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INTEGRATED WATERSHED APPROACH TO NATURAL RESOURCE MANAGEMENT IN RURAL HILL ENVIRONMENT OF KUMAUN HIMALAYA

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ABSTRACT

The Kumaun Lesser Himalayas, known for its rich biodiversity and unique cultural heritage, face numerous challenges including rise in temperature, water scarcity, land and forest degradation, soil erosion, rural out migration. This research paper investigates the effectiveness of integrated watershed development (IWD) initiatives in addressing these challenges and promoting watershed based natural resource management (NRM) in the region. Using a combination of quantitative and qualitative methods, including household surveys, semi-structured interviews, and remote sensing analysis, the study assesses the physical, socio-economic and environmental impacts of Integrated Watershed Development approach. The research findings indicate positive outcomes in terms of natural resource conservation and replenishment livelihood improvement, and community resilience, highlighting the importance of holistic approaches to watershed management in mountainous regions.

Keyword: Natural Resource conservation, Kumaun Himalaya, Ramganga River Basin, Integrated watershed management Approach

INTRODUCTION

Mountain areas are vital for both upland and down slope people, the Global Agenda for resource development have brought mountains to sharp focus. Most of the mountainous areas have not been able to harness their unique resources to improve mountain livelihoods because of inadequate and unfavorable policies towards mountains. Harnessing mountain niches appropriately through better management of natural resources and application of technologies and new methods of production and exchange do generate employment and income opportunities in the mountains.

Natural resource conservation is important in view of physical, ecological, socio-economic, and cultural development. In that it is the basis for the sustainability of any region and contributes significantly to the quality of life of the local people (Environmental Waikato, 2003; Brabyn,

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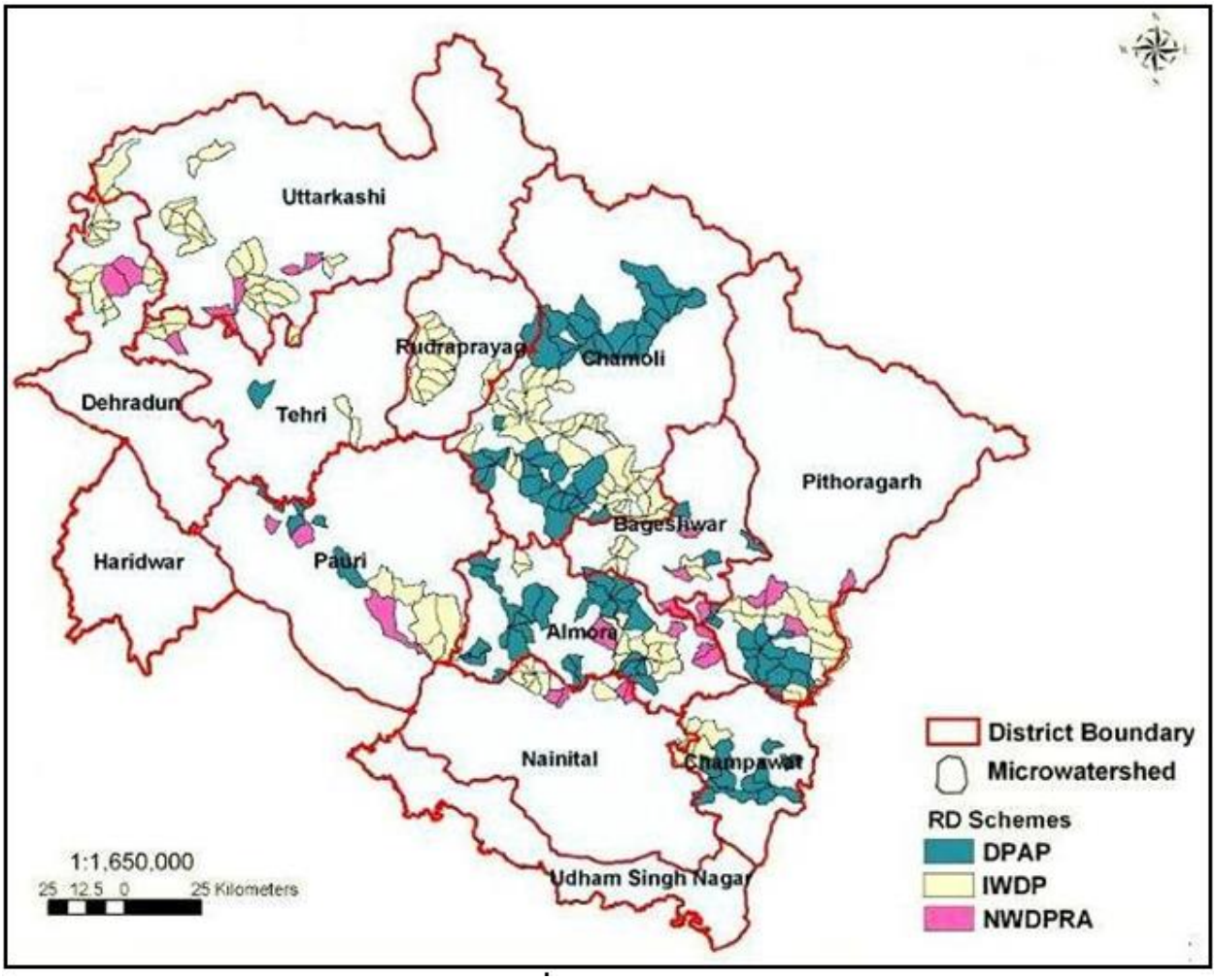
2005). The effectiveness of natural resource management requires a detailed understanding of the patterns and processes that exist within both the natural system itself and the human institutions associated with the use of the resource (Deadman, 1999).

