

A Perspective on Watershed Development in the Central Himalayan State of Uttarakhand, India

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ABSTRACT

This paper discusses the evolution of watershed development projects and their implementation in the central Himalayan state of Uttarakhand in India. It traces the historical growth of thinking on watershed in the region, and highlights issues and influences. Impacts and benefits are discussed in relation to sustainability. The review shows that success in these projects is usually isolated, mostly seen in small micro-watersheds with naturally good water harvesting conditions. Overall, the results and impacts of watershed programmes in the region have been vastly disproportionate to financial and technical inputs, usually because benefits are slow, gradual and unevenly distributed. The involvement of NGOs, which bring a strong social organizational aspect to the activities, brought necessary focus to the programmes. However, in some areas unhealthy levels of community dependence on NGOs are visible, losing the long-term sustainability factor. Gaps in the understanding of technical aspects including hydrogeological issues, changing livelihood and land use patterns, and upstream – downstream linkages continue to undermine possible impacts. However, watershed programmes are evolving with time, adapting and streamlining thinking and processes, and lessons learned are being used in the design and development of future programmes.

Key Words: Drought Prone Area Programme, Integrated Watershed Development Project, Livelihoods, Sukho Majri, Sustainable Development, Watershed Concept

INTRODUCTION

The rate of land degradation in rainfed areas in India in the 1990s is estimated to have been approximately twice the rate observed in the 1980s, basically on account of soil erosion and soil run off (Reddy 2000). Simultaneously, the increasing utilization of water and lack of its natural storage in the subtle niches of ecosystems are causing a decline in the availability of water, particularly in the rainfed areas. Steep, unstable slopes, exposed and thin soils, the depletion of forest cover, overgrazing and unplanned agronomic and construction activities magnify these issues several times in the Central Himalayan region. As a direct consequence, productivity in the predominantly rainfed marginal and small farm plots has declined considerably over time, contributing to large scale migration of able men out of the region.

Watershed management programmes were initiated in India over 35 years ago, initially with a focus on drought prone areas. The programmes were seen as a way to mitigate drought, and were originally initiated and activated by grass roots organizations in the arid/semi-arid regions. Some of those early projects showed visible and astonishing success, reviving water bodies, ground water and greenery in desert like environments. Along with increased water availability, successful projects also showed increased livelihoods, and incomes and a reduction of drudgery. Therefore, such programmes gained popularity, and soon spread from being only drought mitigation activities, to becoming livelihood programmes actively encouraged by the government. Later, these were seen not just as ideal programmes for arid regions to revive the water table and livelihoods, but also as a way to develop rain fed regions which seemed to have been bypassed by the Green Revolution (Rao 2000).

Watershed management is characterized by a variety of possible interrelationships between productivity, conservation and poverty alleviation, in the use of natural resources. Since conservation efforts usually result in higher productivity, at least at the local scale, it has become a popular poverty management approach. However, the linkage of poverty alleviation to the other two factors remains indirect, with benefits often accruing to the wealthier families which live downstream, rather than to the upstream poorest who usually bear most of the costs of the projects.

A breakdown in the traditional socio-economic structure of mountain communities has further, contributed greatly to the increasing loss of efficient water harvesting and storage structures. Primarily agrarian, local economies in the central Himalayan region were originally self-contained at relatively low levels of production, consumption and aspirations. However, with the influence of a rapidly spreading global economy, changes are increasingly rapid. Difficult terrain, lack of transport, the lack of employment, along with small farm sizes and low farm incomes has fuelled large migration from rural areas of the state to cities across the country. Although migration has always been a part of the problem, in recent years the loss of able bodied men has left villages with only women, children and the old and disabled, in an increasingly degraded landscape.

Apart from construction, road building, dam building and deforestation, the large scale disruption of local hydrological flows are also the consequence of the spread of cash crops and seasonal vegetable growing. Natural oak forests, which are known for their ability to store and retain soil water, and in fact are the source of many springs and streams, have been cut down and replaced with apple in many areas. Such changes in land use patterns are causing the disruption and loss of local hydrological flows. Linked to this is the loss of local forest functions. It is observed that in areas where oak forests have given way to orchards, family expenses on fuel, fodder and NTFP related losses have increased.

The biodiversity which abounds in the region, as the plant life – from mosses, lichens, mushrooms, medicinal and aromatic plants to shrubs and trees, migratory fish and birds, animal and insect life are known to be diverse. However, decreasing water availability, changing patterns of vegetation, overgrazing and deforestation, along with excessive harvesting of forest produce, are causing perceptible changes in ecosystem structure, dynamics and functioning in the region. These issues are further magnified by an

increased demand for forest resources and an increasing market.

This paper presents an outline of watershed programmes implemented in the central Himalayan state of Uttarakhand. It discusses the trend of change in programmes over time as learning has accumulated, and the reasons why watershed programmes in the state seem not to be fulfilling the widespread impact which was originally expected of them.

WHAT IS A WATERSHED?

A watershed is a landform defined by high points and ridge lines that descend into lower elevations and valleys, and as a result precipitation is carried as runoff from the area towards one focused, output point. Land elevation defines a watershed, which is easier to see in mountain regions, but much more difficult to perceive in the plains and in low, rolling hills. Several smaller watersheds are usually located within larger ones, and are termed as sub-watersheds. In mountain areas a watershed usually covers a relatively small area, while in the plains a single watershed can cover several thousands of square kilometers. The defining feature is that precipitation in a watershed finds its way into the soils, ground water, springs and streams, and ultimately into a larger channel downstream.

In mountainous regions watersheds are defined by a unique blend of climate, geology, hydrology, soils, vegetation and anthropogenic impacts. Minerals from weathering of rocks, from the decay of vegetation and from groundwater, create localized but sometimes large and dramatic landforms. which characterize the landscape of different watersheds. In the mountains water often cuts out a steep path, with waterfalls and gorges as part of the watershed. In fact each watershed zone - the mountains, plains and coastal reaches - has unique living and non-living components that interact, developing natural processes which define the surrounding landscape and the watershed. Therefore, even though the easiest way to define a watershed is in hydrological terms, holistically it is more than just an area over which water moves; it is a complex mix of processes that convey, store, distribute, and filter water; processes which sustain both terrestrial and aquatic biota - systems upon which human survival depends. This basic concept is used to define watershed management programmes.

Eventually, watersheds are occupied, utilized and altered by humans. Some communities evolve naturally,

working with the ecological flows of the rivers and adapting their survival and livelihood strategies accordingly. Others fight the natural system, building dams, dykes and bunds, working to change natural hydrology and structure, usually with shorter time frames and higher, immediate profits in mind.

