ISSUES IN WATERSHED DEVELOPMENT AND ITS SOLUTION

Abstract

Watershed development aims at managing land, water and other natural resources of watershed that is benefiting human lives. The development of watershed involves all economic, environmental and social concerns in a combined form. Various watersheds have different problems associated with it; thus, the management approach would likewise (therefore) differ for each one. This brings about the factors affecting the watershed development program. This chapter offers an insight of some major challenges encountered during development of watershed viz. difficulty in intervention management; decision making with different watersheds is not identical, competition and conflicts faced during watershed management and global climate change which poses a unique and particular challenge. A clearer solution of problems hindering the watershed development is explained that will provide a new opportunity in better management of watershed.

Keyword: watershed; fundamental problems; watershed management; management problems; management approaches

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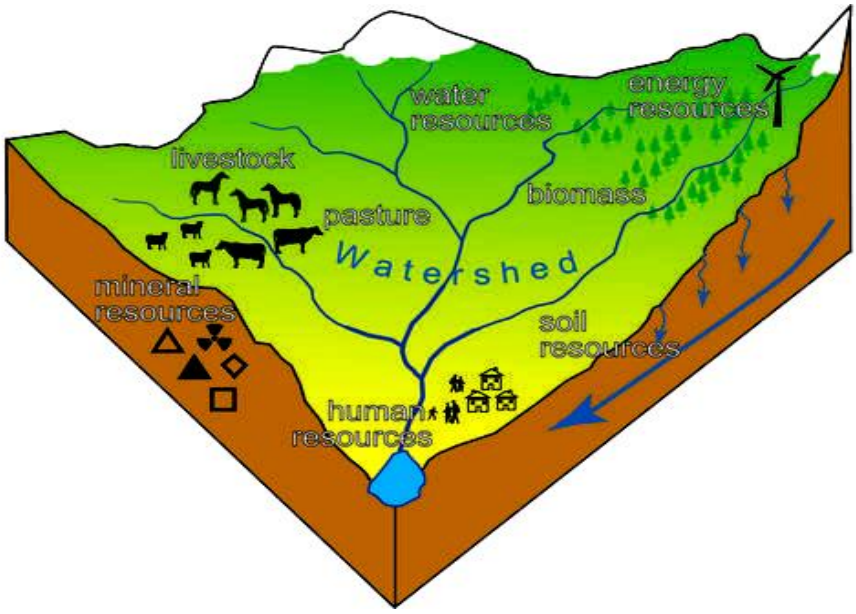
I. INTRODUCTION

A watershed is a topographically delineated area that is drained by a stream system to a common outlet —it is the total area above some point on a stream or river that drains past that point (figure 1). Watershed, catchment, basin, river basin, runoff area, and stream basin are the synonymous terms for drainage basin. Watershed, catchment and basin are most commonly used terms by hydrologists. Watershed as a hydrological unit is comprised of many natural entities such as plant, streams and rivers, natural resources etc. The area enclosed by the drainage divide's vertical projection on a horizontal plane is referred to as the drainage area and the drainage outlets can moved in any direction either up or down the drainage system and any point can be selected as a drainage outlet as per the desirability [1]. Consequently, a drainage basin is described in relation to the outlet. The drainage divide is the physical boundary of the drainage basin. All locations above the outlet's elevation and inside the drainage divide separating neighbouring watersheds are included in the watershed region. In addition, it also consists of artificial elements like building, roads, bridges etc. in it. It is not simply the hydrological unit but also socio-political-ecological entity which plays crucial role in determining food, social, and economical security and provides life support services to rural people, also in management planning and its implementation [2]**.**



Source: Ellen Leipner after Oktiabr Topbaev 2015 [41]

