Incentive-based mechanisms in the hydro sector: CAT plans and beyond

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Citation:
Thadani, R. (2006) *Incentive-based mechanisms in the hydro sector: CAT plans and beyond.* Winrock International India, New Delhi, India, and International Institute for Environment and Development, London, UK.

Developing markets for watershed protection services and improved livelihoods

Based on evidence from a range of field sites the IIED project, 'Developing markets for watershed services and improved livelihoods' is generating debate on the potential role of markets for watershed services. Under this subset of markets for environmental services, downstream users of water compensate upstream land managers for activities that influence the quantity and quality of downstream water. The project purpose is to increase understanding of the potential role of market mechanisms in promoting the provision of watershed services for improving livelihoods in developing countries.

The project is funded by the UK Department for International Development (DFID).

Further information:
Further information on this Indian component is on: www.environmental-incentives.org and on http://www.winrockindia.org/nrm/ap_dmwps.htm. You can also contact Chetan Agarwal at chetan@winrockindia.org

Further information on the international project is on: www.iied.org/NR/forestry/projects/water.html. You can also contact Elaine Morrison at Elaine.Morrison@iied.org

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Acronyms and abbreviations

ACF	Assistant Conservator of Forests, an officer of the Indian Forest Service (IFS)
AISLUS	All India Soil and Land Use Survey
APO	Annual Plan of Operation
CA	Compensatory afforestation
CAMPA	Compensatory Afforestation Management and Planning Agency
CAT plan	Catchment area treatment plan
CEDAR	Centre for Ecology Development and Research
CEC	Central empowered committee
CF	Conservator of Forests (an officer of the IFS responsible for managing the forests and wildlife related issues of a Forest Circle. A CF is responsible for forests in several districts and typically has an area of 3000 to 8000sq kms under his jurisdiction.
CHIRAG	Central Himalayan Rural Action Group, a prominent NGO of Uttarakhand state
CISHME	Centre for Interdisciplinary Studies of Hill and Mountain Environment
CSWCRTI	Central Soil and Water Conservation Research Training Institute, Dehradun
DCF	Deputy Conservator of Forests, an Indian Forest Service officer of rank equivalent to a equivalent to a Divisional Forest Officer (DFO)
DPF	Demarcated Protected Forest
DFO	Divisional Forest Officer, an IFS officer in charge of a forest division
DPR	Detailed project report
EIA	Environment Impact Assessment
EMP	Environmental management plan
GBPIHED	G.B.Pant Institute of Himalayan Environment & Development, an autonomous institute under the Ministry of Environment and Forests
GIS	Geographic information system
GHNP	Great Himalayan National Park, a protected area notified in 1999, the GHNP is located in Kullu district of Himachal Pradesh
GoI	Government of India
HEP	Hydro-electric projects
HRT	Head Race Tunnel, a relatively flat and long tunnel connecting the water intake to the pressure shaft in HEPs with a high head
IAD	Impact Assessment Division
IBM	Incentive-based mechanism
ICIMOD	International Centre for Integrated Mountain Development
IIED	International Institute for Environment and Development (UK)
IIFM	Indian Institute of Forest Management, an Educational, Research, Training and Consultancy organization based in Bhopal, Madhya Pradesh
ISRO	Indian Space Research Organisation
IUFRO	International Union of Forest Research Organisations, a non-profit international network of forest scientists
IWRM	Integrated water resource management

JFM	Joint forest management
LPG	Liquefied Petroleum Gas, a mixture of hydrocarbon gases used as a fuel for heating or in vehicles
MLA	Member of Legislative Assemble, a representative elected by voters of an electoral district to the State Legislature
MoEF	Ministry of Environment and Forests
MOU	Memorandum of Understanding
NGO	Non-governmental organisation
NHPC	National Hydroelectric Power Corporation Limited, a Public Sector company owned by the Government of India
NJHEP	Nathpa Jhakri Hydro-Electric Power Project
NJPC	Nathpa Jhakri hydroelectric Project Corporation – the company was later renamed as the SJVN (Satluj Jal Vidyut Nigam Ltd)
NPV	Net present value
NTFP	Non-timber forest product
PES	Payment for ecosystem services
PMC	Project management cell
PMU	Project management unit
ppm	parts per million
PRA	Participatory rural appraisal
PSUs	Public Sector Undertakings, corporations where management control rests with the Government
SDR	Sediment delivery ratio
SPCB	State Pollution Control Board
SRTT	Sir Ratan Tata Trust
SWC	Soil and water conservation
TD	Timber distribution rights. In the state of Himachal Pradesh trees are sold at much below market prices to local people through TD rights.
TRT	Tail-race tunnel
USVWDS	Upper Satluj Valley Watershed Development Society
UT	Union territory
VLI	Village-level institution
WAPCOS	Water and Power Consultancy Services (India) Ltd, A public sector enterprise under the Ministry of Water Resources
WII	Winrock International India
WPS	Watershed protection services

Executive summary

The hydro-sector is witnessing a rapid growth in India, particularly in the Himalaya. While hydropower is considered by many as a clean source of energy it is both affected by, and impacts, local environmental quality. Since 1994, Environmental Impact Assessment (EIA) has been required for clearance to build hydro-electric projects (HEPs). In addition to the EIA report, the process mandates a public hearing, and environmental management plans (EMPs) designed to mitigate environmental damage and impacts of displacement. One of these plans is the catchment area treatment (CAT) plan which aims to improve the quality of environmental and especially watershed services from the catchment. Often the largest of the EMPs in terms of financial allocation, CAT plan preparation typically comprises 0.5-1% of the total project cost. This study aims to assess the efficacy of CAT plan preparation and implementation, and to look at the scope for devising incentive-based mechanisms around CAT plans to secure watershed protection and improve livelihoods. The Himalayan region, where much of the recent development of HEP is taking place, is the focus of this study.

This study indicates that the impact of CAT funds, in terms of reduction of silt and buffering of water flow, has been limited. While conceptually CAT plans are an excellent mechanism for payment for ecosystem services (PES) and should result in better quality of watershed services, HEPs have not so far benefited due to weak planning and implementation of these CAT plans.

Major problems with CAT plan conceptualisation and preparation include:

A. Lack of clear guidelines. While general directions exist, there is a lack of specific procedures:

    - There are no rules governing financial allocation and CAT funds are negotiated between the HEP promoter and forest department.

    - Institutional mechanisms for implementation are not discussed in the plan. Implementation mechanisms are left vague and at the discretion of the forest department.

    - Minimal competence criteria for the selection of a technical agency to make CAT plans are not defined.

B. The perception of CAT funds as a regulatory mechanism – a tax – rather than an effort to treat the upstream catchment and secure environmental and particularly watershed services.

C. Inadequate ground-truthing and understanding of ecological and socio-economic conditions by the technical agency that prepares the CAT plan. The agency is not involved in implementation or monitoring.

D. Excessive focus on civil structures and afforestation. Stand alone civil works are temporary measures to control silt and have little long-term impact unless supported by

green planting. A focus on tree planting leads to inadequate attention given to shrubs and grasses, which can more effectively meet the objectives of the CAT plan.

E. Weak coordination between the forest and environment sectors. While the EIA is conducted/overseen by the environment department, the CAT plan is implemented by the forest department. Mechanisms for coordination between departments are poorly developed. So much so that often no forest department official attends the public hearings.

These issues are further compounded by weak mechanisms for implementation. Major issues that hinder implementation include:

A. Diversion of CAT funds by the state government: CAT funds are deposited with the state treasury and often diverted for other purposes.

B. Late release of funds and poor utilisation: delayed fund release impacts work schedules and leads to poor execution of time (season) sensitive activities such as planting. Inability to use the large amount of funds released due to limited manpower and utilisation capability is also a problem.

C. Lack of 'additionality': CAT plan implementation is done by existing forest department staff and replaces routine work that would otherwise be done in the catchment.

D. Limited technical capacity: experts are rarely used for non-forestry interventions even though such technical expertise may be lacking in the implementing agency.

E. Lack of rigorous monitoring: There is no comprehensive monitoring of CAT plan implementation. When it occurs, it is inputs, predominantly, that are monitored and the impacts of CAT plans – increase in vegetation cover, decrease in erosion levels and silt loads, or changes in water flows – are not assessed.

F. Absence of involvement of local communities, other than for wage labour. This is a serious lacuna and the lack of incentives for local involvement hampers the efficacy of all actions.

While CAT plans may be viewed as a kind of payment for environmental service (PES) scheme, as hydro projects are paying for upstream conservation, there is an important lesson to be learnt. Typically, PES schemes are in the form of a transaction. In this case, where payments are mandated by law, the seller of the environmental service has no incentive to ensure good quality outputs, as payments are received regardless of benefit being generated and accruing to the buyer. However, in the current scenario, developing and enforcing performance criteria that are monitored by a third party may significantly improve the impact of CAT as well as likely mitigate the negative impacts of hydro projects on local ecology.

