

Watershed Management for Sustainable development

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INTRODUCTION

Watershed development refers to the conservation, regeneration and the judicious use of all the natural resources - like land, water, vegetation, man and animals – within a particular watershed. The Objective and effort is to bring an optimal equilibrium in the eco-space between natural resources, man and animals.

Nature is endowed with perfect balance and harmony between land, vegetation and water. If this balance is disturbed, the consequences are serious for human, animal and plant life. From our experience we all know that vegetation depends on land and water. Likewise *water*, both surface and sub-surface, depends on land and the vegetative cover on it. *Land* with thick soil cover, especially with a natural layer of humus, absorbs good amount of rainwater, which gradually seeps deeper into lower strata of soils/rocks to recharge ground water. A thick *vegetative cover* not only prevents erosion of the top-soil but also traps considerable amount of rainwater, thereby enhancing the recharge. It is this water, we draw from wells and hand pumps, and part of it appears as flows in streams and rivers.

WATERSHED management basically involves harmonizing the use of soil and water resources between upstream and downstream areas within a watershed toward the objectives of natural resource conservation, increased agricultural productivity and a better standard of living for its inhabitants. Landscape and climate changes as well as economic developments in watersheds stimulate a corresponding cascade of dynamic adjustments in both water quantity and water quality at locations further downstream.

Planning and development of watersheds call for a rigorous understanding of the occurrence and movement of water in the surface and sub-surface systems along with soil and nutrient losses in a watershed as the need arises for a proper watershed management of that area. In a country like India, where, a lot of running water goes waste, it becomes very important to apply the technology of watershed management to solve its annual problems of droughts and floods.

Over the last several decades, and particularly since India's Independence, the increasing pace of developmental works and steep rise in population has led to large scale deforestation. In turn, this has had many an adverse effect on land, like drastic reduction in water holding capacity, increased intensity of drainage of rainwater and excessive erosion of land surface. The drainage areas of rivers and streams, known as "*Watersheds*" have been particularly affected by this process. This has resulted in excessive loss of topsoil, increased intensity of floods during monsoon season, an alarming lowering of ground water table and reduction in lean-season flow in rivers and streams. This in turn has reduced availability of both surface and ground water causing the present water scarcity in many parts of the country.

Unfortunately, the degradation process continues unabated. Once the land deteriorates beyond a limit, it becomes incapable of supporting enough and right type of vegetation to prevent further deterioration. Thus the land continues to deteriorate till it becomes totally barren with even worse implications for surface and ground water sources. The economic cost of mindlessly disturbing the delicate balance in nature is enormous and the consequent human suffering is appalling.

This process of environmental degradation is irreversible in nature and corrective measures are very tedious and expensive and are often only partially effective.

We face a serious water crisis, in not too distant a future, if corrective measures are not taken in right earnest to improve the condition of our watersheds and maintain them. The objectives of these measures are to reduce soil erosion, augment soil moisture and retard the drainage of rainwater. These measures have two main components:

- Restoration of the vegetative cover to bring the watershed close to its original pristine condition.
- Artificial land treatment to strike a balance between the needs of development on one hand and protection of watershed on the other.

These measures, if taken up on a large scale to cover the entire drainage area (or watershed) of a stream, can significantly improve lean season flow in the stream and augment the yield from ground water sources like wells, hand pumps etc.

Since the 1970s, Watershed Development (WSD) in India has been a part of the national approach to improve agricultural production and alleviate poverty in rain-fed regions. Essentially, WSD programs aim to restore degraded landscapes in rain fed regions to increase their capacity to capture and store rainwater, reduce soil erosion, and improve soil nutrient and carbon content so that they can ensure greater agricultural yields for local consumption and income generation. As the majority of India's rural poor live in these regions and are dependent on natural resources for their livelihoods and sustenance, improvements in agricultural yields improve human welfare while simultaneously improving national food security.

Watershed Development programs focus on rain-fed regions because these areas represent 65 percent of arable land in India and produces 55 percent of the country's agricultural output, and provide food that supports 40 percent of India's population (Ahmad et al. 2011; Planning Com-mission 2012). These areas, however, are characterized by low productivity, due to both geographical and climatic conditions, and also due to a history of poor land management. Despite these challenges, the Department of Land Resources (DoLR) states, "While it is the rain-fed parts of Indian agriculture that have been the weakest, they are also the ones that contain the greatest unutilized potential for growth, and need to be developed if food security demands of the year 2020 are to have a realistic chance of being met."