THE INDIAN CENTRAL HIMALAYAN REGION

The Himalaya is a vast mountain system, spread across eight countries in Asia. In India, though it covers only 18% of the geographical area, it accounts for more than 50% of the country's forest cover, and 40% of its endemic species. In the Indian Himalaya, agriculture is a minor land use, with only about 10% of the area as net sown area, located in patches across the forest landscape. Nevertheless, this area is ecologically, socially and economically exceptionally important. Traditional crop-livestock mixed farming continues to be the basis for livelihoods of local communities, and is the backbone of the rural economy (Rao and Saxena 1996). This farming system depends on forests for grazing lands, fodder, manure etc. Traditional practices of litter collection, lopping trees for livestock sustenance and for maintaining fertility in croplands are seen to impact the sustainability of ecosystem services. (Semwal et. al. 2004)

The central Himalayan region of India constitutes the states of Himachal Pradesh and Uttarakhand. Uttarakhand came into being in 2000, when the mountain areas of Uttar Pradesh were administratively separated recognising the fact that socially, ecologically and economically the region's management and development needs differed. Elevations in the state extend from approximately 300 to 7000 meters above sea level, and it has a geographical area of 53,485 sq km. The state is interspersed with rivers, deep valleys, high peaks, gorges, uplands, glaciers and snows. It is also divided into 46 tehsils, 73 towns, 95 blocks and over 15 thousand villages. As per the 2001 census, the total population of the state stands at over 8.5 million, of which approximately 75% rural.

Topography and Geology

The state's topography is characterized by a rough, mountainous terrain, rugged, rocky mountains, high peaks, deep valleys and high altitude plateaus. Steep and sharp river flows emphasize the slope, while rapid

soil erosion, frequent landslides and land slips, and widely scattered habitation is characteristic of the rough terrain. High mountain ranges and glaciers cover much of the northern area of the state, while the lower reaches are densely forested and still retain a rich wilderness.

Soils

The state is endowed with a large variety of soil types. They vary from deep alluvial and fertile soils of the terai tract to the recently laid down alluvium of the dun valleys, the thin fragile soils of the Shivalik hills, the black soils of the temperate zones and the arid, bare soils of the inner dry valleys. Various parameters have a significant bearing on the soils types across the state. These include nature, composition, structure and texture of the parent rock below the soil, altitude and aspect, process of formation, climatic conditions, vegetation, use to which the soil is put, the local erosional processes and disturbance (Ghildiyal 1981).

Climate

Climatic conditions and weather experienced in different parts of Uttarakhand are influenced by a number of factors: elevation, aspect, local relief and topography. South facing slopes receive more sunlight and rain than other slopes; there are local rain shadow areas; south slopes receive less snowfall. In the main Himalaya the snowline is lower on the northern slopes. There is a wider range of diurnal temperature at the valley bottom than at the mountain tops at the same latitudes, locations at the valley bottom receive more frost than the mountain tops. As a result, the climate in the state ranges from sub-tropical in the valleys to temperate on the higher slopes, all steered by the summer monsoons. Temperatures range from 16 to 40 °C during the summers, but drop to below 0 °C in many parts of the higher mountain reaches during the winters.

In the terai and bhabar tracts adjoining the plains of western Uttar Pradesh, a typically tropical climate prevails. Sub-tropical climatic conditions are experienced in the Siwalik hills, dun valleys and up to an elevation of about 800m in the lower Himalaya. Temperate climate prevails between 800 and 2400m, and alpine conditions occur above 2400 m. Therefore, across the state temperatures may vary from tropical to icy cold on the same day.

Table 1. Mean monthly rainfall (cm) for all districts of Uttarakhand (mean for 1962 -2002)

Month	Almora	Bageshwar	Chamoli	Champawat	Dehradun	Pauri-Garhwal	Hardwar	Nainital	Pithoragarh	Rudrapur	Tehri-Garhwal	US Nagar	Uttarkashi	State average
January	26	32.37	36.17	23.87	27.78	24.6	22.95	21.67	36.97	36.77	30.05	20.43	35.7	28.87
February	24.01	32.3	38.35	22.77	25.02	22.66	19.44	20.04	39.63	38.21	29.37	17.87	37.82	28.27
March	23.47	32.97	38.73	21.34	21.71	21.13	17.24	18.68	42.62	36.75	25.71	16.71	35.29	27.10
April	14.49	23.12	28.28	13.57	13.16	13.08	10.61	10.94	32.77	26.64	16.63	9.37	25.67	18.33
May	35.11	47.36	48.21	36.37	23.56	28.44	20.95	27.86	60.21	45.24	32.11	24.33	39.62	36.11
June	128.56	143.31	129.86	148.18	90.25	104.8	77.89	118.95	149.63	127.76	110.13	107.68	115.24	119.40
July	308.25	317.45	286.85	343.05	268.04	282.4	247.94	296.19	304.07	287.81	289.18	280.38	265.83	290.57
August	313.86	310.05	276.72	332.74	261.6	292.9	262.03	311.08	288.3	275.56	283.85	301.01	251.14	289.29
September	168.53	173.31	153.44	189.63	130.08	150.2	124.05	165.69	168.67	150.48	146.62	159.34	137.28	155.18
October	34.98	42.97	37.1	43.68	17.8	25.74	16.8	33.91	47.95	33.92	24.36	33.36	26.45	32.23
November	4.54	5.83	7.32	3.08	6.68	4.34	5.95	2.8	7.06	7.63	6.61	2.88	9.36	5.70
December	10.05	12.98	13.91	9.29	9.99	9.25	8.15	8.19	16.22	13.77	11.08	7.33	13.4	11.05
Average	90.98	97.83	91.25	98.96	74.64	81.63	69.5	86.33	99.51	90.05	83.81	81.72	82.73	86.84

(From the India Water Portal - Extracted data from the published global CRU 2.1 dataset consisting of interpolated climate grids from the Tyndall Centre for Climate Change Research, Norwich, UK. For details <http://indiawaterportal.org/mapguide/MetDist/nonGis1.jsp>)

Precipitation

Most parts of the state receive very heavy rainfall from the south-west monsoons from early July to the end of September. However, at the same time, rain-shadow areas of the main Himalayas receive very little rain. Annual rainfall ranges from 92 to 237 cm in different parts of the state (Table 1), with an average of about 1700 mm yr⁻¹ for the state. The monsoon remains active over hardly 100 days. The average volume of water received annually from rainfall is approximately 9.46 Mha-m (94.62 bcm). Of this, 17.5% is lost as evaporation, 29.55% is absorbed into the soils, 15.46% infiltrates into the ground water and 37.5% ends up in rivers. The steep slopes are prone to constant erosion, and an obvious loss of fertility.

According to the water policy of Uttarakhand, 3% of the state's annual rainfall is sufficient to meet the total demand for all purposes. Yet the shortage of water continues across all districts.

Rural Livelihoods in Uttarakhand

The socio-economic structure of rural communities in the state is defined by a simple subsistence economy,

mainly focused on self-consumption. Disadvantages and risks are high, due to fragile environmental conditions: high rates of erosion, constant threat of landslides and landslips during the rains, and an almost complete dependence on rainfed agriculture. Survival depends on constant physical labour, i.e. cultivating the steep slopes, fetching fodder, thatch and fibre grasses, fuel wood and water, taking produce to the market, etc. This is compounded by the fact that almost 40% of the villages in the state have no access to roads and the population living there relies on walking or animal power for all livelihood needs and services.