Figure 1: Image of Watershed Encompassing its Components

Watersheds are of different sizes that depend on the outlet chosen to define it through which all stream discharges. If the chosen outlet connects to Major River that discharges to the ocean, the watershed will be very large. According to factors including size, mean slope, length, and land use, watersheds can be categorised. Irrespective of sizes two watershed, they can behave differently if they do not have same channel and drainage phases. Heterogeneity of the drainage basin increases with increase in size of basin. In other words, spatial variability of watershed characteristics increases with size. Large watershed has higher storage capacity and overall hydrologic processes increases on an average. The watershed

behaviour is linearized as a result of averaging. Smaller watersheds tend to be more nonlinear than larger ones. Thus, in order to distinguish the watershed, it is classified based on area as suggested by Bali 1980 [3]. This classification was reflected by All India Soil and Land Use Survey in 1990 [4] and further classification was done (Table 1). This classification can be considered indistinct, the significance, however, relates to regional variability and the dampening of hydrological processes (Figure 2).

Table 1: Watershed Classification Based on Area

Watershed	Area (kilometre square)
Micro-watershed	<1
Milli-watershed	1-10
Mini-watershed	10-100
Sub-watershed	100-500
Macro-watershed	500-2000

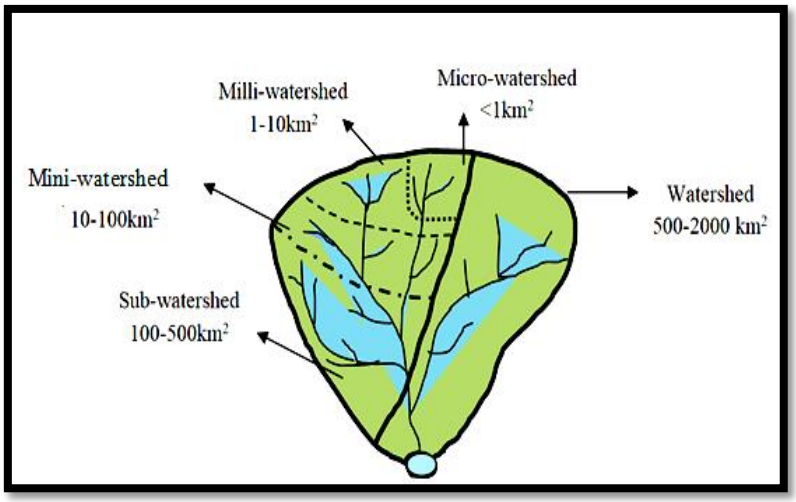


Figure 2: Watershed Classification

II. FUNDAMENTAL PROBLEMS IN WATERSHEDS

Watershed is a provider of essentials for livelihoods such as food, water etc. but the availability of these resources is limited. Several factors being threat to the natural resources availability and reason for its deterioration and thus causing degradation of watershed. Watershed degradation implies for loss of value with time, encompassing loss in productive potential of land and water including remarkable change in hydrological behavior of stream system within the watershed [5]. Degradation of watershed results in high erosion risk accompanied by risk of flooding in low-lands [6]. The major issue behind degradation is unsustainable exploitation of natural resource. Pressure due to increasing population and inappropriate land-use changes account for watershed degradation. On the other hand, Advancement in technologies with this increasing population is intervening in regular functioning of the water resource system. Degradation of watershed the holder of natural resources has been an alarming issue in the present century and threats for human survival It gives rise to food insecurity, poverty and social conflicts [7], [8]. Reasons that lead to

degradation of watershed are many and varying but they do have common traits. These are broadly classified as ecological, socio-economic, technical and institutional issues.