While addressing the above issues can lead to significant impact of CAT plans, the limitations of catchment treatment in the Himalaya need to be acknowledged. The Himalaya

have high base rates of erosion which cannot be stopped. Catastrophic events – such as cloudbursts, deep seated mass movements, or the breach of a glacial lake – cannot be controlled by catchment treatment. Also, natural buffering mechanisms make it difficult to detect the impact of catchment treatment when large catchments, above 500 sq km, are involved.

A critical area that needs to be addressed for CAT plans to have greater impact is the involvement of local communities. Legislation that prevents commercial timber extraction in the Himalaya has restricted silvicultural operations by the forest department, and it is local communities that are the biggest users of forest lands and natural resources. Excluding these communities from management plans for their catchments precludes successful implementation.

Recognition of some basic watershed management principles that have been developed through implementation of community-oriented watershed projects is advocated. These include acknowledging the local expertise of village-level institutions (VLIs) such as the panchayat, and involving them in implementation activities. In addition to villages within the catchment, inclusion of communities that depend on the catchment is important. These might be downstream villages who use catchment forests for their subsistence needs; pastoralists who regularly pass through the catchment; or NTFP collectors who visit each summer.

Activities need to be oriented to achieve the objective of CAT plans. Catchment treatment must identify and address the causes of high silt load. If degradation and increased erosion is caused by cattle grazing, then a community-based animal husbandry programme will have more impact than planting trees or building check dams. Management of existing lands is more important than attempting to convert land use. A well-managed agricultural field will lose less silt than a forest with a degraded understory. Grasslands can have lower silt yields than forests and will usually release more water for the HEP.

The creation of a dedicated project management unit at the catchment level is recommended, rather than giving additional responsibilities to an existing agency. Such a unit can have staff dedicated to CAT plan implementation and can draw upon expertise from a wide range of fields. A dedicated budget will prevent the dilution or diversion of funds. Such project management entities have already been experimented with by innovative forest officers and elements from these can be replicated and built on to institutionalise CAT plan implementation units.

Monitoring of outputs is also required to provide evidence of the efficacy of CAT plans. Community-based monitoring is an effective and low cost method to study the impacts of implementation and can provide valuable data on parameters such as silt flow, besides building community ownership of the programme. Such activities, which involve communities, increase their access to natural resources and their benefits from the implementation process are important incentives. Examples can include community-based decentralised nurseries instead of large centralised facilities, involving communities in forest protection and respecting their usufruct rights to allow for better control and management of resources.

Rather than treating degradation, catchment treatment plans must be designed to mitigate the impacts of agents that cause degradation. When local communities are responsible they must be included in finding solutions. This will lead to enhanced outputs of the CAT plan.

1. Introduction

Winrock International India (WII) is executing a project on 'Developing incentive-based mechanisms for watershed protection services and improved livelihoods in India' in collaboration with the International Institute for Environment and Development (IIED), UK. One component of this project is the commissioning of strategic research studies; this study looks at the applicability of incentive based mechanisms in the hydro-electric sector.

The hydro-electric sector is witnessing rapid growth in India, especially in the Himalayan states. Hydro-electric projects (HEPs) are dependent on the regular flow of clean water for efficient operation. The degradation of Himalayan watersheds results in increased silt flow which inhibits the functioning of the project.

Environmental impact assessment (EIA) has been mandatory for large HEPs since 1994. A series of plans, collectively known as the environment management plan (EMP) are implemented to alleviate environmental impacts caused by the HEP. One of these plans, the catchment area treatment (CAT) plan, works as a kind of payment for ecosystem service (PES). This plan aims at treating the catchment of the HEP in order to reduce silt flow and buffer peaks of water flow.

Conceptually the CAT plan represents an excellent opportunity to incorporate incentive-based mechanisms for upstream communities to increase their interest in catchment protection. This study aims to assess the efficacy of CAT plan preparation and implementation, and the scope for devising IBMs for securing watershed protection services (WPS) and improving livelihoods of upland communities.

1.1 Hydropower: status and future in India's energy scenario

Electric generation potential in India today stands at 123,463 MW. 66% of this capacity lies in thermal plants with coal-based power alone constituting over 63,000MW of capacity (55% of the total). Hydropower stands second with capacity in excess of 32,000MW (26% of India's total) (Government of India 2005).

India has a viable exploitable hydropower potential of 150,000 MW of which 78% is as yet open to exploitation (*National Policy on Hydro Power Development,* Government of India, 1998). While hydropower generation has been steadily rising, the share of hydropower has declined over the past four decades from 44% of India's electricity generation in 1970 to 25% in 1998. Globally, hydropower provides one-fifth of the electricity and is second only to fossil fuels. Worldwide capacity is 650,000 megawatts (MW), with almost 25% of this in the US and Canada.

1.1.1 Hydropower principles and types of dams

A HEP produces power from water that is moving with sufficient speed and volume to turn a generator. To increase the force of moving water, usually dams raise the water level, creating a "hydraulic head," or height differential. The energy released by water falling through this height differential is captured by channelling the water through a turbine which

converts the water's energy into mechanical power. The rotation of the water turbines is transferred to a generator which produces electricity. The amount of electricity which can be generated at a hydro-electric plant is dependant upon (a) the vertical distance through which the water falls, called the "head", and (b) the flow rate, measured as volume per unit time. The electricity produced is proportional to the product of the head and the rate of flow.

As a rough guide, the amount of electricity which can be generated can be calculated by:

POWER (kW) = 5.9 x WATER FLOW (m^3/sec) x HEAD (m)
There are two principle types of hydro plants – those that store water (dam type) and run-of-the-river.

A. Storage or dam-type HEPs: dams raise the water level of a stream or river to an elevation to create water pressure or "head." Dams may create secondary benefits such as flood control, recreation opportunities and water storage. These plants also have enough storage capacity to off-set seasonal fluctuations in water flow and provide a constant supply of electricity throughout the year. Large dams can store several years' worth of water.

B. Run-of-river plants: these facilities typically divert water from its natural channel. The water runs through a pipeline or a tunnel to a powerhouse to run through a turbine. The water thus used is usually returned to the channel downstream of the turbine. These plants use little, if any, stored water to provide water flow through the turbines. Although plants may store a few hours or days worth of water, weather changes (especially seasonal changes) cause run-of-river plants to experience significant fluctuations in power output. In Himachal Pradesh, which is the focus of this study, most new projects being constructed are of the run-of-the-river type.

'Pumped storage' is another form of hydro-electric power. Pumped storage facilities use excess electrical system capacity, generally available at night, to pump water from one reservoir to another reservoir at a higher elevation. During periods of peak electrical demand, water from the higher reservoir is released through turbines to the lower reservoir, and electricity is produced. Although pumped storage sites are not net producers of electricity – it actually takes more electricity to pump the water up than is recovered when it is released – they are a valuable addition to electricity supply systems. Their value is in their ability to store electricity for use at a later time when peak demands are occurring. Storage is even more valuable if intermittent sources of electricity (such as solar or wind) are hooked into a system.

1.1.2 Environmental impacts

HEPs have a high cost of initialisation, but thereafter lower running costs than thermal plants. They also have the advantage of not emitting any greenhouse gases and are hence considered 'environmentally friendly' in the macro sense. However, they can cause massive local environmental changes, and the building of HEPs – which is often in relatively pristine areas – can cause huge impacts on local communities, wildlife and ecosystem attributes.

Disturbance of the downstream hydrology and silt flow patterns, and disrupted fish migration, are also major issues to consider.

The environmental impacts of big dams have been extensively discussed and debated. The loss of large tracts of forests and their associated wildlife due to submergence is one issue. Large reservoirs are blamed for waterlogging and salinisation impacts. Higher incidence of malaria is reported in areas around reservoirs. In addition, large reservoirs can necessitate the need for relocation of large numbers of local communities resulting in huge social impacts on these groups.

Run-of-the-river type schemes are said to be more benign in terms of environmental consequences. However, even these have considerable local impacts. Fish movement can be significantly disrupted as a substantial tract of the river becomes mostly dry due to water diversion. Communities living on this stretch are badly affected. There are huge amounts of construction debris generated due to the tunneling and this is often not disposed of in a suitable manner. Blasting due to tunnel construction can weaken hills and cause landslides.

1.2 Hydropower generation in India

Hydropower generation has been, until recently, in the domain of the public sector. Some of the major Public Sector Undertakings (PSUs) under the Ministry of Power are:

- The Damodar Valley Corporation;
- The Bhakra Beas Management Board;
- National Hydroelectric Power Corporation Limited;
- North Eastern Electric Power Corporation Limited;
- Tehri Hydro Development Corporation;
- Satluj Jal Vidyut Nigam Ltd.; and
- Narmada Hydro Development Corporation.

In recent years, the private sector has also become active. While private participation in India's hydropower sector is still very small, and perhaps less than what the government expected, it has been gradually rising. Despite a large number of memoranda of understanding (MOUs) signed with state governments, only a few have been converted into projects, and these too by domestic groups. Major among these are: Jaypee Group (300MW Baspa–II, 400MW Vishnuprayag, and 1000MW Karcharn Wangtoo) and Bhilwara Group (86MW Malana, 192MW Allain Duhangan).