However, the unique and varied eco-regions which have developed due to the varied physiography and soils, have given rise to numerous micro-ecosystems in which biological diversity thrives. Over time humans developed varied agro-ecosystems in the many different hydro-geological niches of the region, and this diversity in both crops and cropping techniques creates a system of high resilience, well suited to the difficult mountain conditions. Diversity is further maintained by traditional crop rotations and fallowing practices which vary with altitude, irrigation conditions, moisture regime, soil type, degree and direction of slope, and local knowledge. In Garhwal, a predominantly rice-wheat

rotation is followed over most irrigated fields, while a rice-millet-wheat sequence is adopted in some villages. Against this mono-cultural uniformity on irrigated land, crop rotations on largely un-irrigated, rainfed areas are very diverse. Cereals, pulses, millets, oilseeds, pseudo-cereals, beans, vegetables fruits and spices abound. By sowing shallow and deep rooted species together, farmers optimize the usage of soil moisture. Rainfed areas are also usually agro-forestry zones, with grasses, bushes, trees and livestock all part of the system.

Forests

Forests in the regions are intricately linked to the lives and livelihoods of local inhabitants, providing timber, fuel wood, fodder and various non-timber forest products (fruit, honey, silk, lichens and mosses for sale,

medicinal and aromatic plants etc). It is this subsidy provided to the state's large rural population by the forests that allows their survival in this un-irrigated rough terrain.

Uttarakhand has over 60% of its total land area under forests. The distribution of this land across the various districts is however, irregular. Simply put, the districts which are most remote have the highest, surviving forest cover. Uttarkashi, Tehri Garhwal and Pauri Garhwal have the highest percentage forest cover in the state. These are also amongst the most remote and disadvantaged districts where human pressure on forests is also the maximum. The districts in the foothills and valleys - Dehradun, Haridwar and U.S. Nagar - have minimal forest cover, and also have the most urbanization, industry and agriculture (Figure 1).

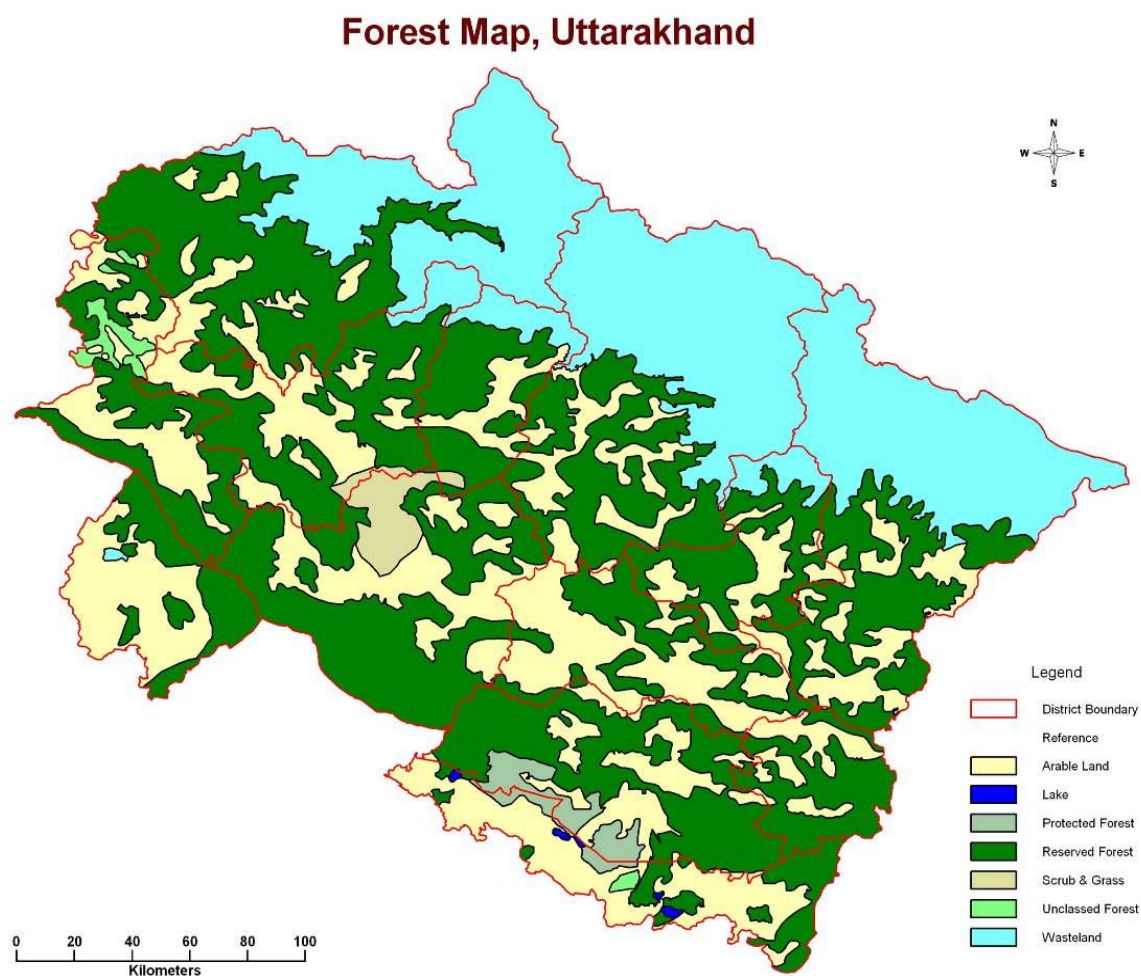


Figure 1. Distribution of forest cover in Uttarakhand

There is great variation in the types of forests in Uttarakhand. Major forest zones are (Kumar and Ram 2005):

Tropical-Subtropical Forest zone: dominated by deciduous, sub-deciduous species. Sal is the most dominant species found up to an elevation of about 1300 m. Other prominent species are Khair, Semal, Kanju, Sissoo and Haldu.

Subtropical-Temperate zone: Pine forests dominate this zone, with chir pine as the dominant tree, and subtropical to temperate shrubs dominate at elevations between 900 and 2100 m.

Temperate-Subalpine zone: extends between 1500 and 3300 m and is dominated by mixed coniferous forests of fir, spruce and birch.

Alpine forests and shrubs: found up to a height of 4200 m. With increasing altitude a gradual transition from larger trees to smaller bushes and alpine pastures can be observed, beyond which there is usually a complete lack of vegetal cover.

According to the State Forest Report (SFR) 2003, published by the Forest Survey of India, actual forest cover in the state is only 24.47 lakh ha, which constitutes 45.74% of the total geographical area. Of the total forest cover, 'very dense forest' are 4.0 lakh (16%), 'moderately dense' are 14.42 lakh (or 59%), and 'open forest' are 6.04 lakh ha (25%). However, area classified as forest by the state is technically 34.66 lakh ha. This area is managed by different institutions: the Forest Department, Revenue Department, Van Panchayats, privately, as municipal and cantonment forests, and in many other categories. The total area managed by the State's Forest Department is 23.99 lakh ha, i.e., about 44% of the total geographical area. This area is further classified as Reserved (23.8 lakh ha), Protected (0.10 lakh ha) and unclassified forest (0.06 lakh ha). The per capita availability of forest area in the state is 0.49 ha, as against a national average of 0.09 ha.