Large number of studies carried out in the Indian Himalaya Region (IHR) focusing on development interventions/initiatives reflect the unscientific exploitation of resources leading to increasing environmental degradations.

Figure 1: Area proposed by DPAP, IWDP and NWDPRA in Uttarakhand (UPSP, 2009-2027)



Reduced dense forest cover (Singh et al. 1985; FSI, 2003) accelerated soil erosion and increased silting of water bodies (Valdiya, 1985, 1897) drying-up of springs (Valdiya and Bartarya, 1989; Negi, 2002) replacement and disappearance of species (Singh et al. 1984) and increased ratio of

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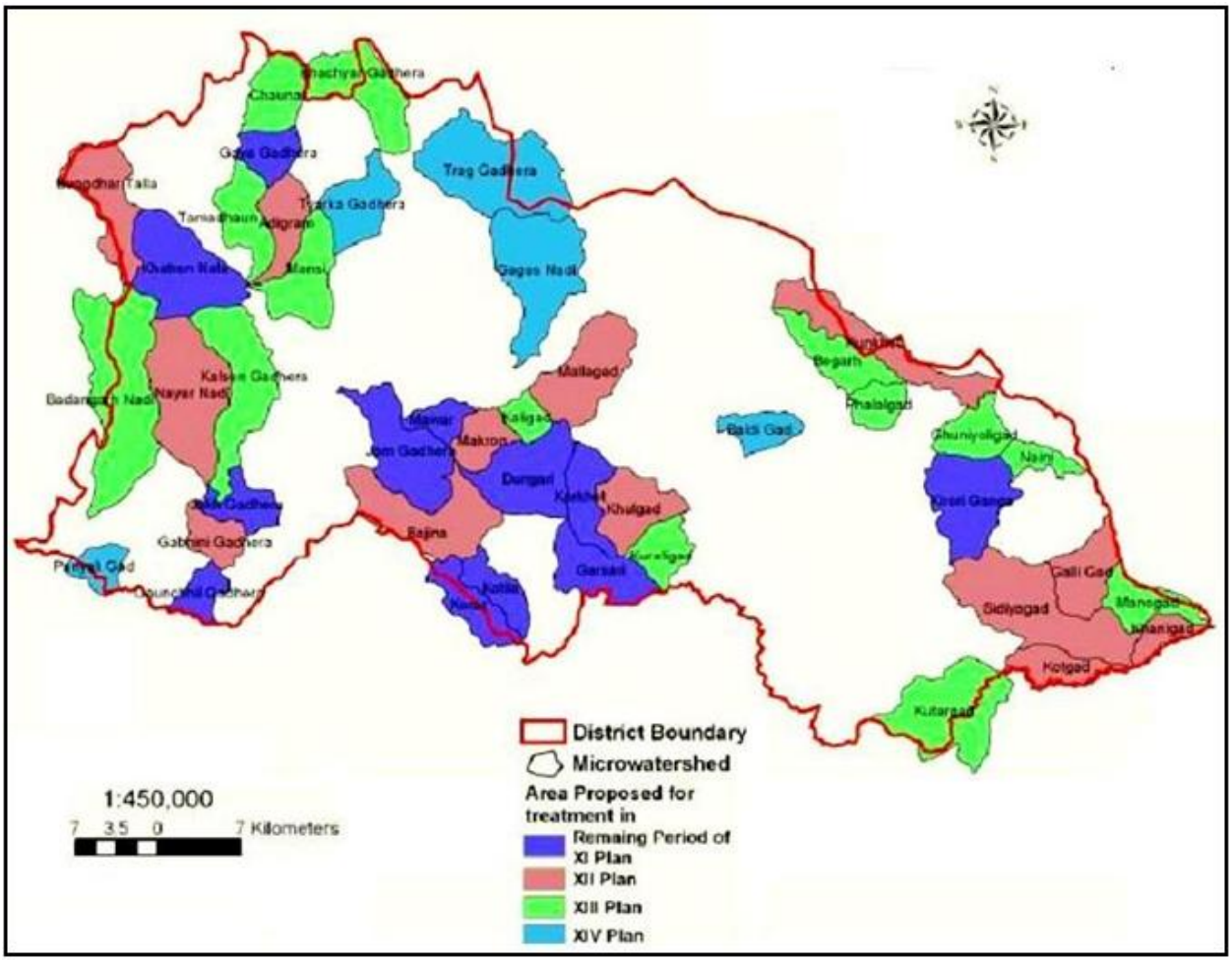
energy expended in fodder, fuel collection, and agricultural activity that increase drudgery of the womenfolk (Pandey and Singh, 1984) are some of the telltale symptoms of environmental ill-health. Access to drinking water varies across the Himalayan region. While Himachal Pradesh has been able to plan for and provide tap water to 83% of its rural households, accessibility is 66.5% in Sikkim and Arunachal Pradesh, and 60.5% in Uttarakhand. Seasonal variations in precipitation and stream flow in the Himalayan basins are very high. Mean monthly discharges of the Himalayan Rivers in the low flow months before June and after September are generally 10-20 times lower than during the monsoon months (Chalise et al. 2001).