The majority of recent developments in private hydropower are taking place in the Himalaya, and in particular in Himachal Pradesh. For example, of the private sector hydro schemes cleared by the Central Electric Authority (CEA, a statutory body linked to the Ministry of

Power, Govt of India) , seven of the nine projects cleared across India (and 2378 MW out of 2796 MW capacity) are in Himachal and Uttarakhand. Thus these two Himalayan states account for 85% of all the Indina capacity of private hydropower.

In addition to these large projects, small hydropower projects – defined as those under 25MW – have been getting some focus and private sector participation. The *Electricity Act* (2003) has put in place a highly liberal framework for generation. There is no requirement of licensing for generation and this has encouraged private companies to get into generation of electricity (Government of India 2005b). Small hydro projects are environmentally more benign and can play a vital role in catalysing local development.

1.3 Payments for environmental services (PES)

Payments for environmental services (PES) are compensation mechanisms by which service providers are paid by service users. PES schemes in watersheds usually involve the implementation of market mechanisms to compensate upstream landowners in order to maintain or modify a particular land use, which is affecting the availability and/or quality of the downstream water resources (FAO 2004).

Although relatively new as a concept, a large number of PES schemes are in operation in Central and South America. Powell et al*. (*2002) identify over 280 cases of proposed or existing markets for environmental services, covering four main ecosystem services: carbon sequestration, biodiversity conservation, watershed protection and landscape beauty. In Costa Rica, for example, hydro-electric power protection is valued at between 10-20 US$ per hectare per year.

As per one comprehensive study (FAO 2004), the advantages of PES are that it can be used to:

- Sensitise the participating population about the value of natural resources.
- Facilitate the solution of conflicts that may occur between the local population and the HEP promoter.
- Generate new sources of funding to conserve, restore and value natural resources.
- Transfer resources to socially and economically vulnerable sectors, which offer environmental services.

However, PES schemes worldwide have shown that:

- They are not the most cost-effective method to attain the goals established.
- They are based on generalisations, which have not been proven by empirical studies about the relation between land use and water-related services.
- A monitoring system must be an integral part of all PES schemes.

Some of the difficulties faced by PES schemes are on account of:

- The model and cost of the service were politically imposed and do not correspond to studies on demand and economic valuation of the resource.
- Service providers, users, and the service itself are not properly identified.
- The design is not based on previous socio-economic or biophysical studies.
- Information about programmes and activities has been poorly disseminated among the local population.
- In some cases, service providers show interest in PES schemes as they may be an informal mechanism to establish property rights for land and natural resources.
- While a few countries have specific legal frameworks for PES, most schemes operate without a specific legal basis.

As compared to other parts of the world, there are a significant number of examples for the application of PES schemes for water-related services in Latin America. There are specific legal frameworks for PES in countries such as Costa Rica and Colombia. In Colombia, for example, the electricity sector transfers 3% of sales to the environmental authorities to finance watershed management projects.

Two fundamental types of PES schemes have been distinguished.

A. The first, related to services at a global scale, has the purpose of using market instruments to pay for services whose users are not limited to the local level, such as biodiversity conservation, or carbon sequestration.

B. The second type of PES scheme is designed to compensate providers by means of a local market, in which users are a better defined group and limited to a particular geographical area, which is close to the location of the providers. Since users and providers are geographically close to each other, the operation of the PES scheme is facilitated as transaction costs are reduced and the information flow becomes easier. PES systems for water services in watersheds, which are the focus of the present report, belong to the latter category.

In the case of PES schemes in watersheds, the service usually relates to the maintenance of availability and quality of water. The providers are upstream land users, whose land use may be modified to render the service, and the users are downstream consumers of the water resources. In the case of HEPs in the Himalaya, the HEP operator is clearly the ‘user’ who is making a ‘payment’ for services by funding a CAT plan. What remains unclear is what constitutes the ‘provider’. While the legal rights of the forest remain with the forest department, usufruct rights are with *the local communities*. While, at present, local

communities rarely get any benefits, this study puts forward a case for the sharing of benefits between these two guardians of these environmental services.

PES systems are more easily managed and more effective in attaining the objectives when they are restricted to small scales, e.g., micro-watersheds. This is because transaction and administration costs are lower at the local level; there is a better information flow among providers and users; the service can be defined more clearly; and the institutions involved may have a greater adaptation capacity. In addition, the cause and effect between land management and silt control is better established for small catchments. Unfortunately, there are no legal requirements for a CAT plan for small HEPs (less than 10MW) and hence small catchments do not typically benefit from any planned catchment treatment.

, Within the overall framework of payments for environmental services this study looks into the implementation of CAT plans in hydropower projects in two Himalayan states. The strengths and weaknesses of this system are looked at, and opportunities for incorporating incentive-based mechanisms for local upstream communities identified.

2. The impact of catchment treatment in the Himalaya: current understanding

In order to evaluate the potential of catchment area treatment (CAT) plans, it is important to first understand the geology and natural processes occurring in the region where hydro-electric projects are being built. This chapter looks into the state of knowledge on this subject and discusses the controversy over the impact of forests in water yield and sediment flow. Forest hydrology remains a much debated subject and often the 'conventional belief' does not match with scientific knowledge.

2.1 Erosion processes in the Himalaya

If the land areas of the world are ranked according to their susceptibility to natural erosion, the Himalaya will rank as amongst the most vulnerable (Tejwani 1987). While the Himalayan and Tibetan regions cover only about 5% of the Earth's land surface, they supply about 25% of the dissolved load to the world oceans (Raymo and Ruddiman 1992). The Ganga-Brahmaputra river system, for example, carries a billion tonnes of sediment annually, which is 8% of the total sediment load reaching the global oceans and the highest sediment load of any river system in the world (Wasson 2003). Studies have shown that the siltation rates in 21 Indian river valley projects were 182% higher than originally estimated (Narayana 1987).. Detailed research is required to ascertain the causes of these high rates of siltation

The middle mountains of the Hindu-Kush Himalayas are densely populated and the population of this region is still increasing at an alarming rate. Scarcity of water is a limiting factor for quality of life and agricultural production. Loss of fertile top soil, due to surface and gully erosion, is a common phenomenon (Kothyari et al. 2004). A two decade-old estimate showed that there were 1,432 persons per square km of cultivated land compared to 483 persons per sq km cultivated land for India as a whole. In addition, there are more than 1.1 cattle units per person (Tejwani 1987). This heavy population pressure has resulted in a variety of development activities, such as roads, and is thought to be the cause of much of the degradation of mountain forests (Singh and Singh 1992) which further exacerbates siltation.

In India, the problem of soil erosion was recognised as early as the mid-1800s. Soon after Independence, India passed the *Damodar Valley Corporation Act* in 1948 and established an inter-state system to undertake integrated watershed management in the catchment of the Damodar River. However at the national level, the concept of watershed management gained momentum only in the mid-1970s during the fifth five-year plan (Kaur et al. 2004).

Traditionally, the rivers of the Indian subcontinent are broadly divided into two major fluvial systems: the Himalayan River System and the Peninsular River System. The differences between the two systems are mainly a result of the differences in the geologic, hydrologic, geomorphic and morpho-tectonic setup of the two major physiographic units of the Indian subcontinent. Noteworthy differences between the two fluvial systems exist, not only with respect to the magnitude and duration of flows, but also in their sediment load, channel morphology, hydraulic geometry, and flooding behavior.

While the monsoon rains contribute much of the water for both river systems, in the case of Himalayan rivers, the flow pattern is to some extent also governed by the melting of the Himalayan snow (Kale 2002). Much of the recent development of hydroelectric projects has taken place in the Himalayan zone and hence the discussion in this report focuses on the Himalayan river system.

2.1.1 Land use and soil erosion

It is well established in geomorphic literature that hillslopes and upstream reaches are closely linked to river channels downstream, and that land-use changes can induce channel changes downstream (Leopold et al. 1964; Kondolf et al. 2002). Along the eastern seaboard of the US (Meade 1982) and in the midwestern US (Trimble 1983), changes in sediment supply from agriculture in the 19th century and resulting channel changes have been well documented (see Kondolf et al. 2002).

A review of the Himalayan literature on plot and watershed level hydrology studies suggests that only forests and a few micro-watersheds in the Central Himalaya have been investigated in some detail. These limited studies reveal that grasslands lose more water; shifting cultivation (locally known as *Jhum*)loses both soil and water of greater magnitude; and forested land use loses smaller quantities of both soil and water. Land under settled agriculture did not show as high soil and water loses as had been suspected by earlier researchers Negi 2002).

Available literature also indicates a huge range of soil loss and percentage run-off even when similar land use is being considered. For example, a review carried out by Negi (2002) finds that runoff (as a % of rainfall) values for croplands range from 1-37% while from grasslands the range is 5 - 86%. For forests however, the range is narrow with run-off being between 0.01 - 2.17%. Similarly, soil loss in crop land varies from 0.3 - 37 tonnes/ha/yr; for jhum-fallow cycle from 1.9 - 565.3 t/ha/yr; and from forest 0.01 - 0.06t/ha/yr. A good part of this variation may be due to differences in methodology. However, soil structure and geology, and differences in management, also have a huge bearing as is discussed in a later section.