Van Panchayats (total number 12,067) manage about 5.22 lakh ha of forests area, and individuals are entitled to usufructary rights. The district wise details of forests managed by Van Panchayats (as on March 2005) are given in Table 2.

Table 2. District wise Van Panchayats in Uttarakhand:

District	No. of Villages	No. of Van Panchayats	Area ha	Total Fund (in lakh Rs)
Almora	2248	2199	69853	414.00
Bageshwar	910	822	38783	126.85
Chamoli	1256	1082	188355	57.89
Champawat	688	629	31233	4.38
Dehradun	746	215	7659	0.00
Pauri	23485	2431	52814	12.57
Nainital	530	496	28068	88.05
Pithoragarh	1638	1666	87054	16.47
Rudrapur	680	574	20702	5.18
Tehri	1778	1332	13180	0.00
Uttarkashi	677	643	7265	6.64
Total	14,636	12,089	544964	732.04

from Uttaranchal Van Panchayat Atlas 2006.

Hydrology, Water Availability and Traditional Water Management Systems

Hydrologically Uttarakhand is a typical mountainous system. Precipitation takes the form of rain, sleet and hail in the valleys and lower reaches, while it falls as snow in the higher reaches. Glaciers in the Himalayan ranges give rise to large rivers such as the Ganga, Yamuna and Kali. Rainfed seasonal rivers (Sitla, Swarna, Tons, Nun, Bindal, Kans, Rau, Asan etc.) drain the lower Himalayan and Shivalik ranges. Most rivers are known for their flash floods which cause high levels of erosion, and damage crop and villages mainly in the districts of Haridwar and Udham Singh Nagar. Non-glacial rivers originating from springs and ground water sources (the Khoh, Ramganga, Kosi, Gola and Nandhaur) are also common in the Lesser Himalaya.

Glaciers melt naturally during the summer and under stable climatic conditions. Ice lost through melting is replenished by winter precipitation in the form of snow. However, in many of the higher arid and semi-arid areas, people are dependent not only on the amount of glacier melt water but on the timing of the water flow. The water has to be available at critical times for irrigation. Snow-pack and glaciers provide a buffer between when the precipitation falls as snow and is released as water. The melt season is often the warmest, driest time of the year, providing large volumes of runoff for irrigation when it is most needed. However, snowfall is gradually decreasing and the

warmer summer temperatures are causing the glaciers to retreat.

In the higher reaches, there are many gads and gadheras (mountain streams) which earlier used to flaunt an abundance of water throughout the year. As a consequence, a variety of water harvesting structures arose within different socio-ecological settings, mainly for domestic use. Often well-to-do land owners would build the physical structure and the source was then managed by the community. Water for household use was, and continues to be obtained from springs, flowing mountain streams or built rainwater harvesting structures. Open water bodies, such as ponds, masonry tanks, chappris, chaals or talaais, provide water. For domestic consumption, people prefer to harvest below-ground seepages (naulas) or tap springs (dharas).

Traditionally, water management at the household level has been a woman's task. Sources in the mountains usually lie at considerable distance from habitations and women spend 2 to 4 hours a day collecting and carrying water to and fro. In many villages they spend up to 8 hours a day. Estimates show that on an average, a hill woman walks over 3000 km in a year. Apart from the labour and time spent, the carrying of heavy loads over long rough and difficult terrain cause numerous physical and health issues, which plague women in the mountains.

Changing Water Availability in the State

Since India's independence in 1947, various interventions of the government to provide water to remote villages have led to a decline in the creation and management of traditional water harvesting structures, impacting huge areas adversely. At the same time, ground water abstraction has increased, though often badly placed hand pumps quickly become seasonal. Deep water aquifers are tapped only in the plains below the foothills. Lakes, wetlands and marshy areas rarely provide water for irrigation, though almost all such areas are used for livestock grazing and for collecting a variety of natural produce such as fodder and thatch.

At present, 11 of the 13 districts in Uttarakhand face regular water shortage, particularly of drinking water. The other two districts in the foothills have ample groundwater sources. Though numerous water supply schemes have been created in the mountains, many stop functioning within a few years of construction, falling into disuse and disrepair.

In spite of the fact that the Yamuna and Ganga, the two major rivers of the country have their origin in

the state, there is increasingly a shortage of drinking water. Springs and streams are drying up and the hydrological patterns in mountain regions are changing. The dependence on traditional methods of water conservation is increasing. Many schemes have become defunct due to depleting water sources, coupled with population shifts. Their rehabilitation or replacement requires considerable capital investment. By government statistics, in 2006 there were 17,948 habitations (villages and hamlets) including those in the Not Covered and Partially Covered (NC/PC) categories that had to be provided with water supply.

Scales in Mountain Hydrology

It is often argued that anthropogenic activities by local inhabitants are damaging the mountains hydrological systems. Although it seems obvious that deforestation and other such activities cause landslides, siltation, etc. which result in floods and associated damages downstream, this reasoning is more defined by scale. It is suggested that the effects of local populations in the mountains must be insignificant in comparison to the large scale geophysical processes ongoing in the area (Carson 1985, Hamilton 1987). A report on Indian floods states that in sections of the Alaknanda valley, seven to ten landslides can be found per 100 ha of land (CSE 1991). The effect of very low temperatures, freezing and melting of ice in the cracks of rocks and mountain crevices causes shattering and rockfalls. the 1970 flood in the Alaknanda valley, and that in 1978 in the Bhagirathi were the result of heavy rainfall events - enormous volumes of water bringing down masses of rock and soil over a very short time period, blocking and changing existing flow patterns. The steep slopes and narrow valleys are prime areas for disasters, which may have impacts far downstream (Wasson et al. 2008).

Upland reforestation therefore may not exert any control over downstream floods and associated disasters. However, if viewed from a larger perspective, this issue is largely a matter of scale and historical perspective (Ives et al. 1987, Lovell et al. 2002, Negi 2002). Different physical processes which impact hydrology, dominate at different scales. For example, hill slope runoff processes may dominate at the sub-catchment scale, the channel network geometry becomes important in mid/meso-scale basins (up to the order of 100 km²) while in larger basins the spatial variability of precipitation becomes important (Gupta and Dawdy 1995, Negi 2002).

An extensive review of hydrological studies in the Himalayan region shows that vegetation and land use practices exert clear positive influences on total water yield and timing of stream flows in catchment areas of less than 500 km² beyond which the effects disappear. Secondly, the conversion of forest to agriculture increases the total water yield, which may increase or decrease dry season flows, depending on soil characteristics, and finally, that reforestation degraded lands with fast-growing trees (which consume large volumes of water and also contribute to high evapotranspiration) leads to reduced total and dry season flows (Bruijnzeel and Bremmer 1989). This study goes on to state that the definition of scale in mountain hydrology is all important. At a local level (microscale) sediment load is strongly affected by human activity, stream discharge characteristics much less. At the meso-scale, downstream of the catchment being impacted, it is higher. At the macro-level in large basins, human impact in the upper catchment is but one factor and may have insignificant impact on lowland floods, low flows, and sediment (Bruijnzeel and Bremmer 1989).