In the 1980s and 1990s, agricultural scientists and planners aimed to promote rain-fed agriculture through watershed development. A watershed is an area from which all water drains to a common point, making it an interesting unit for managing water and soil resources to enhance agricultural production through water conservation

Even though the Government of India and the various State governments together with the international organizations are doing a lot to make this concept a success in India; yet a lot more needs to be done. So far, the story of watershed management in India has been a mixed bag of success and failure.

Watershed Management Concept & Principles

What is a Watershed? :

The area where a river catches its water is called its catchment or watershed. A watershed can be visualized as a landscape shaped unevenly like a bowl or basin. When it rains, water flows down from the top of this bowl to collect at the bottom. The undulating land area of any region forms several such units, each of which are called watersheds. Water within each of these units drains to a common point. So the hills, valleys, forests and fields that encircle the falling rain and guide it into streams and then rivers, all form the enclosure that is a watershed.

Rain falling on the mountains flows down in small rivulets. Many such rivulents, as they come down, join to form small streams. The small streams form bigger streams; and finally the bigger streams join the rivers. The entire area that supplies water to a stream

or river, i.e., the drainage basin or catchment area, is called the watershed of that particular stream or river.

In other words, a watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a larger river (or) lake.

A watershed is a basin-like landform defined by highpoints and ridgelines that descend into lower elevations and stream valleys. A watershed carries water 'shed' from the land after rain falls and snow melts. Drop by drop, water is channelled into soils, ground waters, creeks, and streams, making its way to larger rivers and eventually the sea. Water is a universal solvent, affected by all that it comes in contact with: the land it traverses, and the soil through which it travels. The important thing about watersheds is: what we do on the land affects water quality for all communities living downstream.

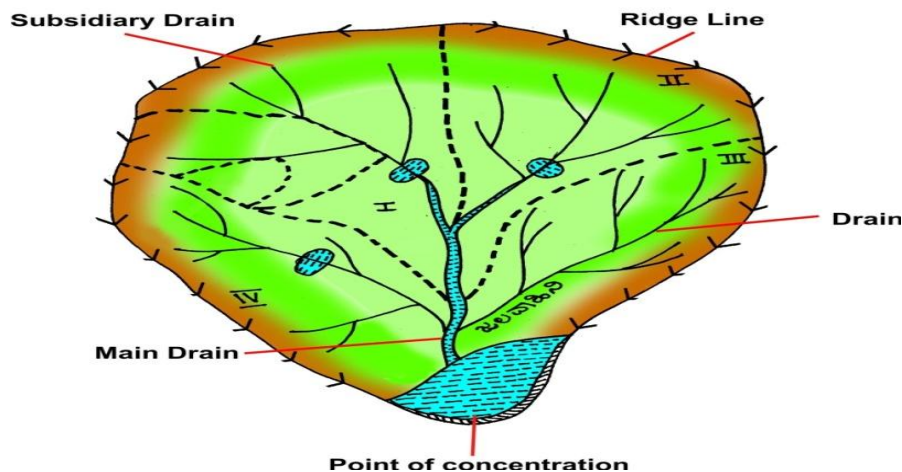
Delineation of Watershed:

Delineation of a watershed means determining the boundary of the watershed i.e. ridgeline. A Watershed consists of three types of lines - ridgeline, drainage line and contour lines.

After knowing the concept of watershed, it becomes important to see how a watershed can be identified on the site. The watershed of any size can be delineated from the following:

- 1. RidgeLine
- 2. Outlet (Drainage Line)

Ridge line is the line that joins comparatively the highest elevation points and that becomes the boundary of the watershed (in the figure below, the ridge line is shown in dark brown colour).



A ridge line bifurcates the falling water on two opposite sides.

The most important aspect for defining and delineating a watershed is to fix the *outlet* of the drainage course. As the outlet goes down stream of the drainage course, the area of the watershed goes on increasing. Basically location (position) of the outlet defines the area of watershed.

Hydrologically, watershed is an area from which the runoff flows to a common point on the drainage system. Every stream, tributary, or river has an associated watershed, and small watersheds aggregate together to become larger watersheds. Water travels from headwater to the downward location and meets with similar strength of stream, and then

it forms one order higher stream as shown in Figure-2 below.