A recent study by Kothyari et al. (2004) in the Kumaon Hills of Central Himalaya assessed the runoff, soil loss, and nutrient losses from different land uses for a 4 year period. Unreplicated plots, each 20X5m are measured for surface runoff, soil loss, and other parameters. While an open pine forest shows highest soil loss levels, the surface runoff (and hence water yield) is also highest. Water yield per unit soil loss, as calculated from the figures presented, is comparable for open pine forest and rainfed agriculture. However, the lack of replication and weak methodology limit the replicability, and the findings of such studies may not be valid.

It seems that lack of uniform methodology, proper instrumentation, and logistic facilities influence the data collected and it would be difficult to make any definite conclusion with regard to the impact of a particular land use/vegetation type on soil and water conservation

(SWC) in the Himalaya. There is a strong need to undertake systematic and more careful studies to strengthen SWC efforts in the Indian Himalaya.

Despite the Himalayan rivers being among the heaviest carriers of silt, some researchers have suggested that soil conservation measures can remedy the issue in large part. For example, Narayana (1987) suggests that : 'the area can be rehabilitated through adoption of scientific soil and water conservation measures' . While the author of this paper (the Director of the Central Soil and Water Conservation Research Training Institute, Dehradun) feels that techniques developed by the CSWCRTI are applicable to the catchments of large river basins, current knowledge would regard this as being an unlikely solution. Data gathered by the Soil Conservation Cell of the Indian Ministry of Agriculture however indicates that if even 25% of the catchment area is covered by various soil conservation practices, a 50% reduction in sediment production can be achieved (Das et al. 1980 in Narayana 1987). While this may hold true for certain types of micro-watersheds, it is unlikely to hold true at a large scale and no recent studies support such data. Such studies, which appear to extrapolate the results of small scale studies to larger watersheds, may have little scientific validity, as discussed in the next section.

Generalising the impact of a particular type of land use has limited utility. For example, while forest cover does check soil erosion, it is the undergrowth and forest litter, rather than the tree canopy, that is responsible for this benefit. A highly porous surficial layer of soil, caused by forest litter, promotes a type of flow wherein, at least during low rainfall intensity, water soaks into the soil rather than flowing over the soil. Even at high rainfall intensities, the undergrowth and rough surface layer help break the flow of water and trap sediment particles. Tree canopies, in themselves, may do little to prevent erosion other than intercepting and evaporating part of the rainfall. Experiments indicate that the erosive power of raindrops under trees can be quite high because the raindrops coalesce into larger drops before dripping off the leaves and therefore hit the ground with greater force (Wiersum 1985; Brandt 1988). This leads to increased erosion in areas where the soil has been cleared of vegetation and litter to reduce fire hazard, or where litter is collected for livestock bedding or fuel (FAO 2005).

Again, hill agriculture can provide very different results for sediment yield. For example, a study by Sen et al. (1997) in the Pranmati watershed of the Central Himalaya showed that agricultural land on low sloping terraces (<2 degree slope; soil loss 0.30 to 0.66 t/ha/yr) had 10-100 times lower sediment yield than strongly sloping terraces (6-10 degree slope; soil loss 6-64 t/ha/yr). While potato occupied 50% of the cropped area, 73% of the soil loss was from potato fields which tend to be more sloping. Also, as potato uses higher levels of organic manure, it would result in less litter being available on the forest floor – thereby increasing erosion in the forested areas. Similarly work by Tripathi et al. (2005) shows the impact of different tillage practices on sediment yield and hence discusses crops that are appropriate for growing in vulnerable sub-watersheds.

Grasses such as *Panicum maximum* can be used to stabilise waterways (Narayana 1987). In addition contour bunding and terracing and the making of small farm ponds to store excess runoff is recommended (Sastry et al. 1981).

Radionuclide studies have also been a useful tool to determine the impact of land use. Soil cores and suspended sediments were collected from a watershed in Ohio (USA) following a thunderstorm (Matisoff et al. 2002) and analysed for Be, Cs and Pb radionuclides to compare the effects of till vs. no-till management on soil erosion and sediment yield. About 6 to 10 times more sediment was derived from the sub-basins that are predominantly tilled compared with the sub-basins undergoing no-till practices. The study also found that 'erosion control methods may be most beneficial at upland locations near the head of the drainage in the watershed where erosion is the greatest, and that the effects of improved land management practices in these areas should be reflected quickly in the receiving waters.'

Lu et al. (2003) analysed seasonal water discharge and sediment load data for major tributaries of the Upper Yangtze River over a thirty year period. The large storage capacity of reservoirs built in the area complicates analysis as these trap sediment and thus give a false sense of lowered sediment transport. However, evidence nonetheless suggests a significant increase in sediment load in the wet season and decrease in water flow in the dry season as a consequence of high levels of deforestation in the catchment.

Under undisturbed forested conditions, suspended sediment yields are generally below 1 t/ha per year for very small (<50 ha) headwater catchments, regardless whether these are underlain by granitic, young volcanic, or sedimentary rocks (Bruijnzeel 2004). Somewhat higher values (typically 3–5 t/ha per year) are obtained for forested catchments of a few square kilometres in size on sedimentary rocks.

The construction of roads, skidder tracks, and log landings during mechanised logging and clearing operations represents a serious disturbance to the forest and generally causes sediment yields to rise 10–20 times. In addition, the very considerable volumes of runoff generated by such surfaces may promote downslope gully formation and mass wastage. Therefore, as already noted, runoff sediment contributions to the stream network by roads and settlements may be disproportionately large for their relatively small surface area (Bruijnzeel 2004).

However, the effect of localised one time disturbance usually subsides within a few years as skidder tracks become revegetated, roadsides stabilize, and (in the case of clearing) the new vegetation establishes itself – although the stored sediment may be remobilised during extreme events even after many years. Compaction of the soil – another consequence commonly associated with vegetation removal – results in lower water storage capacity of the soil and increased surface runoff.

The results of about 80 studies of surface erosion rates in tropical forest and tree crop systems (after Wiersum 1984) show surface erosion to be minimal in those cases where the soil is adequately protected (on average <0.5 t/ha/yr for natural forests, tree gardens, and plantations). Erosion rates rise dramatically only when the litter layer is removed or destroyed (50 t/ha/yr for clean weeded tree crops or forest plantations where litter is removed or burned). The initial effect is rather small due to the effect of residual organic

matter on soil aggregate stability and infiltration capacity, but becomes considerable upon repeated disturbance of the soil by burning, frequent weeding, or overgrazing – which tend to make the soil compacted or crusted, with impaired infiltration and accelerated erosion as a result (e.g., Toky and Ramakrishnan 1981).

2.2 The hydrological role of forests

The debate on the hydrological role of forests is an old one. On the one side were the proponents of the 'sponge theory" a paradigm that appears to have been developed by European foresters at the end of the 19th century (FAO 2005). As per this theory, the complex of forest soil, roots, and litter acts as a giant sponge, soaking up water during rainy spells and releasing it gradually. Thus, the flow of water continues during dry periods, when the water is most needed.

Early arguments against the "sponge theory' can be found in a fascinating debate in *Tectona,* the forestry journal of the former Dutch East Indies. Protagonists of the 'sponge' theory (such as Oosterling 1927) vigorously opposed the "in-filtration theory" which stated that base-flow is governed predominantly by geological substrate rather than by the presence or absence of a forest cover – see papers by Roessel in *Tectona* from 1927 onwards (Bruijnzeel 2004).

While a good layer of organic matter on the forest floor can indeed soak up large quantities of water, the sponge theory is an oversimplification. For example consider the statement made by Gifford Pinchot just over a century ago:

> 'The forest floor, which has more to do with the fallen rain water than any other part of the forest, can affect its flow only so long as it has not taken up all the water it can hold. That which falls after the forest floor is saturated runs into the streams almost as fast as it would over bare ground.'
>
> From: Gifford Pinchot, *A Primer for Forestry,* 1905.

Recent reports have challenged and severely criticised the continued persistence of the "sponge-theory" claiming that it is bad science that leads to initiatives such as logging bans that have minimal environmental benefits but definite negative social and economic implications (e.g., see FAO 2005).
In tropical forests, considerable quantities of rainfall (up to a third) are commonly intercepted by tree canopies and evaporated back into the atmosphere without contributing to soil water reserves (FAO 2005). A large quantity of the water that does soak into the soil is used by the trees themselves through transpiration (Hamilton and Pearce 1987). Thus, in the case of a small catchment, the total water flow is likely to be lower if dense forests prevail than if other kinds of land use exist (FAO 2005). Converting forest to grasslands, however, will normally result in an increase in total water runoff. Bruijnzeel and Bremmer (1989) found that reforesting degraded grasslands or croplands with fast growing trees generally leads to reduced total and dry-season flows as the associated increase in water consumption will override the effect of improved rainfall infiltration.