Figure 2: Area proposed for treatment under IWMP in Almora District (UPSP, 2009-2027)



The Kumaun Lesser Himalayan region is characterized by their rugged terrain, diverse ecosystems, and unique cultural heritage. Land, water and vegetation are the three basic resources of the life support system. These resources are under intense pressure in the Kumaun

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Himalayan region due to natural and human induced factors. The overall ecosystem in this region tends to become fragile and precariously balanced due to over exploitation of natural resources to meet the food, fodder and fuel requirement of inhabitants and unscientific management of the resources. Undulating terrain and erratic and meager rainfall, has further accelerated the resource degradation and depletion processes leading to the deterioration of the overall ecosystem. The agricultural production system in this region is mostly rainfed, mono-cropped and at subsistence level.

In developing countries like India, the major thrust of any planning and management activities is the development of rural areas at sustainable basis. This is possible only with proper planning of watershed, which is essential for the conservation of land and water resources management. Integrated watershed development (IWD) is a comprehensive approach that integrates various natural resource management activities, including afforestation, soil conservation, natural and artificial water recharge and community development, to achieve sustainable development goals. Previous research conducted in Himalayan regions has highlighted the importance of integrated watershed development in mitigating soil erosion, improving water availability, and enhancing livelihoods (Wang et al., 2016). However, challenges such as inadequate funding, limited institutional capacities, and socio-cultural bariers have hindered the effectiveness of integrated watershed development (IWD) initiatives. Despite these challenges, successful examples of integrated watershed development (IWD) approach based natural resource management demonstrate the potential for transformative change in mountainous landscapes. Integrated watershed development (IWD) has emerged as a holistic approach to address these challenges by promoting sustainable land and water management practices, enhancing livelihood opportunities, and empowering local communities.

Watershed Scenario in Uttarakhand

Since 1980s many externally supported programs/schemes and major government programs related to watershed development have been going on in Uttarakhand. Drought Prone Area Program (DPAP), Integrated Wasteland Development Program (IWDP) and National Watershed Development Program for Rainfed Areas (NWDPRA) are the major centrally sponsored programs being implemented in the State by the Rural and Agricultural Departments. Ramganga River Valley Project (RVP) was implemented by the Forest Department of the State which is centrally sponsored in Macro Mode by the Ministry of Agriculture. Ramganga Valley project was started in the year 1962. The main aim of the scheme was to protect the Dam constructed on the Ramganga River near Kalagarh from excessive siltation and to increase the life of the reservoir. The main works under the scheme are afforestation, pasture development treatment of the arable land, plantation of horticulture tree species, Drainage Line Treatment and Soil and Moisture Conservation works.