1. **Ecological issues:** Ecological issues are related to interaction between living things and environment. Natural resources are degrading day by day thus degrading the watershed. Watersheds if being healthy provide valuable services to living beings, also includes pure and fresh water. But with the pressure of increasing population and developing technologies, morality of these valuable services provided by the watershed is lost. This results in degradation in amount and quality of water resources available [9]. A number of critics from different area claimed that inappropriate utilization of the forest and its resources, leads to deforestation. Increasing deforestation lead the path towards increasing sedimentation in surface water, also reducing the rainfall events, elevating runoff flow, worsening flooding during the rainy season, and drought during the dry season. Substantial and rapid deforestation and exploitation of forest through legal or illegal activities leads to groundwater depletion [10], [11]. Deforestation results in destabilization of frail mountain slopes, conversion of forest land for agriculture use, excessive grazing and development of roads and other infrastructure has increased soil and land degradation rate [12], [13]. Rate of soil erosion have been reported 15.3 Mg ha^{-1} for degraded forest land and 213 Mg ha^{-1} for uncontrolled grazing land Currently, Rajasthan is most degraded states owing to its climate followed by Maharashtra and Gujarat. Some reports reveal that about 97.85 million hectares of land in Rajasthan which is 2.5 times of India's total land area has already been degraded. Thus, Rajasthan which holds almost 22 percent of degraded land of country has reclaimed about 38,000 ha of the land. In addition to this, Uttarpradesh and Telangana reclaimed 285,665 ha and 19,974 ha respectively [14]. This arises the need for assessment of Land use and land cover changes as it is essential in order to analyze the impact of problems they pose on watershed and for future prediction of trends (Lambin, 1997). Modification of land-use and land-cover has significant consequences on environment through their effect on soil and water quality, biodiversity, microclimate and hence, contribute to watershed degradation [15]. Modification by human such as dam construction and fluctuation of water level has extensively affected the production and input of nutrients in the tributary watersheds. Also dam construction has an impact on reservoir water quality. This may be the cause of siltation and sedimentation that further causes declining discharge through mainstream [16], [17]. Degradation of soil due to Soil salinity is also one of the major and widespread challenges in the present scenario. Intrusion of salinity creates negative impact on agriculture. Thus, obstructing the food security world-wide and environmental sustainability. Making matters worse, the negative effects of climate change hasten the development of soil salinity and may soon affect areas that are not now afflicted [18]. Water and soil, the natural resources available on watershed in contaminating day by day due to inappropriate use of chemicals in different sectors all over the world. Not only human interventions, but nature also becomes a cause degradation of watershed nature of rainfall (amount, intensity, variability, distribution), soil (texture, structure, depth, moisture, infiltration rate) and topography play an important role in the scope and scale of occurring degradation features. Under normal circumstances, soil erosion caused by these factors is a normal process [19]

2. **Technical issues:** Degradation of watershed due to several reasons is a threat to food and environment security. With increase in modernization globally, paved a way for

development of infrastructure such as roads, housing, bridges, recreational structure etc. Development or extension of roads, buildings or bridges due to the increased population, forest areas or trees obstructing the construction process are cut down to progress with the construction process. This activity is definitely inevitable and results in changing the natural environment [20]. Studies reveal that, mining also has direct effects on natural resources with severe consequences [21], [22], [23], [25]. Improper planning and execution of plans for development directly or indirectly prick the purity of the environment. In addition to above mentioned causes, pollution due to movement of chemicals in soil and water in form of fertilizer or pesticides are degrading the natural resources. Increasing population demands to increase the fertilizer supply in order to upgrade the crop yield and ensure food security [26]. About 90% of urban source watersheds have found noticeable level of watershed degradation, with the average pollutant yield of urban source watersheds increasing by 40% for sediment, 47% for phosphorus, and 119% for nitrogen [27]. Altogether, these factors are polluting the agricultural sector. One more in the queue for degradation is overexploitation of resources. Overexploitation could be over abstraction of surface and groundwater, mainly for irrigation [28], [29] Overexploitation also occurs when cultivable land is over used beyond its fertility limits without an appropriate amount of nutrient supplies or allowing appropriate fallow periods. A shift from rain-fed agriculture to modern agriculture methods such as cash cropping etc. also contributes to this overexploitation. Further, this overexploitation would lead to exploitation of resources due to erosion features such as landslides, gully formation etc [30].

