country, where a network of around 20 project Partners (hydrologists/ climate scientists /agriculturists /community workers) from the lined departments will be developed who will assess the watersheds and will prioritize the most effective technologies according to the local climate change scenarios. The first inception cum training workshop was held in Pakistan, where the experts have selected the following technologies for dissemination.

1: Check Dams and Structures

A check dam is a small barrier wall made of rocks, gravel bags or sand bags, constructed across a waterway or channel to counteract erosion by reducing the flow velocity of a water stream as shown in Figure 1. This obstruction induces infiltration and reduces erosion. They can be used not only to slow flow velocity but also to distribute flows across a swale, to avoid preferential paths and guide flows toward reinforced sections of vegetation, stone pitched or mulched areas. Although some sediment collection may result behind the dam but check dams do not primarily function as sediment trapping devices. The check dam works as energy dissipater structure for minimizing the soil erosions and enhancing the ground water storage capability. As per site situation and the availability of the material, different types of structures can be constructed and the design of the structures may also vary accordingly.

Figure 1: Loose Rocks (Check Dam)

2: Forestation

The hilly areas with steep slopes are prone to accelerated erosion due to runoff losses from rains. The absence of forest trees and shrubs cause greater rainfall impact on soil particles to detach and splash thus causing initiation of rill erosion. The flowing water with high velocity attains greater momentum and exacerbates the erosion process, thus quickly transform the land into deep gullies. Consequently, watersheds are turned less productive, barren and more vulnerable to floods and poor livelihood.

Forestation helps in the absorption of the rain water and in decreasing the water flow velocity. It also makes the ground strong enough to hold the soil as illustrated in Figure 2. These plants did not only keep the soil intact but also provide shelter to wild life and facilitate growing of grasses on the ground surface thus reduce soil erosion. Few main reasons of deforestation are urbanization, farming, overgrazing, and tourism development.

Keeping in view all these factors, the PARC has introduced different types of plantations to reduce erosion through land cover in the Rawal watershed areas. Forest plants species with deep roots, nitrogen fixing, quickly growing and easily adapted to local environment, both palatable and non-palatable were demonstrated. The tree plantation includes Iple lple, Eucalyptus, Bottle Brush, Kachnar etc. Moreover, existing forest and shrub covers of Kaho, Pullai, Granda and Wild Olives etc were also conserved and protected.

Figure 2: Pine trees forestation

3: Rainwater harvesting

Rain water harvesting is the collection and storage of rainwater in reservoirs rather than allowing it to waste as runoff. The harvested water can also be used not only for irrigation but also for drinking and other domestic purposes.

Rainwater harvesting systems are comprised of a catchment area, a conveyance and a storage systems. The catchments can be rooftop (as shown in figure 3) or land surface. The cconveyance systems transfer the rainwater collected on the catchments to the storage tanks. The storage systems can be tanks, mini dams, ponds etc. Rainwater harvesting can be helpful for sustainable watersheds and livelihood.

Figure 3: Roof top rainwater harvesting

4: High Efficient Irrigation

Irrigation water is the most critical input in crop production and its efficient use enhances productivity of other non-water inputs as well. Despite shortage of irrigation water in many areas, there are still huge water losses due to inefficient irrigation systems on majority of farms. In the climate change vulnerable hilly areas water is available in springs, streams, rivers but mostly at deeper depths, thus gravity irrigation of unleveled lands, generally lying at higher elevation is difficult. On the other hand, inefficient use of available canal and ground water in majority of irrigated areas in lower Indus basin have significantly reduced the water productivity of majority of irrigated crops. Consequently, a much lower water and crop productivity is produced from a very highly productive resource base. High efficiency irrigation systems (HEIS) are water and nutrient efficient (Figure 4), thus can be instrumental to reduce irrigation application losses and in bringing more areas under cultivation in both hilly as well as leveled lands.

Figure 4: Rain-gun irrigation system

Drip, bubbler, sprinkler, rain-gun, center pivot, furrow bed etc. are together referred to as high efficiency irrigation systems, majority of which use pipes for conveyance of water from the source to points of use. These systems can improve watershed sustainability and livelihood in many areas.

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