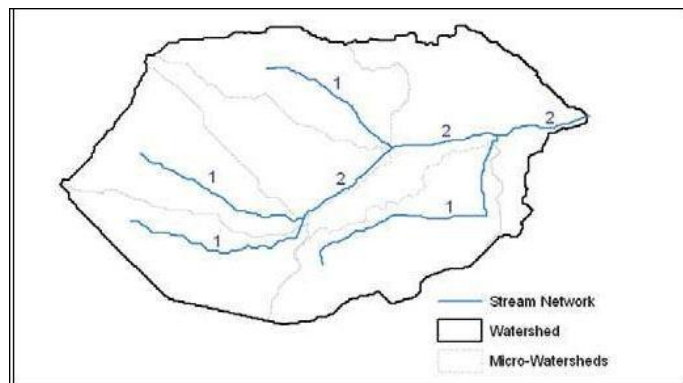


Fig. 2

Stream network, micro-watersheds and watershed large watershed has divided into six micro-watershed based on stream order. Numbers on the stream network shows the stream order of respective stream

IMPORTANCE OF WATERSHED DEVELOPMENT

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Liveable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges.

Man and environment are interdependent. It is basically the area of survival of the community living within it and drawing its sustenance from it. In resources fragile areas these demands and the claims on the environment are enormous. Any change in the surrounding environment directly affects the people living therein. A degraded environment results in a degraded quality of life of the people and environmental degradation does not recognise administrative and political boundaries (e.g. Village, taluka, block etc.). Hence a watershed provides a natural environmental unit for planning the developmental initiatives. It is a scientifically proven method for soil moisture and water conservation.

Integrated Watershed Management

Integrated watershed management is an approach that brings together appropriate technologies and social strategies for optimum use of natural resources within a drainage area. It aims to improve the livelihoods of the people within a watershed who depend on the resources of the watershed and enhance their ability to manage these natural resources in a sustainable manner.

Why Integrated Watershed Management is Required?

Indiscriminate and over exploitation of natural resources not only degrades the resources but also increases dependence on the degraded resources for livelihoods. This forms the basis of a vicious cycle. To break this cycle and arrest the process of degradation, an intervention in the form of integrated watershed management (IWM) is required.

A large percentage of people in rural areas cannot meet their basic needs because they are dependent on agriculture and natural resources which are being degraded and depleted rapidly by erosion, exploitative harvesting of trees, over grazing and indiscriminate use of water resources.

The objective of IWM is to organize and motivate people to use and generate these resources so as to provide a sound and sustained base for their livelihoods.

On one hand there is continuous degradation of natural resources to meet the needs of human and livestock, on the other hand these natural resources have to replenish in order to sustain life and livelihoods especially of the poor. A balancing act has to be carried out by supporting natural and human interventions. Involvement of people at the local level is critical to this strategy.

PRINCIPLES OF WATERSHED MANAGEMENT

✚ Catch water where it falls / Make water walk: Conserve as much rain water as possible in the area where it falls and drain out excess with a safe velocity which does not wash the soil away.

✚ Bring life back to soil: Replenish the soil to get maximum productivity and manage it in a way that sustains this productivity.

Address three objectives – Productivity, sustainability and equity: Maximize productivity per unit area, per unit time and per unit of water. Ensure sustainability of the ecosystem maintaining the balance between human-animal-plant-land-water in the watershed. Focus on the marginalized poor sections particularly the landless and the women in every activity or investment.

COMPONENTS OF WATERSHED DEVELOPMENT:

Watershed development being an inter-sector activity, different components have to be taken into consideration and addressed. The main components may be summarised as:

✚ Human Resource Development (Community development)

✚ Soil Conservation and Land Management

✚ Water Conservation and Management

✚ Afforestation

✚ Pasture or Fodder Development

✚ Agriculture Development

✚ Livestock Management

✚ Rural Energy Management

✚ Farm and non-farm value addition activities

It can be pointed out that the components of watershed development includes the Five J's – Jal (water), Jag(Land), Jeev(life), Jungle(Forest) and Janvar(animals). All these components are interdependent and interactive.

Benefits of WDM:

Watershed development benefits local households and farmers, the local community, and the society at large.