3. **Institutional issues:** Institutional issues are concerned with laws and policies governing the use of natural resources. The term property rights means right to get control over to access the resources and in this way any individual or group of individuals holds the responsibilities and rights over land and natural resources. The matter of property rights presents important issues such as who has access to the land and its natural resources, who is in charge of managing these properties, and who has rights to particular resources. Then, it is important to note how land and property rights can either promote or impede the effective management and regulation of all natural resources, including watersheds, agricultural lands, forests, freshwater resources, and coastal areas. Households with secure rights to land and other resources are undoubtedly more common than those with insecure, restricted, or nonexistent land rights. Alternatively, failing to modify the incentive mechanisms built into land and property rights regimes may result in unsustainable consequences and the destruction of natural resources. Certainly, economic growth will occur if property rights are made worthy to undertaken and results in social productivity. But the fragile property rights i.e., fragmented legal framework and weak law enforcement creates an obstruction to economic and social development administrative system with inadequate capacity and service providers also weakens the policy system. Many National-level planning has been made and guidelines have been established for the development of watershed but these guidelines do not sufficiently reflect watershed perspectives. Lack of peoples and local stakeholders' participation in planning turned out to be reason for obstruction in development of watershed. Lack of well-trained personnel and decision-making mechanisms at the watershed level. Due to lack of knowledge and participation for gaining knowledge some traditional approaches such as top-down approach are still prevalent. Not only peoples but government officials also lack behind and do not have hand full of knowledge. Overlapping jurisdictions and

conflicting regulations also creates hindrance. Insufficient coordination combined with no clear mandate for national or cross boundary collaboration. Lack of awareness related to the importance of watersheds and their functions at the local and national level. All these together results into a fragile management system and thus watershed gets degraded.

III. WATERSHED MANAGEMENT ISSUES AND ITS POTENTIAL SOLUTIONS

1. **Problems in management of watershed:** Watershed management is an entire process that encounters many problems. Some of the major problems such as flooding, landslides, erosion, water supply deficit, shortage of sources of energy and food supplies, degraded water quality, sedimentation of navigation tracks etc. One of the major problems is the degradation of land mainly in rainfed areas due to soil erosion caused by runoff. The rate of soil erosion is increasing rapidly year by year. Major constraints in the rainfed lands is the erratic rainfall patterns and uneconomical conditions that acts as a barrier to farmers for making investments in the lands and thus restricts the watershed development and management. Another problem is inequitable benefit sharing among the farmers community, also within different regions in the watershed. This hinders the growth of women farmers and marginal laborers as the lack behind in getting the opportunity for their growth. The overdevelopment of water harvesting facilities in the upstream portion of watersheds had drastically decreased the inflows into the downstream reservoirs, according to several case studies conducted in India's water-scarce Gujarat and Madhya Pradesh states. On the other hand, it is also observed that the construction of big reservoirs led to the submersion and hardship in the upstream sections of the same watershed or an adjoining watershed, typically having an urban or an industrial sector, and benefits for residents in the downstream parts. Inspite of watershed management programs in the required regions, still severe water shortage has been observed in many watersheds, that limits the food productivity and gains. Also, the barren lands are not treated properly and re-vegetation does not take place due to inadequate management programs. Due to increased water withdrawals by other uses or as a result of overgrazing, domestic/ecosystem water needs and livestock water/fodder needs are either not sufficiently met or are made to suffer.

In watershed management problems may pop up due to inappropriate understanding of interaction between biophysical and socio-economic processes. A major problem in watershed management is also due to disagreement among various government ministries those related to agriculture sector, rural development, forest, also between government bureaucracy and elected representatives in their eagerness to control funds. Lack of baseline data for monitoring and comparing the current status makes it tough to undertake significant effect assessment studies on watershed management projects. Without adequately estimating water supply scenarios in drought, normal, or surplus years, as well as without effectively managing demand, particularly in drought years, the entire watershed management exercise is carried out. Due to decreased forest yields, deteriorating land quality, a lack of tribal agriculture policy, and population pressure, large areas with a large tribal population lack facilities to extract water and sustain their food, crop, and fodder production. As a result, the indigenous people experience ongoing suffering, sociopolitical turmoil, and rebellion.