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The Watershed Management Directorate of Uttarakhand since 1982 has been implementing externally aided watershed projects in various micro watersheds of the State. At present the World Bank Aided Uttarakhand Decentralized Watershed Development Project (UDWDP) is being implemented the project period is from September 2004 to 2012. It proposes to cover 2348 Km^2 of area covering 76 MWS, 11 districts and 18 blocks. Till the start of this project 193 MWS covering an area of 7592 Km^2 had already been treated under various externally aided projects (Figure 1).

MATERIAL AND METHODS

The study is conducted in the Kumaun Lesser Himalayas region, focusing on selected micro-watershed areas identified in collaboration with local stakeholders. The study area falls in the middle valley of western Ramganga River covering an area of ~ 200 Km^2 from Chaukhutia to Bhikiyasain which is a part of the Kumaun Lesser Himalayan terrain of Almora district, Uttarakhand. The objective of the study is to identify problems and issues related to natural resource degradation and suggest management strategies and measures for their conservation and promotion through integrated watershed development. Different data sets, accessed from various sources (local, regional and global) have been used through this study. Data were collected through a combination of household surveys, semi-structured interviews with key informants, and remote sensing analysis of land use/land cover changes. Primary data is collected through a well-structured questionnaire.

RESULTS AND DISCUSSION

Land-Use Practices and Land Degradation

Physiographic conditions specifically related to mountain regions play an important role towards land degradation processes. High slope gradients and directions establish the nature and intensity of erosion. Steep slopes may increase the loss of soil profile but also the formation of soil. Soil losses on steep slopes are also interlinked with slope length because the overland flow of volume and its velocity may increase by this factor. The Himalayan mountain region altitudinal variations within a short distance between the peaks, heights and valleys are common. Tectonic activity, abrupt climatic variations are threats that render mountain slopes more prone to degrade and have impact on landform covers/uses, resultantly, initiating land degradation processes.

Land-use practices involving deforestation in any form cause a reduction in the infiltration capacity and groundwater recharge, increase in surface runoff and erosion, and increase in evaporation from soil and surface storage. Hydro-metrological studies conducted in Khulgad watershed in the Kumaun Himalaya (Rawat, 1988) indicate that rainwater absorbing capacity

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(infiltration) and evaporation loss from the soil moisture regime have been dramatically changed in the anthropogenically disturbed lands.

Water Scarcity and Water Resource Degradation

Drying up of rivers, insufficient water available for irrigation and long queues at public water sources reveal that water is a scarce resource. The water supply from public sources is often inadequate because of insufficient rainfall and low recharge of shallow aquifers during the dry season, which can last up to eight months per year. As per the findings of the People's Science Institute (PSI) Dehradun, just 25% of villagers in Uttarakhand have been getting 40 liters of water per day, the minimum standard set by the government. A sizeable majority in the state has routine access to just 11 to 20 liters per day. In historical towns like Almora, located strategically at the hill tops, the water crisis has assumed alarming dimensions following the 'devastation wreaked on the catchments of the rivers in the name of development'

Plate 1: People force to wash their cloth in the direct flow of the Ramganga River (Ramganga gauge station near Naula village)

An interesting picture emerges when dividing the micro-watersheds into different zones according to elevation and aspect. This division is based on the assumption that water availability changes with increasing or decreasing altitude because of differences in both rainfall conditions and topographic settings. Aspect influences rainfall input as well as water loss through evapotranspiration. Although the uppermost areas in the watershed along the water divide receive fair amount of monsoon rains, they are the areas with least access to perennial water sources such as streams and major river (Ramganga). In many places, residents of these

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areas have to walk long distances for their drinking water. In lower areas, water availability may be affected by upstream extraction of water mainly during the dry season.