The FAO (2005) report is part of a growing tendency nowadays to emphasise the more 'negative' aspects of forests – such as their higher water use and their inability to prevent extreme floods – rather than their protective values (enhanced water quality, moderation of most peak flows, carbon sequestration). Such arguments are one-sided, and it is unfortunate that an agency such as FAO focuses on only one part of an argument. For example while the report correctly points out that forest trees transpire and evaporate vast quantities of water, thereby leading to lower water flow from a basin, it omits to mention that the higher evapotranspiration and greater aerodynamic roughness of forests compared to pasture and agricultural crops will lead to increased atmospheric humidity and moisture convergence, and thus to higher probabilities of cloud formation and rainfall generation (e.g., see Pielke et al., 1998). Thus, while in the case of a small catchment, having a forest cover may indeed reduce the amount of water that flows out of the watershed, these forests may contribute to a slightly higher level of precipitation in nearby watersheds. It suffices to say that a debate does exist over the role of forests in maintaining an even flow of water and no clear evidence has been provided by either side.

To better understand, the limitations of the "sponge theory", the mechanism of infiltration of water into the soil needs to be understood. A brief introduction to this is provided in the next section.

2.3 Water flow and silt erosion: the role of 'Dunne' and 'Horton' type flows

In arid or semi-arid regions, on impermeable materials and often exacerbated by human disturbance, a mechanism termed as 'infiltration excess overland flow' or 'Horton flow' may dominate (after Horton 1933, Church and Woo 1990). Monsoonal conditions with heavy and prolonged rainfall saturate the soil, which then favours Horton flow and the result is a down-slope movement of a thin sheet of water. Embedded in this sheet of overland flow are 'veins of high discharge' which can result in the creation of a minute network of channels known as rills. These in time can get incised to more pronounced channels known as gullies. 'Horton flow' is thus the flow of water in sheets over the surface of the soil. It is an important mechanism of sediment transport in the Himalaya and is greatly increased by deforestation, road building, and other activities (such as free grazing) that compact the soil. It is also more pronounced during heavy rains when soils are already saturated. Furthermore, in addition to land use, the parent geological material is important in determining how quickly the soil gets saturated and Horton flow is initiated.

A contrasting mechanism is 'Saturation Overland Flow', also known as 'Dunne flow' (after Dunne and Black, 1970a, b) wherein water infiltrates the upper soil horizon and flows under the surface for a while before returning to the surface at a place where the rising water table intersects the ground surface. Increasing this kind of flow is an important objective of watershed programmes in the Himalaya as it helps increase the water discharge of deep infiltration wells and springs which are the lifeline of the hill people. A good layer of compost on top of the soil surface helps trap water and increase infiltration, but during heavy rains,

even a thick layer of humus and topsoil will get saturated and start losing the ability to absorb any more water.

Thus, the same area may exhibit predominantly Dunne flow during light showers or at the beginning of the monsoon season, but as intensity of rains increases, Horton flow may start dominating leading to higher levels of silt being generated.

It is correct that on a local scale forests and forest soils are capable of reducing runoff, generally as the result of enhanced infiltration and storage capacities. But this holds true only for small-scale rainfall events, which are not responsible for severe flooding in downstream areas. During a major rainfall event, especially after prolonged periods of preceding rainfall, the forest soil becomes saturated and water no longer filters into the soil but instead runs off along the soil surface (FAO 2005). The sediment load carried by storm flow will depend, in addition to factors like forest cover and human disturbance levels, on various geological parameters. However, few studies have looked into the impact of these. For example, even in small catchment studies, the mechanisms of storm-flow generation are rarely studied. While geological conditions and rainfall patterns are essential in determining the dominance of one kind of flow over another, management of forest and agricultural areas in the catchment also has a large impact. Runoff records from the Himalaya however do not contain information on if the flow is Horton type or Dunne type (Negi 2002).

Studies in the Himalayas indicate that the increase in infiltration capacity of forested lands over non-forested lands is insufficient to influence major downstream flooding events (Gilmour et al*.* 1987; Hamilton 1987). Instead, the main factors influencing major flooding given a large rainfall event are: (i) the geomorphology of the area; and (ii) preceding rainfall (Bruijnzeel 1990, 2004; Calder 2000; Hamilton with King 1983; Kattelmann 1987).

Some lands may have a geology that makes them more susceptible to erosion. For example, the Siwaliks have a geology that results in a much higher rate of soil erosion compared to other parts of the Himalaya. But studies also show that deforestation of the Siwaliks leads to a far greater increase in soil erosion than in other areas. Sediment yield is estimated to increase 15 fold when deforestation occurs in this region (GBPIHED 2002).

2.4 Mass movements: natural or due to climate change

Mass movement erosion due to natural factors can dwarf human-induced erosion (Bruijnzeel 2004; FAO 2005). An example would be the devastating flood of August 1st, 2000 that swept away 200 people in Kinnaur and Shimla districts. Initially attributed to cloud bursts, Indian Space Research Organisation (ISRO) scientists later revealed the cause to be the bursting of a glacial lake on the Pareechu River. Such an incident is unlikely to be isolated. Using global climate data, the Washington-based Worldwatch Institute had long warned that the rivers originating in the Himalayas are expected to swell abnormally (Sharma 2005). Worldwatch Institute also reports that the average retreat of Gangotri Glacier is now 30m per year compared with 18m/year from 1935-1990 and 7 metres/year between 1842-1935. This works to a four-fold increase in the speed of glacial retreat in about a century.

Basing its argument on the fact that the Himalayan glaciers were rapidly melting, the report had also warned about the sudden bursting of glacial lakes due to above normal discharge. With 334 glaciers in the river basin, the frequency of such previously 'rare' events is likely to increase. Such floods cannot be controlled by catchment treatment, in part as much of the catchment of rivers such as the Satluj lie outside Indian territory. A glacial lake burst in Nepal in 1985, sending a 15-metre wall of water rushing 90 kilometres down the mountains, drowning people and destroying houses (Worldwatch Institute 2000). At least 12 glacial lake outburst flood events have been recorded since 1935 in the Tibetan area of the Himalaya alone. The collapse of a glacial lake in Sangwang Cho at the headwaters of the Nyangqu River in the Yarlung Zangbo basin in Tibet in July 1954 buried the upper valley with 3 to 5 m thick debris. The flood which released 300 million cubic metres of water and created a 40-metre high surge flood in Nyang Qu River damaged the city of Gyangze 120 km away and the city of Xigaze 200 km downstream (ICIMOD 2001).

Mountain floods can be defined as flash floods that cause significant disasters/hazards in river valleys. They are often caused by (1) rapid melting of snow and ice in high mountain areas, (2) cloudburst/ heavy downpour in the Himalayan foothills, (3) glacial lake outburst in the high Himalayas, and (4) failure of landslide/debris flow dams in high, rugged mountain areas. Large mountain floods are characterised by enormous energy and high flow velocity combined with substantial bed load and debris flow, sudden rise and rapid decline in water level, and strong erosion and deposition processes leading to catastrophic consequences (ICIMOD 2001) and often massive damage to HEPs.

A cloudburst is an extreme rainfall event that typically lasts only a few minutes (or at most hours) and is capable of creating local flood conditions. Cloudbursts usually descend from very high clouds, sometimes with tops above 15km. This is still a little understood phenomenon but is getting more attention from scientists due to its potential to cause massive destruction to life and property. Typically, in the Indian sub-continent a cloudburst occurs when a laden monsoon cloud drifts across the plains and into the Himalaya bringing rainfall as high as 75mm an hour. Among the best known recent examples is the cloudburst over Mumbai in July 2005 which led to about 950mm of rainfall over a 8-10 hour span, completely paralysing India's financial centre.

Cloudbursts occur several times during each monsoon season in different parts of the Himalaya and are by no means very unusual. However, they tend to get noticed only when they cause extensive damage. For example on the night of 20 July 1993, a severe cloudburst in the catchment area of the Kulekhani Dam near Kathmandu unleashed 540 mm of rain in a 24 hour period bringing down five million cubic metres of silt and boulders into the reservoir. The rain dumped in one night a sediment load several times larger than the estimate made by Kulekhani's designers for the entire lifespan of the dam. Events at this scale may not be greatly impacted by human activities in the catchment. Glacial lakes tend to form in areas where few humans live, and where no catchment area treatment work is typically carried out.

The presence of a forest cover is generally considered important in the prevention of shallow (<1m) slides, the chief factor being mechanical reinforcement of the soil by the tree root

network (O'Loughlin 1984). However, mass wasting in the form of deep-seated landslides, more than 3m deep, are not influenced appreciably by the presence or absence of a well-developed forest cover. Geological (degree of fracturing, seismicity), topographical (slope steepness and shape), and climatic factors (notably rainfall) are the dominant controls (Ramsay 1987).