<p>Benefits to households:</p> <ul style="list-style-type: none"> • Improved water availability and fertility levels for crop production and diversification. • Improved soil quality and better drainage. • Increased access to biomass for multipurpose use (firewood, fodder, fruits, construction, and others) and higher profits. • Increased resilience to shocks and improved livelihoods. • Increased participation in income generation activities. 	<p>Benefits to local community:</p> <ul style="list-style-type: none"> • Lower land-development costs. • Reduced erosion, deforestation, flooding and waterlogging. • Increased overall agricultural productivity and access to markets and basic services. • Improved livelihood options, including for the poorest households. • A more dependable, clean water supply for domestic and industrial use – recharge of aquifers. 	<p>Benefits to the society at large:</p> <ul style="list-style-type: none"> • Better conservation of natural resources and biodiversity. • Less danger from floods to downstream farmlands. • Reduced sedimentation of costly irrigation projects and protection of major infrastructure (e.g. roads) increased water supply and improved health. • Reduced occurrence of drought and increased stability of production systems.
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VARIOUS CONTROL MEASURES in WATERSHED development and Management

Some of the various control measures in a watershed development management program are

1. Vegetative measures (Agronomical measures):

Strip cropping; Pasture cropping; Grass land farming; Wood lands

2. Engineering measures (Structural practices):

Contour bunding; Terracing

3. Construction of earthen embankment

4. Construction of check dams

5. Construction of farm ponds

6. Construction of diversion channels

7. Gully controlling structure

Rock dam; Establishment of permanent grass and vegetation

8. Providing vegetative and stone barriers

9. Construction of silt tanks distensions

Rainwater harvesting is the main component of watershed management. Some of the watershed management structures are as follows:

WATERSHED MANAGEMENT APPROACHES

1. Integrated Approach

This approach suggests the integration of technologies within the natural boundaries of a drainage area for optimum development of land, water, and plant resources to meet the basic needs of people and animals in a sustainable manner. This approach aims to improve the standard of living of common people for increasing their earning capacity by offering all facilities required for optimum production (Singh, 2000). In order to achieve its objective, integrated watershed management suggests to adopt land and water conservation practices, water harvesting in ponds and recharging of groundwater for increasing water resources potential and stress on crop diversification, use of improved variety of seeds, integrated nutrient management and integrated pest management practices, etc.

2. Consortium Approach

Consortium approach emphasizes on collective action and community participation including of primary stakeholders, government and non-government organizations, and other institutions. Watershed management requires multidisciplinary skills and competencies. Easy access and timely advice to farmers are important drivers for the observed impressive impacts in the watershed. These lead to enhance awareness of the farmers and their ability to consult with the right people when problems arise. It requires multidisciplinary proficiency in field of engineering, agronomy, forestry, horticulture, animal husbandry, entomology, social science, economics and marketing. It is not always possible to get all the required support and skills-set in one organization. Thus, consortium approach brings together the expertise of different areas to expand the effectiveness of the various watershed initiatives and interventions.

People involvement in Watershed Management

Active participation of all stakeholders in a watershed program ensures the following:

- The process builds ownership of the program activities, institution and assets created out of the program. People begin to call it their program rather than the Government's or NGO's program.
- Once this sense of ownership is established, the program as a whole and the outputs become more sustainable as people who actually own them have a better understanding of their importance and hence take interest in managing and maintaining them.
- When people are involved closely, they are able to judge what is really required for the area and therefore funds are judiciously used leading to reduced costs and better quality of work
- People are able to integrate into the program plan, traditional practices in soil and water conservation measures which help cut down the costs.
- Where upfront contribution in cash is difficult, people have changed the strategy and taken the whole amount required for treatment on private lands as a loan. Contribution is one of the instruments of deepening participation and ownership leading to careful planning and prioritising their needs which in turn leads to cutting down of costs.
- A truly participatory program builds self-reliance and confidence in the people

Participatory Watershed Program:

- People organize themselves into institutions like Watershed Development Associations, Self-Help-Affinity Groups, which function like mature institutions with a shared vision and a strategy to achieve it.
- People's institutions comprising all stakeholders, participate and progressively take the lead in planning, budgeting, implementing and managing the watershed program.
- People participate in all the training program conducted and are sensitized towards the need to conserve and upgrade their natural resources and take responsibility to achieve this objective.
- The institutions maintain the assets – both on private and common lands, created out of the program.
- Participation at every stage such as Planning and budgeting, ownership to the process, contribution by the people, maintenance of structures and institution managed by the people themselves.
- Decentralized decisions either by the farmers themselves or by the watershed institutions.