2. **Potential solutions and new prospects associated with watershed management:** Even though above paragraphs state many problems associated with watershed management, managements programs hold on various new opportunities and prospects. Also several problems come with certain solutions such as flooding can be controlled by means of construction of reservoirs, levees, re-vegetation; landslides can be controlled by protection of slope by constructing bunds, terraces and drainage structures; erosion due to runoff can be controlled by means of erosion control structures, contour terracing; water supply continuity can be maintained with storage structures, water harvesting structures, vegetation manipulation; energy and food shortage can be controlled with fuel wood harvesting, hydro power development, developed agriculture areas and practices, increase livestock; to enhance drinking water quality by pumping water through developed well and springs, by treating water using water treatment structures. It is imperative to increase food production while preserving the ecosystem and ecology, particularly the land, water, forests, wildlife, and atmosphere. This may involve implementing best management practices (BMPs) like organic farming, de-silting to increase crop productivity as well as reservoir capacity, sprinkler and/or drip irrigation to reduce excessive water use, a no-tree-falling policy, reforestation and arboriculture using high oxygen-yielding plants, etc. A key aim should be to increase engagement from all groups of people after the project has been implemented in order to maintain sustainable watershed management. Only this can guarantee progress overcoming the hydro-geological, socio-political, and other uncertainties on a sustained basis. The moderate benefit-cost ratio may be increased by lowering the costs at which the advantages are recognized, which would open up new possibilities for watershed management. Several villages in India have seen the implementation of numerous successful watershed management projects on a modest scale due to the collective efforts of government agencies, non-governmental organizations (NGOs), and academic institutions. Therefore, it is necessary to expand watershed management efforts over sizable areas, which may include remote and/or challenging terrain, in order to successfully address various issues facing our agricultural, rural, and forest sectors.

IV. WATERSHED MANAGEMENT APPROACHES

There are two approaches related to watershed management viz. integrated approach and consortium approach. Integrated approach works within the natural boundaries of watershed and integration of technologies takes place within these boundaries for the most effective development of land, water, and plant resources to sustainably satisfy the fundamental requirements of people and animals. This technique intends to support the earning potential of the average person in order to improve their standard of living by providing all the facilities necessary for maximum production. In order to accomplish its goal, integrated watershed management recommends adopting land and water conservation techniques, water harvesting in ponds, groundwater recharge, and stress on crop diversification, use of improved variety of seeds, integrated nutrient management, and integrated pest management techniques, among other things.

The consortium approach places a strong emphasis on group efforts and community involvement, which includes key stakeholders, governmental and non-governmental organizations, and other institutions. The management of watersheds demands for diverse abilities and capabilities. Simple access and prompt assistance to farmers are crucial factors

in the watershed's impressive effects. These increase farmers' awareness of issues and their capacity to consult the appropriate parties when issues emerge. The fields of engineering, agronomy, forestry, horticulture, animal husbandry, entomology, social science, economics, and marketing all demand multidisciplinary proficiency. It is not always feasible to find every necessary support system and skill set within a single business. In order to increase the effectiveness of the many watershed programmes and interventions, the consortium approach draws together the knowledge of different fields [31].