THE WATERSHED CONCEPT

In Uttarakhand, large sections of uncultivated, denuded common lands usually comprise of the upper section of the watersheds. Rehabilitating these lands implies protecting them, a cost which is paid for by the rural poor. Benefits of this protection usually accrue downstream to wealthier families who own lands in the irrigated valleys. Overtime however, rehabilitating lands makes them more productive, benefiting the people who use them; and therefore, watershed projects usually work around this issue by providing employment to the landless and poor for the first 2-3 years it takes to rehabilitate common lands. Furthermore, due to uneven distribution of benefits, projects focus on developing institutional mechanisms to ensure that all parties benefit. Despite efforts, if those living in the upper catchment lose essential necessities, or face additional hardships to increase flows which eventually benefit downstream users, without direct compensation, their partnership in the project is lost, and the result, inevitably is a failed project. Watershed projects in India, particularly over the past few years have been showing fewer results, and one of the major reasons appears to be delayed, uneven distribution of benefits (Govt of India 1994a, Kerr 2002, Kerr et al. 1996).

Within watersheds too there are different users,

with multiple objectives. Often these functions of water are mutually incompatible, and any one use may impact another potential usage. This necessitates localized, village specific interventions. Projects therefore often operate at the level of a micro-watershed within one, or a few neighbouring villages, focusing on conserving soil moisture for rainfed agriculture, recharging aquifers to augment groundwater irrigation and capturing surface water into small ponds. In a good watershed programme therefore, activities attempt to manage hydrological relationships to optimize the use of natural resources for conservation, productivity, and poverty alleviation. And achieving this requires the coordinated management of multiple resources within the watershed, including forests, pastures, agricultural land, surface water and groundwater - all linked through hydrology.

Watershed Management

Watershed development has become an important component of many countries' rural development and natural resource management strategies. The World Bank, for example, invested \$1.73 billion in watershed development between 1990-2004 (World Bank 2007), and the Government of India spent over \$6 billion between 1996-2004 (World Resources Institute 2005). In developing countries watershed projects which focus on water harvesting and soil conservation typically state three objectives: firstly, to conserve and strengthen the natural resource base; secondly, to make natural resource-based activities like agriculture more productive, and finally, to support rural livelihoods to alleviate poverty. The first objective builds the foundation for the second, which in turn supports the third. Individual projects, however have different specific objectives depending upon local needs. For example, some watershed projects may be about protecting water quality and/ or flows, in others about flood control, water harvesting, or as is more common, about concentrating soil moisture to raise rainfed agricultural productivity. In virtually all watershed projects, soil conservation is either a specific objective or a means of achieving another objective.

Watershed Management in India

Although watershed development projects in India began over half a century ago in very simple form as soil and water conservation efforts (Pangare and Gondhalekar 1998), the big, recognized successes were

three efforts in the 1970s, namely Sukhomajiri, Ralegaon Siddhi and Pani Panchayat. All three were successful in turning dry wastelands productive, by linking soil conservation to water harvesting. Pani Panchayat and Sukhomajiri also demonstrated innovative village level institutional mechanisms in the sharing of costs and benefits within the community (Salunkhe 2000, Seckler 1986).

Following on the heels of these successes, the 1980s saw large scale watershed development programmes around the country that focused on poverty alleviation benefits and adopted technology used in the 1970s successes. However, these projects followed decades of top down agricultural development in the country, and as could be expected, were themselves top-down approaches with emphasis on technology and relatively little local knowledge and management abilities. Village level institutional arrangements which had been emphasized in the three early projects were largely ignored (Government of India 1990, World Bank 1990). Community participation usually implied the involvement of one or two key people from the village. As a result, across the country most of these projects gave little or no benefit in the long run (Farrington et. al. 1999, World Bank 1990). In effect, large-scale projects in the 1980s including the World Bank-supported Pilot Project on Watershed Development and the Model Watershed Program of the Indian Council of Agricultural Research, took a purely technocratic approach as the benefits of watershed development were assumed to be self-evident. The World Bank-supported pilot project operated at a vast scale of tens of thousands of hectares, with little effort to organize communities. Inevitably, results were slow, and project managers soon realized that collective focus and action to manage common pool resources was not easy to develop, especially when benefits were gradual, incremental, and unevenly distributed (World Bank 2007).

The consistent lack of results by these projects caused contemplation, and some changes - in terms of emphasis on increased local participation, increased use of local technologies, and increased conservation efforts (Farrington et al 1999, Hanumantha Rao 2000 and Hinchcliffe et al. 1999). NGO participation was re-structured, with small, independent projects trying to combine technical and institutional interventions. Some linked watershed development with other non-land based activities to take benefits to the poorest. MYRADA (Karnataka), Agha Khan Rural Support Programme (AKRSP in Gujarat) and the Social Centre

(Maharashtra) developed such programmes which focused on high risk groups aiming to build organizational skills (Fernandez 1994, Farrington and Lobo 1997).

In the 1990s several international agencies (DANIDA, EU, German Development Bank) began major programmes across the country, aiming to develop collaborations between the government and NGOs. European bilateral agencies including the Indo-British project in Karnataka and the Indo-German project in Maharashtra worked at scale. It is however variously stated that most benefits from these projects accrued to the better off families in the villages, and very few to the landless (Ninan 1998). Also in the 1990s, the Government of India stepped up with new and changed policies. The new policies (1994 guidelines of the Ministry of Rural Development) devolved power, promoted local techniques and recognized NGOs as implementing partners. It gave village level institutions (VLIs) independence in designing and developing their own watershed programmes, and to obtain assistance from NGOs rather than government line departments. It focused on strengthening VLIs for collective action, and provided funds for indirect activities.

The Ministry of Agriculture however recognized these guidelines only in 2000. Under the new guidelines as many as 10,000 watershed projects under the Drought Prone Areas Programme (DPAP) were launched across the country post-1995. The fact that the policy does not protect the poorest from paying for benefits which accrue to the better off households has been discussed by Shah (2001). However, many studies report that the programme created higher crop yields, increased crop intensity, increase in employment and stability and reduced emigration (Rao 2000). Rao concludes that a direct indication of soil and water conservation is not possible from the various evaluations present, except indirectly as can be inferred from increased yields. Therefore, indicators and methods for gauging improved soil status are required.

Watershed Management in Uttarakhand

In Uttarakhand, numerous resources of a watershed, such as pastures, forests and water sources, are often a common property. Other resources tend to be managed individually, especially agricultural land. The hydrological linkages among all these resources in a watershed necessitate collective action amongst all users to manage them for maximum productivity. However, watershed is not a natural unit of human social

organization (Rhoades 1999, Swallow et al. 2001), and the hydrological linkages among different parts of a watershed are often not visible beyond very small scales. As a result, self-organization among watershed users is unlikely beyond the smallest watersheds. In Uttarakhand specifically, it is not possible to examine either clear impacts, or watershed governance outside the context of a specific project or management effort.