2.5 The impact of scale

Different physical processes dominate at different scales. For example, hill slope runoff processes are important at a sub-catchment scale, channel network geometry becomes important in meso-scale basins (of the order of 100 km^2), while in large basins the spatial variability of precipitation becomes important (Gupta and Dawdy 1995). As per Bruijnzeel and Bremmer (1989), in catchment areas of 500km^2 or less, vegetation and land-use practices exert a clear influence on total water yield and timing. However, for larger catchments, land-use practice and vegetation do not have a very significant impact (FAO 2005; Kiersch 2001). Carson (1985) demonstrated that flooding and sediment problems in India and Bangladesh were caused by the geomorphic character of the rivers and that deforestation was only likely to play a minor role in these problems. Similarly, Hamilton (1987) concluded that afforestation would not prevent flooding or sedimentation in the lower reaches of major rivers.

It would appear that catastrophic floods caused by extreme rainfall distributed over a large-scale area, will not be significantly reduced by any kind of large-scale reforestation programmes, the adoption of soil and water conservation technologies in agriculture, logging bans, or even the resettlement of upland people to lowland areas (Bruijnzeel and Bremmer 1989). In basins larger than 50,000 hectares, the effects of flooding tend to be averaged out across the different sub-basins as storms pass over. Since the flood waves from the different sub-basins do not usually reach the main basin area simultaneously, there may be little or no cumulative effect from the individual flood waves.

Extrapolating siltation rates from an 'average slope' to a watershed level is inaccurate because erosion material moves into temporary storages and topographic depressions, where it may be deposited – often for short periods of time, but sometimes it may be colonised by plants and remain as an altered relief feature for several decades (Hamilton 1987). The relationship between erosion occurring on-site and sediment at a point in a stream is expressed as sediment delivery ratio (SDR) for a catchment. While this may be 90% for a 1ha catchment, it is likely to average only 50% for a 80ha area and <30% for a drainage area over 500 ha. A theoretical sediment delivery ratio curve for a basin the size of the Ganga gives a ratio of well below 10% (Hamilton 1987). It is because this stored sediment exists in various parts of the catchment, in a large basin changing the land use or erosion rates will not have an immediate impact. In California for example, hydraulic mining from 1850 to 1884 delivered a pulse of sediment to the Sacramento River system, causing extensive downstream aggradation and widening, which was followed by gradual recovery over a period of several decades (see Kondolf et al. 2002).

Geomorphological systems are not often appreciated by managers and decision-makers, who are typically responsible for a discrete reach of river, and who usually consider management actions on short spatial and time scales (1–5 years). Moreover, they tend to view the channel as a stable form and tend to accept its recent condition as natural and proper, which is not the case. The impact of spatial scales selected in research design has been investigated by researchers in the context of the Himalaya (Gamble and Meentemeyer 1996; Hamilton 1987). These researchers advocate the need for further investigation of physical processes at the regional and continental scales as so far these processes have been investigated mainly at smaller scales.

The 'Theory of Himalayan Environmental Degradation', which gained popularity in the 1980s, suffered from this problem in that it extrapolates the impacts of deforestation from micro-scale mountain watersheds to the macro-scale watersheds of the Ganga and Brahmaputra (Gamble and Meentemeyer 1996).

2.6 Research needs

Overall, the understanding of sediment movement in Indian rivers is limited. Knowledge of the sources and ages of sediment in a catchment area is a fundamental component in understanding the processes of erosion, transport and deposition, and for developing management strategies for controlling the supply of sediment (Matisoff et al. 2005). Various portions of watersheds contribute sediment at different rates, of different size and composition (Matisoff et al. 2002). While several recent studies have used radionuclides to track the movement of these sediments, in India this tool is not as yet popular.
Despite the many watershed programmes over the past three decades, it has been observed that the national soil loss rates have not been brought down. A lack of accurate and scientific information on natural resources at watershed level is one major shortcoming in implementing watershed programmes (Kaur et al. 2004). To overcome this, a number of hydrologic models have been tested in various parts of the country (see for example Kaur et al. 2004; Jain et al. 2003). However, as yet the practical applicability of these models remains uncertain. Watershed management programmes must first identify the subsets of hydrologic units that are contributing the highest silt loads. These sub-watersheds must be prioritised for treatment (Adinarayana et al. 1995).

Two areas in particular, relevant to catchment treatment and in need of further study, are: (a) the effects of forest conversion on regional rainfall patterns and (b) the effect of land cover change on low flows (Bruijnzeel 2004).

The 'low flow problem' is the single most important 'watershed issue' requiring further research, along with evaluation of the time lag between upland soil conservation measures and any resulting changes in sediment yield at increasingly large distances downstream. Such research should be conducted within the context of the traditional paired catchment approach, complemented with process-based measuring and modelling techniques. More attention should also be paid to underlying geological controls of catchment hydrological behaviour when analysing the effect of land-use change on (low) flows or sediment production (Bruijnzeel 2004).

There is very little published data on hydraulic properties of Himalayan soils or even crude infiltration rates. Typically, generalisations which oversimplify the hydraulic processes and establish direct links between forest degradation and runoff are constantly being made (Kattelmann 1987).

The Sediment Yield Index (SYI) model developed by the All India Soil and Land Use Survey (AISLUS), Government of India, is a well-known criterion for priority delineation in river valley projects and flood prone rivers (Adinarayana et al. 1995) and has been recommended by several authors for use in river valley projects. However, while indicative, its accuracy is based on several generalisations and assumptions.

The understanding of glacial retreat and the resultant sediment and water flows needs to be improved. While an increasing amount of water is reaching the rivers as a result of glacial melt, the impacts will be reversed once these glaciers have melted. Also, glacial retreat in the Himalaya is leading to the exposure of a large amount of silt which is not well reported in the literature.

Hasnain and Thayyen (1999) report the rather obvious fact that sediment transport rates are highest in the monsoon when a swiftly flowing river and rivulets erode large quantities of soil. $8X10^4$ tonnes of sediment were transported from the Dhokriani Glacier in the Garhwal Himalaya in the month of July – which is twice the sediment load they find in June. This increase is correlated with the rise of monsoon precipitation.

2.7 Conclusions

Natural rates of erosion are very high in the Himalaya which leads to among the highest base silt flow rates in the world. Heavy population pressures in the mountains that have led to forest degradation, and activities such as road building, have contributed to further increasing silt rates. While some kinds of land use are associated with high erosion levels, good land management is more important. Forests with a denuded understory and no litter layer can have high levels of erosion while well-contoured agricultural fields with sediment traps can show low sediment loss. Poor research methodology that does not consider management regime, underlying geology, or replication of plots has resulted in considerable bad science being generated.

The hydrological role of forests is controversial. The old notion of the forest being a giant sponge that soaked up water in times of excess and release it during dry periods has been proven to be excessively simplistic. As forests use a large quantity of water, the water yield from a forested catchment is actually likely to be lower than if other land uses predominate. While sediment yield does tend to be lower from forested areas, a good litter layer and understory are more important than an intact canopy. The underlying geology plays a very important role – often more so than the kind of land use. Also, mass wasting events such as deep-seated landslides are not much impacted by land use or forest cover.

A lot of the erosion generated in a large river valley may come from a few catastrophic events – such as the bursting of a glacial lake, or a cloudburst. These may increase sediment loads for a watershed by several orders of magnitude. Land management will have little impact on these random events. The frequency of these events is low if small catchments, of the order of a few hundred square kilometres or less, are taken into consideration.

For small catchments, land management practices do have a large impact on silt yield and water flow. Thus different physical processes dominate at different scales and it is not correct to extrapolate from small to large scales or vice versa.

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3. The making of CAT plans: policy, legislation and procedure

An understanding of the policy and legislation governing CAT plans is essential to analysing the effectiveness of these plans. A catchment area treatment plan is one of the many environmental management plans (EMP) funded by the project authorities of a large hydro-electric project (HEP). As per a Government of India notification of January 1994, environmental impact assessment (EIA) was made statutory for 32 different kinds of activities, including medium to large hydro-electric projects above 10MW in size. The EIA process includes the making of an environmental impact assessment (EIA) report, a set of environmental management plans (EMP), and the holding of environmental public hearings.

3.1 Legal framework for environmental laws

India has a complex regime of environment-related legislation. Some of this legislation establishes approvals processes that complement the EIA process in anticipating and preventing or mitigating adverse environmental effects. While, an analysis of all of these is beyond the scope of this study, some of the key legislation that has an impact on EIA includes:

- The *Environment (Protection) Act*, 1986;
- The *Forest (Conservation) Act*, 1980;
- The *Indian Forest Act*, 1927;
- The *Wildlife (Protection) Act*, 1972;
- The *Water (Prevention and Control of Pollution) Act*, 1974;
- The *Water (Prevention and Control of Pollution) Cess Act*, 1977, *Amendment Act*, 1991, and *Amendment Act*, 1995;
- The *Water (Prevention and Control of Pollution) Act*, 1974, for example, establishes approvals processes that complement EIA in anticipating and preventing or mitigating adverse environmental effects.

3.2 Environmental impact assessment (EIA)

The origin of EIA processes in India dates back to 1976-77 when the Planning Commission asked the Department of Science and Technology to examine river valley projects from an environmental angle. Subsequently, this was extended to cover those projects that required approval of the Public Investment Board. These were, however, administrative decisions and lacked legislative support.