V. INTEGRATED WATERSHED MANAGEMENT

1. **Integrated aspect of watershed management:** The process of developing and putting into action strategies, programmers', and projects to maintain and improve watershed functions that offer the products, services, and values needed by the community impacted by circumstances inside a watershed border is known as integrated watershed management. The Ministry of Rural Development's Department of Land Resources implemented the Integrated Watershed Management Program (IWMP). The main aim of IWMP's is to restore ecological balance through the utilization, conservation, and development of degraded natural resources such soil, vegetation, and water. IWMP works in order to utilize the lands according to its capabilities and thus provides the land use classification. Some practices such as allowing the vegetation on the soil in accordance with its capacity, conservation of rainwater as much as possible and utilizing it at farmlands or for domestic purposes. IWM focuses on enhancing the drinking water quality through wastewater treatments, consistent and ample amount of water supply, tries to involve local communities participation as they know better their place, also focuses on encouraging self-help groups (SHGs) that will support the development of the watersheds from base levels, balancing environmental requirements with economic development, to use the resources available in sustainable manner helps in increasing the productivity, productivity improvement through active cultivar selection, stabilizing and protection of natural resources.

2. **Conceptual model for developing an integrated watershed management plan:** Watershed management is a practice that evolves by involving the management of land, water resources, and other resources in a definite area for ecological, social, and economic purposes. Developing any plan a pre-defined strategy is required that can be modeled. Initially for planning, conceptual model can be developed to visualize the development of the plan in action. The conceptual model for developing an integrated watershed management plan involves several steps viz. preliminary survey of the targeted watershed and determines its state using ecosystem health indicators; then identifying the partners such as people of communities, people and organizations with an interest in the management of watershed and receiving the profits out of development; identifying the interests and aims of the stakeholders then accordingly establishing the goals and plans to achieve the required targets; then put the plan into action, which involves keeping monitoring on management practices and enforcing them; to increase management success, examine management success and failure, reevaluate the goals, and make necessary plan adjustments.

3. **Concepts of watershed management:** The concepts start with the entry point approach (EPA) which is the first project intervention in a official manner that which has been

carried out after the transect walk, selection and initialization of the watershed. It is strongly suggested to use knowledge-based entry point activities to establish rapport with the neighbourhood. Direct cash-based EPA must be avoided because such actions first send the wrong signal to the people about various measures. The specifications of the knowledge-based EPA designed to establish trust with the community while delivering real economic benefits for all community members are described here. The initial steps for watershed management are the soil and water conservation practices that involve in-situ and ex-situ approaches. The in-situ management involves the construction of contour bunds, graded bunds, field bunds, terraces, and furrow practice, and other soil-moisture conservation methods used in agricultural fields to conserve land and water. These methods prevent soil erosion, enhance soil quality, raise soil moisture availability, and recharge groundwater. Ex-situ management also refers to the building of check dams, farm ponds, gully control structures, and pits across stream channels. Ex-situ strategies for managing watersheds boost the capacity of watersheds for irrigation and groundwater recharge by reducing peak discharge, reclaiming gully formation, and harvesting significant amounts of runoff. In addition to the above steps integrated management of pest and nutrient. As water alone cannot help in achieving the desired productivity thus required the adequate application of nutrient and pest management. When compared to unmanaged land, agricultural production can increase several fold with a balanced nutritional diet, proper moisture availability, and a free of pests and diseases environment. When compared to unmanaged land, agricultural production can increase several fold with a balanced nutritional diet, proper moisture availability, and a free of pests and diseases environment.

Utilizing organic manure, crop straw, and other plant and tree biomass materials consistently while applying minimal amounts of chemical fertilizer is known as integrated nutrient management (INM) (both macro and micro-nutrients). In order to reduce pest infestations, integrated pest management (IPM) makes use of a variety of crop pest control techniques, including cultural, biological, and chemical treatments. In order to balance costs, benefits, public health, and environmental concerns, INM and IPM's primary objectives are to maintain soil fertility, manage pests, and protect the environment. Crop intensification is the process of raising crop yield and intensity to fulfil the constantly rising demand for food in a particular terrain. Cropping patterns should be changed to a more balanced cropping system to lower the chance of crop failure. Through the use of cutting-edge technologies, particularly good diversity of seeds, balanced fertiliser delivery, and through providing supplemental irrigation, watershed management places an emphasis on crop diversification and intensification. One of the concepts of watershed management is to allow the use of multiple factors. Due to a variety of catastrophic occurrences, pest and disease attacks, and market shocks, farmers who are completely dependent on agriculture face significant levels of uncertainty and danger of failure. Therefore, integrating on-farm and off-farm operations is necessary at different scales to generate a reliable source of revenue and support their way of life. For instance, combining agricultural, livestock production and dairy farming can result in a system that is more resilient and sustainable than one that only uses agriculture practices. One system's product or by-product may be used in another, and vice versa. In this illustration, biomass production that results from crop harvesting might be used to feed livestock, while livestock dung could be used to fertilise the soil. Aquaculture, animal husbandry, and plantation horticulture are all included in this. The improvement of the