Forest Resource Degradation

Green cover is indicator of resilience of the natural resources and a primary requirement for sustainable development of any region. Thus, forest cover needs to be recognized as the 'natural resource infrastructure for rural economic growth including agriculture/primary production/water requirement'. According to a study by Shah (1982), the total growing stock of forests in the Kumaun is 66 million m^3, while the out turn is 4.54 million m^3/year and the annual increment is 0.78 million m^3/ year. So, at the net depletion rate of 5.8% per year, the growing stock of trees will be completely wiped out by AD 2031 and the grass stock by 2040.

Table 1: Major uses of Chir-Pine in Kumaun Himalayan Region

Major Indigenous Uses	Part Used
Timber	Wood
Fuel-wood	Wood, bark
Livestock bedding	Leaves
Resin	Resin
Lighting	Resinous wood
Religious purpose	Twigs

If the present trend of forest exploitation is not reversed; than within half a century the Kumaun Himalaya would become a barren wasteland. The grazing pressure on forests is 2.5 to 5 times more than the carrying capacity of the forests in the Kumaun region. Pinus roxburghii commonly known as long-leaved pine or chir-pine is one of the most important conifers in the Himalayan region (Tiwari, 1994), which moulds the life of various ethnic and other communities of the region. In recent years, detailed ecological studies have been carried out on the chir pine forests in the Uttarakhand hills (Tiwari, 1994; Singh and Singh, 1992; Zobel *et al.* 2001). Chir-pine is the dominant tree species in the upper reaches of the study area while Ghingaru is the dominant shrub. However, pines are a commercially important species. They were felled until 1981, when the government imposed a ban on the felling of green trees above 1000m, by contractors for the state Forest Department for pulpwood and timber. There are several indigenous uses of pine, of which following are most prominent in the study area (Table 1). The resin is one of the most important non-wood products. Satellite imagery has shown the condition of forest cover in the

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study area which is having 32.3% of land cover. Forest land having dense foliage canopy has been reported only 8.7% of the total geographical area, having pine monoculture. Area under forest cover is more important for conserving water resources. It has been observed that the diversion of uncultivated land is towards fallow land, as cultivation is decreasing due to large scale migration of agricultural male work force which has an adverse impact on water resource of the study area. Fallow land has more adverse impact on water resources than even pasture land in terms of surface runoff, which is increased through lack of vegetative cover; it also results in greater soil erosion, which further contributes to decline in water conservation.

Natural Resources Management Based on Integrated Watershed Development

Watershed management involves management of land, water and vegetation so as to conserve the soil and water for immediate and long-term benefits to the farmers, community and society as a whole. It is an integration of technologies within the natural boundaries of drainage area for optimum development of land, water and plant resources to meet the basic needs of people in a sustained manner. The main objective of watershed management is "*Proper use of all the available resources of a watershed for optimum production with minimum hazards to natural resources".*

Development concerns in the Himalaya revolve around how could resources of the region be managed for conserving/improving the environmental values of the region together with socio-economic development of mountain people.

An analysis of the State agencies established in 1975 the Jal Sansthan and Jal Nigam-reveals that as agencies with monopoly powers and responsibilities to provide drinking water, they have reportedly achieved drinking water supply coverage to almost 100% of the identified 'problem villages', which by themselves constitute about 76% of the total number of villages. But the actual performance of these agencies in terms of supplying the prescribed quantity of water sustainably and equitably leaves much to be desired. Evaluated in terms of the chosen parameters, the functioning of these institutions fails on most counts. This explains the drinking water crisis that has prevailed in the state for the last couple of decades. This also becomes more evident from the survey of nine sample villages conducted in the study area. Village people in the study area are predominantly dependent on springs for ensuring their water security. The springs that have been in existence for a great many number of years are slowly on the verge of drying up, having a direct impact on the livelihood and productivity of communities in the study area. Development of spring catchment area for rain water harvesting for recharging springs, artificial recharge of ground water through infiltration structures, rooftop rain water harvesting and promotion of adaptive land-use are some of the most effective technologies that can be best implemented under integrated watershed development.

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Plate 2-IWD based NRM practices, Field preparation for line-sowing (upper), Pisciculture promotion at-village-Chinoni (middle) lined percolated tank at Bhatoli village (down)

In terraced fields, there are two options which can adopt, in case of barren 'staggered trenches' can be made and in cultivated areas 'drainage trenches' can be made. In sloping fields which are not terraced, instead of trenches staggered pits and plantation along the bunds will work efficiently. Vegetative measures include brush-wood check dams, planting of low water demanding and shallow-rooted grasses, shrubs, trees, live hedge rows, inter-culture operations like mulching, gap filling etc. Social measures include control over grazing, limited fuel-wood and fodder cutting and social fencing of the recharge areas. Spring-shed development involves the preparation of spring-shed development plan, followed by the creation of the soil and moisture conservation and vegetative works. Significant changes that have occurred over the last couple of centuries in the land and vegetative features have had a deleterious impact on water resources. The management of water and other natural resources in the hill areas are logically thus dependent on location specific social and economic cultures. Anthropogenic changes therefore exert a direct impact on the water and other natural resources regime.