As mentioned earlier, the land is prone to erosion and land slides which block river valleys, creating temporary dams. Such a landslide-created lake on the Alaknanda river in 1970, burst later after intense rainfall in the upper catchment causing severe damage in the villages downstream and loss of human lives. After another devastating flood in August 1978 on the Bhagirathi river, a high level Working Group for flood control in the Ganga-Yamuna Basin was constituted to study causes, and to suggest remedial measures. On the recommendation of this group (1979) the government decided to treat the watershed regions of the major rivers of the upper Ganga basin. In November 1981, the Forest Department of the then Uttar Pradesh State developed a plan for treating the northern regions (now in Uttarakhand). As a result, in March 1982, a Watershed Management Directorate was established by the state government to carry out works in an 'integrated manner' on the basis of watershed regions. These were tasks till then performed by various other minor departments. Through this Directorate it was proposed to gradually treat the entire mountain region on the basis of mini-watershed units, under which state, district and regional units were approved to carry out soil and water conservation work. Two large projects were initiated in the region during this period, the South Bhagirathi Phase – I, an EEC backed, five year (1982-88) project, and the World Bank's Integrated Watershed Management Project (1983-92), both implemented by line departments of the state government. With the creation of Uttarakhand State in 2000, the Watershed Management Directorate (WMD) was re-established in 2005. Apart from co-ordination, operation, evaluation and monitoring of watershed projects, the Directorate is the nodal department for all projects related to watershed management. The WMD develops proposals as per the need of the state, and once funded, implements the programmes. Some such programmes have been under the integrated Wasteland Development Programme (IWDP), Drought Prone Area Programme (DPAP) and the National Watershed Development Project based on Rain (NWDPR) (Table 3).

Until the late 1980s, work on watershed management in Uttarakhand progressed in a piecemeal manner; physical works along the same slope would not necessarily be connected hydrologically, upstream use was not necessarily linked to downstream scarcity. It was only in the late 1980s to early 1990s that the watershed concept of water conservation began to be used and watersheds began to be treated as single, holistic units. A wide variety of donors and development agencies including the central government, state government, the World Bank and bilateral assistance programmes with different NGOs promoted watershed development. In Uttarakhand these imply a few large, state level government projects, and numerous smaller projects being implemented by NGOs. A few non-governmental programmes are also coordinated between several NGOs (SRTT 2008). Almost all projects in the state involve NGOs for implementing activities at the village level.

Government programs in the state learnt lessons from their earlier failures, and new programs in the 1990s aimed to incorporate required changes. The Integrated Watershed Development Project (IWDP) attempts to identify the conditions associated with successful common resource management. The issue of reliance of the rural poor on common lands and the reasons for their declining area and productivity was highlighted by Jodha (1992). Though the IWDP still operates in very large watersheds covering tens of thousands of hectares, for operational purposes it is divided into smaller micro-watersheds with more distinguishable boundaries. User committees are established to represent different interest groups in the watersheds and are given powers to make rules; system of graduated sanctions was established based on traditional institutions; and monitoring systems were established.

The new institutions were however established on shaky foundations. Committees sometimes existed in name only; systems of graduated sanctions were established based on traditional institutions; and monitoring systems were put in place (Kerr and Pender 1996).

Under the IDA/IBRD-financed Integrated Watershed Development Project (1999-2005), 0.04 million ha of watershed area was treated by the state government. According to state estimates, outputs showed considerable increase in agriculture, floriculture, horticulture, animal husbandry, irrigation through water harvesting structures, tanks and minor irrigation projects. The beneficiaries' incomes reportedly rose by 38 percent. The IWDP had three main components.

Table 3. A timeline for the evolution of the watershed concept in the region of Uttarakhand, India

Time Period	Event/ Incident/ Issue	Details
1875-1947 Pre-independence colonial rule	Transformation of a traditional forest cum agrarian subsistence ecosystem into a supply zone of raw material under British rule.	The government attempted to gain total access to forest resources and reduced or divested local communities of ownership of common resources. They deliberately promoted individuals rather than communities, causing the failure of traditional societal control mechanisms. The introduction of commercial crops – tea, apples, potatoes, etc. and clear cutting of forests began. At the same time rail and road links were enhanced in the region, while the recruitment of young men into the army began.
1947 Post- independence, self rule	Agriculture development given top priority.	Schemes introduced in the country's 5-year plans focused on institutional and infrastructure initiatives including drinking water, health, irrigation development, agriculture. Shift to HYV fertilizer based agriculture. Jamindari Abolition Acts led to the redistribution of land, which had mixed impacts in traditionally managed community lands in the state.
	Government interventions on forest and common lands management	Numerous government initiated interventions under social forestry programmes increased plantations on degraded village forests.
	Numerous forest legislations passed	Various rules and regulations of the FD sat heavily upon local, traditional systems of management, and contributed to the loss of sustainable management systems.
1958	SCU set up in Tehri town	A Soil Conservation Unit set up in the town of Tehri.
1962	Indo-China war along the borders of the present state	The war led to improved border roads in rural regions and increased employment for local men in the army. However, centuries old trade routes in the high altitudes and remote alpine regions till Tibet were blocked and all trade ceased, causing a major shift in the regions economy, and increased migration of able bodied men. Traditional trade had mainly functioned in medicinal plants, salt, oils, gems, fibre and forest products.
1970-73	Alaknanda river floods	The floods, caused by the bursting of a lake created by landslides, devastate downstream regions and take many lives
1973	Chipko Andolan initiated	Women cling to trees to stop their cutting.
1978	Bhagirath river floods	Devastation downstream caused the constitution of a high level Working Group by the Government of India for flood control in Ganga – Yamuna basin. Recommendations led to a number of initiatives, inserted into the Sixth Five Year Plan The Land Survey Directorate was created at Dehradun, which mapped the watersheds of Uttarakhand in detail
1979	Submission of recommendation report by the Central Working Group	
1981	Presentation of the 'Overall Development Plan' by the Forest Department of the erstwhile UP state	Decision of the forest department of the erstwhile UP government to get work done on the basis of watershed areas through a 'multi-disciplinary force' under an administrative authority in an integrated manner in mountain areas based on the overall plan. Decision to treat the entire mountain region on the basis of micro-watersheds Establishment of Watershed Management Directorate at state level, financed by an EEC project The directorate begins work on 1103 identified watersheds across the state, on a priority basis.