resource base and livelihoods of the rural population involves numerous interventions as part of the watershed development process. Building capacity is necessary for all stakeholders, from farmers to decision-makers. Strengthening people's capacities to use resources effectively and efficiently in order to consistently attain their own goals is known as capacity building [32]. The causes that affect the performance of the watersheds are due to the stakeholders' ignorance of the aims, strategies, and actions [33]. The construction of low-cost soil and water conservation techniques, the production and application of bio-fertilizers and bio-pesticides, income-generating activities based on livestock, the development of waste land, and market linkage for key stakeholders are the main areas of focus of capacity building programmes.

VI. WATERSHED DEVELOPMENT PROGRAMMES

India's development plans have given high emphasis on Watershed Development Programmes (WDPs) [34]. In India, these watershed development programmes have been initiated to enhance and sustain productivity and the output potential of the nation’s arid and semi-arid regions by launching various programs. The WDP strategy aims to develop and enhance every type of land—public, forest, community, and private—that is located within a specific watershed. It is a comprehensive strategy to develop the natural resource base and economy of dry and semiarid regions. Watershed Development Programs (WDPs) are one of the Ministry of Rural Development's Department of Land Resources' (DOLR) very important programmes (MORD). The State Governments have prioritised the widespread implementation of three significant programmes, namely the IWDP, DPAP, and DDP. The DOLR has made a commitment to upgrading these schemes' rules on a regular basis with input from groups like research organisations, nonprofits, technical committees, workshops, and seminars, among others. Particularly well-liked are the contributions from the Parthasarathy Committee and the C.H. Hanumantha Rao Committee [35], [36]. The development of a watershed's land and water resources is intended to strike a balance between their preservation, renewal, and human usage. Successful watershed development initiatives frequently result in increased access to drinking water as well as improved agricultural yields. The improvement of wastelands, runoff reduction, water conservation, and protective irrigation mechanisms in all areas, including desert-and drought-prone areas, have been emphasized in the programmes. The improvements work fall under different components of watershed development programme would include soil and land management; water management; crop management a forestation; pasture or fodder development; livestock management; rural energy management; other farm and non-farm activities; and development of community skills and resources. All these components are interdependent and interactive Almost all activities involving land, water, and biomass production are included in the development initiatives envisioned within its scope [37]. Some of the major programmes are presented in table 1 [38], [39], [40].