The *Environmental Protection Act* was enacted by the Government of India on 23rd May 1986. To achieve the objectives of this act, it was decided to make EIA a statutory

requirement. After following the required legal procedures, a notification was issued on 27th January 1994 that made EIA statutory for 29 different activities. This number was later raised to 32 categories. These included hydropower, nuclear power, thermal power, industries that make products such as pesticides, primary metallurgical industries, and various other large operations that can potentially have significant environmental impact. This legislation, which was subsequently amended in April 1997 and then again in January 2000, is the principle piece of legislation governing EIA. There are several other notifications issued by the Government of India under the *Environment (Protection) Act* 1986, but they are limited to certain kinds of activities and certain geographical area. As they do not have a bearing on hydropower, they are excluded from this discussion.
The EIA notification is entitled the *Notification on Environmental Impact Assessment of Development Projects* (Government of India, Ministry of Environment and Forests 1994). Individual states are expected to adopt the EIA Notification as a minimum, but may adopt their own more stringent legislation. Typically, EIA studies include the following components:

1. Water: quality and quantity of water resources. Impacts of the project on these and on flow regimes.

2. Land: identification of eroded and vulnerable areas, prediction of impacts due to diversion of forests.

3. Physical: changes in micro-climate, noise, pollution and other physical parameters due to project construction and operation activities.

4. Biotic: a survey of existing resources, and inventory of rare, endangered or economically important resources. Assessing project impacts on these.

5. Socio-economic and health: compiling baseline data on human settlements and social structures. Impacts of the project on the local people. Assessment of people's perception, aspirations and apprehensions.

3.2.1 The EIA process

The EIA process is undertaken after initial clearances. In the case of a HEP, sanctions are first taken from the Power Department, based on which a detailed project report (DPR) is prepared. The DPR is a technical document submitted for getting a techno-economic clearance. An application for site clearance is filed with the MoEF which initiates the participation of the forests and environment departments. Subsequently the EIA study is commissioned by the project proponent. Several interim clearances are required from various departments. These tend to occur in a parallel fashion with complex inter-linkages between them.

The EIA clearance process requires the proponents of the HEP to submit an application on a specified proforma, along with a project report that should include an environment impact assessment report, environment management plans, and details of public hearings prepared in accordance with the guidelines issued by the central government. Select projects, such as

hydro-power, require that the project authorities must first intimate the location of the project site to the central government (MoEF) and obtain a site clearance for surveys and investigation. The MoEF conveys a decision regarding the suitability of the site within 30 days. The applicant is also required to obtain a 'No Objection Certificate' from the concerned State Pollution Board. This certificate is given only after the completion of a public hearing.

In the EIA notification that has been proposed as a replacement to the 1994 notification (*EIA Draft Notificatio*n 2005), a four step clearance process is envisioned. This would include screening, scoping, public consultation and appraisal.

The project proponents usually contract an external group of technical consultants with expertise in EIA. These technical consultants, in coordination with the project authorities, forest department and other concerned agencies, draw up the EIA report using secondary data and information gathered from field visits. This process is described in more detail in the ‘Making of EIA / CAT plan’ section in this chapter.

3.2.2 Public hearings

Under the 1994 law, the Impact Assessment Division (IAD) of the Ministry of Environment and Forests (MoEF) had discretion over whether to hold public hearings to solicit comments about the project application. Typically, public hearings were called for in projects involving a large displacement of residents or severe environmental impacts. The decision to hold hearings had to be made within 30 days of receipt of the proposal. If the IAD decided to hold hearings, it was required to provide notice in at least two newspapers at least 30 days prior to the hearing.

This procedure was changed by the two notifications on public hearings enacted in 1997: *Public Hearing Notification, S.O. 318(E)*; and *Public Hearing Notification, S.O. 319(E)* (the public hearing notifications) (Government of India, Ministry of Environment and Forests 1997a; 1997b). As per these notifications, public hearings are now mandatory for all projects to which the EIA notification applies. In support of this requirement, the process includes provisions for public access to information. Project proponents are required to provide the concerned State Pollution Control Board (SPCB) with an executive summary of the project ‘containing the salient features of the project both in English and local languages’. They must also provide copies of all application forms relating to the project that were submitted pursuant to other environmental approval processes and ‘any other document necessary for the Board to dispense with the application’. Twenty copies of each of these documents must be provided to the SPCB.

The State Pollution Control Board is required to issue a notice for the environmental public hearings which is to be published in at least two newspapers that are widely circulated in the region around the project. One of these is to be in the vernacular language. Suggestions, views, comments and objections are invited within 30 days from the date of publication of

notification. The public hearing is to be completed within a period of 60 days from the date of receipt of complete documents.

The public hearing panel is represented by the SPCB, the district administration (district collector or nominee) and representatives from the concerned departments of the state government, up to three representatives of local bodies (municipalities or panchayats), and up to three senior citizens of the area nominated by the district collector. As per the notification, the presence of a representative of the forest department is not specifically required and nor are forest officials usually present.

To ensure good access to the executive summary of the EIA report, copies are to be made available at the district collectors' office; district industry centre; office of the zila parishad CEO or municipal corporation commissioner, the SPCB head office and concerned regional office; and concerned departments of the state government.

3.3 Making of the EIA / CAT plans

The project proponent, which may be a PSU or a private sector player, is free to commission a technical consultant of their choice to develop the environment impact assessment report.

The technical consultant puts together a planning team of experts from various disciplines. Persons with local knowledge, NGO workers, and forest department officials may be part of this team.

The team generates an EIA report along with a set of plans that form the EMP report. The study, including field work, typically takes a year and the management plans made include:

- Catchment area treatment (CAT) plan (a very major part of the report)
- Biodiversity conservation plan
- Fisheries management plan
- Plan for green belt near reservoir periphery
- Landscaping of area where quarrying is to be done
- Rehabilitation of dumping sites
- Landscaping around new colonies and settlements
- Relief and resettlement plan
- Economic rehabilitation plan (vocational training etc. – as a goodwill measure)
- Disaster management plan
- Public health delivery system plan
- Sewage disposal plan

In addition to the activities proposed, these plans contain the financial requirements, a time period for implementation, and usually the agency to carry out the proposed activity is identified (if different from the project management authority).

The CAT plan is typically the most important and lengthy of these plans for run-of-the-river type projects and it may alone account for 60% or more of the total EMP budget (see Chapter 4 for details). In dam-type HEPs however, there is considerable allocation to resettlement and compensatory afforestation, primarily because there is much more land affected in dam-type projects.

Work on a CAT plan is typically started using a *Survey of India* toposheet and satellite imagery. Geological and soil data may also be used. The project authorities have usually done detailed geological surveys around the critical construction sites and this data may also be used. These tools are used to create slope, land-use and other maps through a geographic information system (GIS). The catchment is divided into several sub-watersheds, typically around 10-100 sq km each. A soil erosion classification map is generated based on steep slopes, weak geology, poor land use and other such variables. The CAT plan focuses on the free-draining catchment area, i.e., the area from which the water comes directly to the dam without being intercepted by other dams. Thus, if other dams exist upstream, the catchment of these dams in usually not included.

Using the All India Soil and Land Use Survey (AISLUS) guidelines, a silt yield index is calculated. Areas of severe erosion potential are identified and then prioritised for treatment. Ground-truthing is simultaneously carried out and several field trips are undertaken at periodic intervals to verify the maps and obtain seasonality data. Based on this information, a schedule for treatment of the watersheds is made with a focus on areas where (a) physical access is possible (b) where erosion is most likely to occur.

The stated objective of the CAT plan is to reduce the inflow of silt. A combination of engineering and vegetative measures is used to achieve this objective. Sample surveys help identify which measures are most needed. In these surveys the help of the forest department is usually sought – but may not always be available according to some of the technical consultants interviewed.

3.3.1 CAT plan approval and funding

Once made, the CAT plan is put together with other plans to form the environmental management plan / EIA. They are then presented to the Environmental Appraisal Committee (Impact Assessment Division) of the MoEF. The application must include: (i) a proforma prescribed by regulation; (ii) an EIA report (or an environmental management plan); (iii) a risk analysis report; and, (iv) an executive summary containing the project details and the findings of environmental assessment studies that were conducted (Government of India Ministry of Environment and Forests 1994).

The Impact Assessment Division of the MoEF approves the EIA/EMP which includes the CAT plan. The River Valley Committee, one of the expert committees in this division reviews these plans and grants approval.

As per the *EIA Notification* (Schedule III) this expert committee has members from the following disciplines:

1. Ecosystem management;
2. Air/water pollution control;
3. Water resource management;
4. Flora/fauna conservation and management;
5. Land-use planning;
6. Social sciences/rehabilitation;
7. Project appraisal;
8. Ecology;
9. Environmental health;
10. Subject area specialists;
11. Representatives of NGOs/persons concerned with environmental issues.