Time Period	Event/ Incident/ Issue	Details
1980	Ban on clear cutting of forests in the mountain regions above 1000m altitude	Around this time the watershed was being recognized as <i>the</i> unit of work for all national agencies of the country.
	First ever integrated WSD projects initiated as 3 major WSD programmes in Uttaranchal state	IWMP: in Flood Prone River Valleys HWMP: in the Nayar and Saryu watersheds and Panar South WS South Bhagirathi Project
1982-88	South Bhagirathi Phase- I Project financed by the European Economic Community (EEC).	District Tehri Garhwal (6 MWS), 172 sq.km., Expenditure – Rs. 6.46 crore, Execution through line departments
1983-92	Himalayan integrated Watershed Management Project financed by the World Bank	Districts Pauri and Almora (75 MWS), 2867 sq. km., Expenditure – Rs. 80.49 crore, Execution – through line departments upto the year 1987-88
1986	NWDPPA initiated	National Watershed Development Programme for Rainfed Areas initiated
1988	Policy on Eco-development initiated	After the mid term review of the Himalayan Integrated Watershed Management Project, execution of the project by the project by the project administration under the “Unified Command
1988-96	South Bhagirathi Phase II initiated	South Bhagirathi Phase II financed by the EEC, Area – District Tehri Garhwal (18 MWS), 356 sq. km., Expenditure – Rs. 19.56 crore, Execution – by the project administration under the Unified command
1990	India's 8 th Five Year Plan	A series of WSD programmes launched across the country
1991-98	Bhimtal Project financed by the EEC	District Nainital (8 MWS), 216 sq.km., 1991-1998, Expenditure – Rs. 12.68 crore, Execution by the project administration under the Unified command
1992-93	HARC	Farmers trainings in watershed training activities initiated
1993-2001	Doon Valley Watershed Management Project financed by the EEC	District Dehradun, Tehri and Nainital (62 MWS), 2408 sqkm, expenditure Rs.102.12 crore, Execution by project administration under Unified command. Construction, implementation and evaluation of rural schemes at village level. Implementation of works on basis of community participation, Constitution of Gram Resource Management Association (GARIMA) and self help groups, Village Resource Management Plan for sustainability of created assets.
1996	CAPART, Government of India	Programme for involving Voluntary Organisations (VOs) for watershed development initiated. Small scale projects up to 1000ha. CAPART establishes PSI as a training and support VO
1997	An NGO – Peoples Science Institute, Dehradun started training for the first batch of VOs funded by CAPART on watershed development projects.	Approx 1000 ha each. 5 organisations. SBMA, SMTA, Gomti Jan Kaliaan Vikas Parishad, Disha, UIRDC, (Uttaranchal Integrated Rural Development and Youth Centre)
1999-2005	Integrated Watershed Development Project (IWDP) initiated	Districts Pauri, Udham Singh Nagar and Nainital (24 MWS), 1573 sq km, expenditure Rs. 189 crore. Planning, implementation and evaluation of rural schemes at village level, Implementation of project works on the basis of Community participation, Constitution of Gram Resource Management Association (GARIMA) and self help groups, Village Resource Management Plan for sustainability of created assets, Beneficiary contribution also. NGO involvement and VLI strengthening. Income generation and micro enterprises encouraged. Numerous NGOs joined the project, implementing it across the state. WB funded

Time Period	Event/ Incident/ Issue	Details
2000	The state of Uttarakhand is formed, breaking off from Uttar Pradesh	
2004-2011	The Uttaranchal Decentralized Watershed Development Project (UDWDP)	Again, many NGOs are part of the programme, through some from the first phase dropped out
2003-2012	IFAD or the Ageevika Project funded by the WB	8 year livelihood project
2002-2007	SRTT Watershed Initiative Phase I	
2008-2011	SRTT Watershed Initiative Phase II	

Data compiled from different sources, including from the WSD site, UK

The first financed participatory watershed development and management by promoting social mobilization and community-driven planning at the village level. In addition to the government staff, NGOs were involved in the participatory planning. This component was also to promote transparency by providing a budget to each village, to be used to prioritize, implement, operate and maintain village development and watershed investments. The second component would fund initiatives to enhance livelihood opportunities to farmers, including improved technologies and practices for agriculture and horticulture, and the creation of a pilot agribusiness fund to identify and develop opportunities. This component would also fund small income-generating micro-enterprise activities and training, specially for the vulnerable groups, such as seasonal workers, women and landless farmers.

The Uttaranchal Decentralized Watershed Development Project (UDWDP) (2004 - 2011) was aimed at expanding the coverage of successful practices as learnt from the previous project, so as to cover about 300,000 ha in the middle Himalaya (700 to 2000 m above sea level). The project has a US\$ 69.6 million interest-free credit from the International Development Association that carries a 0.75 service charge, 10-years grace period and a 35-year maturity. The project itself involves the promotion of social mobilization and community driven decision making, participatory watershed development and management, enhancing livelihood opportunities through farming systems improvement, value addition and marketing support and income generating activities for vulnerable groups, and institutional strengthening involving the capacity building of Gram Panchayats (GPs) and local community institutions and information, education and

communication. The project aims to benefit the populations of about 461 Gram Panchayats spread across 18 blocks of the state, in 11 hill districts in the Garhwal and Kumaon regions, in a phased manner. It will cover about 9200 villages.

The responsibility of the implementation, coordination and monitoring lies with the Watershed Management Directorate, under the Chief Project Director. There are Project Directors of various divisions, Deputy Project Directors, and Multi-disciplinary teams in the target districts and blocks. NGOs are recruited to help in implementation and monitoring. The project is in its 5th year, and is now in the process of building micro-finance and market linkages for its established communities. Although in its first few years, the project was said to have presented a dynamic approach, various issues have apparently slowed down results and impacts, including a high project staff turnover.

NGO Efforts

NGOs evolved in India soon after independence. Disillusionment with the state of government-run development gave a fillip to natural resource management initiatives headed by communities, or the concept of CBNRM (Community Based Natural Resource Management). The Chipko Andolan (movement) in Chamoli district of Garhwal showed the need for a more decentralized decision making process (Kothari 1989). Studies suggested that a centralized state-led natural resource development programme ignored local cultures and systems and often led to inept projects. Hence, NGOs stepped in across the country to organize communities around various activities related with

conservation, irrigation and agricultural systems, using a variety of methods. Community and community development was the focus and became the way to get the development to reach remote rural regions. In Uttarakhand, Gandhian idealism and ecological thinking led the process. In the late 1980s and 1990s watershed programmes began, becoming more participatory in the late 1990s. As mentioned earlier, NGOs worked through different programmes, trying to replicate the success of Sukhomajiri and Ralegaon Siddhi. Activities involved the same basic issues of soil conservation, irrigation, agricultural activities, agro-forestry etc. Many NGOs began work in the area of watershed conservation in the state in the 1980s and 1990s, including the DVS (Doodhatoli Vikas Sansthan), PSI (People's Science Institute), CHIRAG (Central Himalayan Rural Action Group), INHERE (Institute of Himalayan Environmental Research and Education), SBMA (Sri Bhuvneshwari Mahila Ashram), HESCO (Himalayan Environmental Studies and Conservation Organization), and HARC (Himalayan Action Research Centre). These organizations began the first wave of implementation of the watershed concept in the state. Later, by the 1990s a host of other organizations joined the work, either through government hosted programmes or through individual grants. The NGOs have been involved with different kinds of programs, variously titled as watershed or livelihood projects, and Government funded programmes which are state or centre driven.