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The management of the forest resource in the mainland of Uttarakhand is getting setback due to two reasons; first, an inaccessibility of the temperate forestland and second, the depletion of forest around the settlements. The instability of the land due to natural phenomena (terrestrial and atmospheric), such as slope failure, landslides, mass-movements and rock-fall, further accentuate the problem of depletion of forest. Forest is major land-use/land-cover category (as recorded forest area) which covers ~34% of geographical area in the study area. Villagers have identified degraded land in the van panchayat and civil forests where plantation activities can effectively be undertaken through IWD.

Natural Resource Conservation and Management Strategies

Remote sensing analysis indicates that positive changes can be made in land use/land cover patterns, with an increase in forest cover and a reduction in bare soil areas. Soil erosion control measures, including contour trenching, vegetative barriers, and check dams, can led to significant reductions in soil loss rates and sedimentation in rivers and streams. Water resource management interventions, such as construction of check dams, ponds, and water harvesting structures, can improve water availability and quality in the watersheds.

Forest resource conservation efforts, including reforestation and afforestation programs, and community-based conservation initiatives, can enhanced watershed livelihood functions and protected valuable watershed resources of rural hill environment.

Policy Implications and Corrective Measures

The findings of this study have several policy implications for promoting sustainable natural resource management in the Kumaun Lesser Himalayas. Integrating IWD principles into government policies and programs, strengthening institutional capacities, enhancing stakeholder engagement, and fostering partnerships between government agencies, NGOs, and local communities are essential for scaling up successful interventions. Furthermore, investments in research and development, as well as the dissemination of best practices, are necessary to support evidence-based decision-making and adaptive management strategies.

Water, soil and forest are the basic requirements of the community residing in the study area. The availability of these resources determines the sustainability of livelihood. Here, the requirement is to protect the catchment of water sources by planting more trees, especially those species having broad leaves like oak, rhododendron, kafal, utis etc. Pine, which is a major cause of forest fires, should be replaced with the species that will aid water conservation. Villagers have identified degraded land in the van panchayat and civil forests where plantation activities can be undertaken.

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CONCLUSION

The problems in the Himalaya are complex, having intricate linkages between social, economic and ecological concerns. The solutions, therefore, cannot be addressed in isolation. Therefore, the basis of natural resources development and management in mountainous areas has to be centered around man's relationship with nature. The relationship is desired to be governed by a sense of justice and equity. Each culture is the result of the people trying to survive within their environment and indeed of an attempt to optimize the use of its resources (Agrawal, 1992). The intense vulnerability of mountain ecosystems and their elements to the human as well as climate-induced changes, therefore, is of great concern. These events have arrived at a consensus that mountains would require specific approaches and resources for sustaining livelihood needs and improving the quality of life. This would require an integrated approach, which gives due consideration to closely intertwined aspects of human socio-economic-cultural systems and natural ecosystem components/processes. Therefore, natural resources development in the mountains particularly in the Himalayan region has to have a different approach, given the fragility and vulnerability of the Himalayan ecosystems due to the uniqueness of mountain specificities (Jodha, 1992). This necessitates a long term developmental approach aimed not only at optimum utilization of natural resources but also at development of the natural resources such as land, water, vegetation and man power for restoration of ecological balance. The effective conservation and management of land, water and vegetation resources aimed at obtaining optimum and sustained return from these resources without degrading them can be achieved by adopting watershed as basic unit of development.

Thus integrated watershed development has emerged as a promising approach for promoting sustainable natural resource management especially in rural hill environment. Empirical evidence suggests that IWD initiatives have contributed to socio-economic development, environmental conservation, and community resilience. However, challenges remain, and concerted efforts are needed to address institutional, financial, and socio-cultural barriers to implementation. By adopting a holistic and participatory approach to watershed management, the region can achieve its sustainable development goals and secure the well-being of current and future generations.

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