Table 1: Some of the Following Major Programmes to Solve Water Issue

Year	Program/Policy/ Guideline	Major Objectives	Relevant Institution
1973-74	Drought Prone Area Programme (DPAP)	Encourage the social inclusion of economic growth in drought-prone areas and the conservation of soil and moisture.	Ministry of Rural Development (MoRD)
1977-78	Desert Development Programme (DDP)	Works with the objective of reducing the effects of drought and desertification through reforestation	MoRD
1989-90	Integration Wasteland Development Programme (IWDP)	To rejuvenate degraded non-forest land through silvi pasture and soil and water conservation on the village and micro-watershed scale.	MoRD
1989	Integrated Afforestation and Eco-Development Scheme (IAEPS)	Participatory methods should be used to restore and regenerate the ecological balance of damaged forests on a watershed basis.	Ministry of Environment & Forests and state Forest Department (MoEF)
1990-91	National Watershed Development Project for Rainfed Areas (NWD-PRA)	Encourage the management of natural resources in a sustainable way, boost agricultural output, restore ecological harmony, lessen regional inequities, and generate long-term employment possibilities in rain-fed areas.	Ministry of Agriculture (MoA)
1992	Indo-German Watershed Development Programme	Using a participative approach, restore the micro-watershed for the objective of regenerating natural resources and sustainable livelihoods.	National Bank for Agriculture and Rural Development (NABARD) and the Watershed Organisation Trust (WOTR)
1999-2000	Watershed Development Fund	Promote a more coordinated approach to WSD by providing financial support to scale up successful participatory WSD programmes in hundred target districts.	MoA and National Bank for Agriculture and Rural Development (NABARD)
2001	Common Guidelines for Watershed Development	Update the 1994 WSD guidelines to be more project-specific, participatory, and flexible in their implementation.	MoRD
2002	National Afforestation Programme	Participatory forest resource development is carried out while marginalised communities' capacity is increased, created by combining IAEPS and three additional forestry programmes to lessen the number of different programmes.	MoEF
2003	Hariyali Guidelines	Empowering Panchayati Raj institutions to carry out the nation's watershed development programme financially and administratively.	MoRD
2005	Mahatma Gandhi	Enhancing livelihood security in	State Employment

	National Rural Employment Guarantee Scheme (MGNREGS)	rural areas by providing at least 100 days of guaranteed wage employment in a financial year, to every household whose adult members volunteer to do unskilled manual work	Guarantee Council (SEGC)
2006	Parthasarathy Committee report	It was a Technical Committee on DPAP, DDP, IWDP Programmes constituted by the Department of Land Resources. Its report has attempted an exhaustive review of the experience of the watershed programme in India.	MoRD
2008	Neeranchal Watershed Development program	The project intends to accomplish the Pradhan Mantri Krishi Sinchai Yojana (PMSKY) watershed component, reducing surface runoff of rainwater, raising groundwater levels, and improving water availability in areas that are rain-fed.	World Bank Assisted-National Watershed Development Program
2015	Pradhan Mantra Krishi Sichai Yojana	Implemented to increase irrigation reliability, decrease water waste, and enhance water usage effectiveness. Employing "Jal Sanchay" and "Jal Sinchan" to capture rainwater at the micro level to create protective irrigation. Additionally, subsidies are used to encourage micro watering so that "per drop-more crop" is achieved.	State Department of Agriculture

VII. CONCLUSIONS

Recognizing the interactions between land use, soil, and water, as well as the connections between upland and downstream areas, is one of the fundamental principles of watershed management. A watershed's physical changes can have a range of effects, from short-term occurrences like flooding and landslides to long-term processes like soil erosion, water depletion, and non-point-source pollution. Therefore, a wide variety of spatial information and temporal data must be integrated in order to establish and evaluate watershed management. The common pool resources (CPRs) of land, water, fodder, forests, fisheries, wildlife, and agriculture, which greatly support people's livelihoods, particularly in rural regions, need to be preserved and improved. It is important to stop the decline in agricultural prices, the pay disparity between urban and rural areas, and the job chances gap while also fostering opportunities in agriculture, natural calamities like floods and droughts, forest and mountain economies. Some recommendations to the practioners will reduce the scope or error and allow successful implementation of watershed development program such as prioritize the watershed area according the severity of problems and perform the work where there is dire need mainly in terms of modifying the soil and water status, improving productivity and increasing output and raising living standards. Also practioners should adopt a comprehensive and inclusive consortium strategy right away, starting with the choice of the watershed. Make sure that the community and consortium partners are informed of the

ground rules for operation. Adopt a knowledge-based entry point strategy to establish trust with the community and guarantee real economic gains for it.

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