Research Institutes

Amongst the institutes working on various aspects of watershed management, the Central Soil and Water Research and Training Institute (CSWRTI), Dehradun, and the G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, have made significant contributions. The CSWRTI was among the first organizations in the state to begin work on a watershed basis in the region. They started with 42 experimental watersheds in the 1960s, and successfully worked on the sedimentation of Sukhna Lake (Chandigarh) in 1974. They also developed watershed strategies for the famous Sukhomairi village in Haryana. Their extensive work covered issues of soil loss under different conditions, on agriculture and forestry options and on water run off. Their initial success stories in Sukhomajri, Fakot, etc. paved the way for the launch of the larger, government-backed projects. Their work extends to the recharging of aquifers through integrated watershed

management and on developing crop resistance to drought conditions. They are also the largest training centre for soil and water conservation in the state. The G. B. Pant Institute of Himalayan Environment and Development focuses on evolving integrated management strategies for the conservation of natural resources in the region. They focus on hydro-ecological studies of the region, and have contributed considerably to the understanding of watershed systems in the central Himalayan region.

CONCLUSIONS

Why Isn't it Working: Institutional Sustainability and Stable Leadership

The projects implemented over the past decade or so have not yielded the expected impacts. It can be safely assumed that each watershed in Uttarakhand has hosted at least one project, and more commonly two to three. Many watersheds have hosted up to seven or eight projects, under various aliases, though all are linked to the watershed concept. They are also linked to different state department schemes funding activities of similar nature. Results are vastly disproportionate to the financial and technical inputs into the programme. And successes are usually isolated, often seen in small, micro-watersheds with naturally good water harvesting conditions. Benefits are slow, gradual, incremental, unevenly distributed and often have no apparent linkage to investments. Upstream-downstream linkages are part of the problem. For example, grazing in upper catchments, as against protecting them for regeneration to support downstream irrigation, is common, and invariably a complicated issue to solve. A project using incentive-based mechanisms (IBMs) was completed in neighbouring Himachal Pradesh a few years ago by an international NGO. The programme saw partial success and is unlikely to sustain beyond the project period. Clearly, if benefits are large and mature quickly, short-term losers are willing to wait for gains, and devising mechanisms to diffuse costs may be manageable. But this is difficult, even impossible in the majority of cases where benefits are gradual and incremental. In Uttarakhand where rainfall is good, vegetative regeneration takes about three years - too long a period to ask poor people to refrain from using resources they need.

At the country level, Kerr et al. (2002) found that NGO-government collaborative projects performed the

best, followed by purely NGO projects, and lastly by the first generation government projects. The projects with an NGO component had a strong social organization focus that dealt specifically with the uneven distribution of benefits and costs, and they operated in smaller watersheds within a single village. On the other hand, government projects were solely technocratic, operated in multiple-village watersheds and performed the worst. Success by the projects with an NGO component came in the form of reduced soil erosion, higher crop income, improved management of common pastures, more employment and increased irrigation. Kerr et al. (2003) cautioned that the successful cases were consistently in small micro-watersheds and did not operate widely, with no evidence they could replicate substantially or operate in larger scale watersheds.

However, the work of NGOs is becoming all encompassing. NGOs are not only directly implementing their own integrated rural development programmes with funds from different sources but are also collaborating extensively with state agencies in implementing components of many of the government-defined sectoral programmes. The revival of traditional systems is usually NGO-promoted, often with state assent (Menon et al. 2007). It is expected and assumed that the NGO involvement ensures community participation and good results are the reason that the state is willing to collaborate with groups to which they may have been hitherto antagonistic. NGOs on the other hand feel that collaborating with the state will help them scale-up their impact beyond the small projects. Therefore, the NGOs in Uttarakhand are now at the centre of community-based activities (Menon et al. 2007) to the extent that many have become irreplaceable. This is borne out by the fact that activities often collapse soon after the lapse of the project period. The fact is that true sustainability is not being built into the system.

Furthermore in India, recent hydrological research suggests that watershed projects may be exacerbating precisely the water shortages they aim to overcome. At the macro-watershed level, Batchelor et al. (2003) document cases where water harvesting in upper watersheds reduced water availability downstream. Calder et al. (2006) refer to this as 'catchment closure' whereby water harvesting upstream concentrates groundwater locally and then intensive pumping exhausts the shallow aquifer. Thus, watershed development prevents both surface runoff and groundwater from moving naturally downstream. It suggests two perverse project outcomes: first, what is

good for one micro-watershed can be bad for others downstream, and second, what is good for a watershed in the short term can be bad in the long term.

There are more examples of inaccurate understanding of technical relationships in watersheds. One example is the faulty assumption regarding the role of trees in watershed hydrology. Trees are planted compulsively in watershed projects with the aim to promote groundwater recharge. However, most trees have precisely the opposite function because they are net consumers of water (Calder 2002). Similarly, soil scientists usually estimate landscape-wide erosion rates by extrapolating upward from experimental erosion plots. This assumes that all the watershed land would erode at the same rate, and all the eroding soil disappeared entirely from the watershed. In fact, most eroding soil simply moves from one part of a watershed to another (e.g. Swallow et al. 2001). Many downhill farmers actually benefit from soil and silt deposition on their land (Chambers 1990).

At the same time changing livelihood patterns are taking a toll on present ecological systems. Over the last two decades rapidly increasing tourism has begun to show negative impacts on Uttarakhand's environment. A study of a Himalayan Tourism Center, Manali in the neighbouring Himachal Pradesh, states that between 1971 and 1995, the overall Ecological Footprint of Manali town increased by over 450%, from 2102 to 9665 ha (Cole and Sinclair 2002). This implies that the Ecological Footprint of Manali town is now 25 times greater than its size, and the town is increasingly dependent upon outside ecosystems for sustenance. This is particularly true for its water resources, which are used in abundance and are also polluted though the discharge of untreated wastes. The same streams are used by downstream villages and towns, and ultimately reach the plains. Numerous similar towns, and even villages, are rapidly changing the Himalayan landscape and spreading their need for water, fuel, timber, fodder and food across the rural landscape.

Programmes are, however, evolving with time. In most cases, watershed development programmes work in degraded watersheds, but indicators for degradation are not uniform. One such 3-yr-old watershed initiative by the Sir Ratan Tata Trust (SRTT) has now evolved from a soil and water conservation programme to a phase highlighting livelihoods (personal communication). This has happened as a response to both, stakeholder needs, and donor requirements. In another 5-yr-old water and sanitation programme which built pipelines from nearby streams up to the village, the

high rates of local forest degradation were realised only after three years. Project design was adapted after realizing that for a constant, base stream flow, watershed conservation was imperative. The project has now built in strict watershed conservation measures and pollution checks as also village management institutions buttressed by policies and governmental backing (SRTT, personal communication).

Such evolution in the design of projects results from learnings, more from failures than success, and leads to increasing awareness and understanding amongst the target population. Further, increased and systematic participation of agencies other than NGOs - the government departments, banks and village level institutions increases the degree of sustainability.

The experience of numerous watershed projects in Uttarakhand, through the existence of gaps between concept and implementation, the lack of field coordination and the genuine lack of understanding in the way project implementation translates into results in the field on a large scale, is common to numerous administrative programmes in many regions and countries. This is no way a unique experience. The negative is that the funds allotted to such programmes do not give the results and benefits expected of them, while the positives are the numerous lessons learned on which future programmes can be designed.

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