- Rules and Regulations are diverse, depending on local situations, locally framed, flexible and self imposed.
- Technology is varied with several options, with priority to traditional practices.
- Bottom up planning lead to institutions built up with vision of their own, enhancement of skills and capacities of local people, maintenance of structures by the people themselves and follow up by the people themselves.

The Stake Holders in a Watershed

The following category of people usually have stake in a watershed:

- Landowners, marginal small and big farmers and their families who own land in the watershed. Some of them live within the watershed and some live outside the watershed.
- Landless people: who do not own land but they are highly dependent on the resources of the watershed for their livelihood for example gatherers of fuel, fodder, fibre who depend on land owners for their livelihood through providing their labour.
- Tribals and other vulnerable people who often have small holdings in the upper reaches which are degraded and unproductive.
- Livestock Owners: Who are dependent on fodder for grazing their animals in common grazing land or forest lands in the watershed.
- People dependent on minor forest produce such as leaf Plate Makers, Basket Weavers, Fruit gathers, Honey Hunters etc.
- Brick Makers, Potters, who are dependent on soil from Tank Bunds.
- Other Watershed resources users such as women who fetch water and fuel from the watershed.

Participatory Planning and Budgeting

Planning and budgeting are the two crucial components in the process of watershed development and management. People must be involved in this process because it is their lands on which work is carried out and the intervention concerns their livelihoods. They should be fully involved and increasingly gain ownership of the process and not remain just as beneficiaries. Thus ensuring that they acquire the skills and confidence which are necessary for sustainability of impact. These skills can be acquired by people if space and support is extended to genuinely involve them in the planning, budgeting and implementation of watershed treatment.

Budgeting forms a crucial part of any planning and is in-built in a micro plan. While preparing the budget one should take into account the smallest details that have any financial implications. The treatment works opted by the farmers should be listed and finalized in consultation with technical team, with participation of the people. The treatment planning should be done in presence of the concerned Gram Panchayat members. The budget should include the smallest details that have any financial implications such as local contributions (in cash, kind, labour etc.), operational costs (direct and indirect), equipment, facilities, services, maintenance, supplies etc. Available and required facilities and services should be studied and assessed.

The following are the reasons for estimating the monetary terms for meeting expenses such as services, facilities, equipment and materials.

1. The community gets a clear idea about its contribution to the project
2. A sense of ownership of the project is inculcated in the community

3. The project holder is able to assess the capacity of the community to provide matching fund or as contribution at the time of budgeting which makes it easier to raise contribution during implementation of the project

The planning and budgeting should be done for the following three categories:

1. Planning and budgeting for private lands
2. Planning and budgeting for common lands / resources
3. Planning and budgeting for drainage line treatments

Before proceeding with the planning and budgeting exercise, the facilitator should know the provisions which can be made under watershed development program by referring the project guidelines. The facilitator should be aware of the following:

- The land based programs that can be taken up in a watershed.
- The non land based programs that can be provided for the landless poor in the watershed area.
- The village development programs which can be promoted
- Allocation of funds for various activities in the project
- Financial linkages which can be mobilized such as community contribution, loans, revolving fund, working capital etc., from various sources

Conclusion:

The following aspects are to be considered during the planning exercise:

- All the farmers in the watershed should be involved in the planning exercise.
- People not owning the land but dependent on the watershed resources should also be involved.
- Depending on the needs of the program the personnel following department officials should be involved: Horticulture, Fisheries, Village Industries, Animal Husbandry, Forestry etc.
- Women participation should be ensured.
- The interest of vulnerable groups should be considered.
- The Gram Panchayat members should be involved in the planning process.
- The treatment plan should cover every inch of land in the watershed area, common lands, private fallow lands, temple lands, government lands etc.
- Discuss with people and list out their priorities and decide on the treatment measures to be taken up by them with assistance from the Project.
- While budgeting the internal and external resources that are available should be taken into account, during implementation.
- Build on the indigenous knowledge of the people, while preparing the plan.
- Ensure that impact of any treatment measures already taken up either by the farmers themselves or with external support is considered during the planning exercise.
- Involve technical staff during participatory planning to avoid activities which are not practical.