After the completion of the EIA approval, funds for implementation of the CAT plan are released to the state treasury, from where they are subsequently reallocated to the relevant departments for implementation. The procedure normally followed is that the forest department submits its Annual Plan of Operations to the state government for procuring its annual budgetary allocation. All watershed treatment activities, including compensatory afforestation, CAT etc. are included in the various plans made by the different forest divisions. Based on these the Finance Department releases funds. The forest department is responsible for carrying out these activities and for requesting of these funds from the Finance Department. Thus, there are no mechanisms that ensure that CAT plan funds are used exclusively for catchment treatment and these funds, at least for some time, get mixed in a vast general pool.

As a result, these funds are often reported to get diverted during this process and utilised for other expenditures. For example, as per the *Seventh Report of the Standing Committee on Energy* (Lok Sabha August 2005, Government of India): 'The Committee finds that the States have been unable to meet the projected targets and at times the money transferred to State Governments has been diverted to the general revenue budget of the State."

To prevent the diversion of these funds, as per a 2002 directive of the Supreme Court, it was proposed to create a new authority, the Compensatory Afforestation Fund Management and Planning Authority.

3.4 The Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

CAMPA was created through an order issued by the Ministry of Environment and Forests (Forest Conservation Division) on April 23rd 2004 (SO 525(E)). This came about after a Central empowered committee (CEC) examined issues relating to compensatory afforestation and net present value of diverted forest land, and found that it was desirable to create a separate fund. Money received from all user agencies is to be kept in this centralised fund and subsequently released directly to the implementing agencies in the various states and union territories as and when needed.

The recommendations of this CEC were accepted by the Supreme Court in October 2002 and the central government was directed to 'take necessary steps required for implementing the recommendations of the CEC'. Under powers conferred by sub-section (3) of Section 3 of the *Environment (Protection) Act*, 1986 (29 of 1986) the Central Government constituted the Compensatory Afforestation Fund Management and Planning Authority (better known as CAMPA) with effect from 23 April 2004. This is approved under the *Forest (Conservation) Act*, 1980 for issues related to non-forestry uses of the forest land.

CAMPA is chaired by the Minister for Environment and Forests. The Chief Executive Officer of CAMPA is the member Secretary. In addition to these two, there are eighteen other members (see Annexure 1). The executive body is headed by the Director General of Forests and consists of seven members.

CAMPA is to be the custodian of the Compensatory Afforestation Fund. It is to receive all the money from user agencies for compensatory afforestation, catchment area treatment, net present value (NPV) of the forest land diverted for non-forestry purposes, and any other conditions stipulated by the central government that are approved under the *Forest (Conservation) Act* of 1980. Unspent money that is with the states on this account is supposed to have been transferred to CAMPA.

The money received for compensatory afforestation is to be used as per the site-specific schemes proposed by the states/union territories. The money received for diversion of forest land in protected areas is to form a corpus and the income from this corpus is to be used for undertaking protection and conservation activities in protected areas. These funds are treated separately from other funds and no part can be used by CAMPA for its operational expenses.

Money is to be released to the states in instalments through the State Level Management Committee as per the Annual Plan of Operation finalised by the concerned state/union territory (UT). The CAMPA legislation also clarifies that money received from a state will be used exclusively for that state (or UT) after deducting the operational costs of CAMPA.

However, despite the notification having been passed, CAMPA is not yet operational at the ground level. This is a result of some states having questioned the constitutional validity of the notification as it apparently changes centre-state fiscal relations (Sethi 2006). As a compromise, the Prime Ministers Office (PMO) has asked the MoEF to look into creating several state-level CAMPA-like authorities which the MoEF has as yet refused to do and the situation remains deadlocked.

If the fund becomes operational, it will potentially have huge impacts on the ground level and can potentially leverage far better utilisation of the CAT funds than is currently being undertaken.

4. CAT plans in the field: case studies and some comparisons of CAT plans

4.1 Introduction

The main objective of the CAT plan is to incorporate measures in the catchment area that reduce silt load problems for hydro-electric projects. The aim is also to buffer the flow of water by reducing storm water peaks, and increasing dry season flows through better infiltration.

Catchments areas vary greatly for large HEPs. Obviously the size of the HEP influences the catchment size. Precipitation is the other determinant and a river flowing through an arid zone can have quite a large catchment. In Himachal for example, while Allain Duhangan and Malana have catchments of the order of 200 sq km, 1,000-1,500 km appears to be a common size of catchment. However, some HEPs, such as Nathpa Jhakri, have extremely large catchments of the order of 50,000 sq km.

CAT plan costs form a significant proportion of the EMP costs for these projects, typically ranging from 30-60% of the EMP cost. Overall, most CAT plans have a financial commitment equal to 0.5-1% of the total planned project cost, but this may vary significantly. Also, planned and actual costs differ greatly,. There is no predetermined formula for working out the budget of a CAT plan. It depends to some extent on the need of the catchment, though negotiations between the project authorities and the forest department plays an important role in deciding the final CAT outlay.

The implementation phase of the CAT plan is usually 5-6 years, but many CAT plans now have a 3-5 year maintenance phase – hence a total CAT period of 8-10 years. Engineering as well as biological measures form the bulk of the costs of a CAT plan. The focus is on forest areas, though in recent years CAT plans have begun to pay attention to private and agricultural lands.

As per field observations CAT plans have the following shortcomings:

- CAT plans are not based on field realities. Ground-truthing is often not adequately carried out by the technical agency that develops the CAT plan.
- There is often excessive focus on stand alone engineering measures, which are at best short-term solutions. Biological solutions are inadequate and not integrated with engineering solutions.
- CAT plans do not adequately consider the impact of local communities and do not provision to include their participation.
- Monitoring mechanisms are weak.
- There is a shortage of plant nurseries which hinders vegetation-related measures.

This chapter looks into these emerging trends with respect to CAT. Towards this end, field visits were made to three catchments in Kullu district where HEPs are being developed. In addition, catchments of some HEPs coming up along the Satluj valley (Nathpa Jhakri, Rampur, Baspa II) were selected for field work. These projects are equally divided between the public and private sector. It was hoped that by selecting projects in different geographical belts with varying degree of remoteness, several dimensions of the CAT plan would get clarified in the course of field investigations.
The methodology used during fieldwork was to ascertain the status of the CAT plan by scheduling interviews with the forest department, the project authorities and the upstream local communities. Interviews were based on open-ended but structured questionnaires. The CAT plans of these, as well as a few other HEPs, were studied and used for comparative analysis. The following sections summarise the main findings entirely based on evidence from the field.

4.2 Project: Parvati-II (800 MW)

Parvati-II is among the largest hydro-electric projects of Kullu district. Under construction since September 2002, the project is designed to harness the waters of the Parvati River, which is a major tributary of the Beas River. The project is likely to be in operation by June 2008 and is managed by the National Hydroelectric Power Corporation (NHPC) Ltd. As per the CAT plan documents, the total catchment area for this hydro-electric project is 1,355 square kilometres.

The geographical spread of the HEP catchment encompasses 1,155 square kilometres of the Parvati River catchment, as well as the catchments of the Jigrai Nallah, Hurla Nallah and Jiwa Nallah catchment. 84% of the catchment is permanently under snow. The catchment areas of Hurla Nallah and Jiwa Nallah comprise densely wooded forests.

About 99% of the catchment area is under the jurisdiction of the Forest Department and is classified as reserved forest, protected forests (DPF), unclassed forests and alpine pastures as per departmental records. Land under private ownership is negligible.

Photograph 1: Degraded Forests of the Parvati Watershed

As was the case with the other HEPs studies in the Kullu area, the Forest Department considerably revised the original CAT plan made by the technical consultants, viz.

the Centre for Interdisciplinary Studies of Hill and Mountain Environment (CISHME), Delhi University. The study was commissioned by the NHPC with the main objective of arresting soil erosion in the upstream catchment.

The report states that the area has a " the history of frequent cloud bursts" and that "an intensive downpour is likely to occur at some point in time,[which] has the capacity of causing wide spread damage due to erosion." Anthropogenic factors are also identified and the report states that "Besides geological, hydrological and seismic factors landslides may also be caused by single or a combination of activities like deforestation, overgrazing and road construction".

Various engineering and biological measures have been proposed for arresting these processes. It is stressed that catchment area treatment would lower the cost of de-silting mechanisms which the project authorities are compelled to install. An important recommendation made is that resource benefits could be used to induce cooperation of the local villagers especially for the success of the plantation programmes. The report envisages the formation of 'Plantation Protection Committees' for sustained protection of the plantations. These community-managed plantations would be a good incentive for people's protection (see Chapter 7 for further information). A total commitment of rupees 256 million (Rs. 25.6 crore[1]) spread over a period of eight years, was proposed for implementation of the CAT plan.

Table 5.1: CAT plan interventions for soil conservation: Parvati-II (800 MW)

Interventions	Area	Activities	Amount	Percentage
1. Plantations	1,509 ha.	Actual plantation	33,955,168	
		Maintenance	34,619,224	
		Sub-Total	**68,574,392**	20.2%
2. Pasture development	1,795 ha.	Actual plantation	8,058,950	
		Maintenance	11,487,300	
		Sub-Total	**19,546,250**	5.7%
3. Engineering works		Crate walls	180,433,670	
		Check dams	23,694,372	
		River protection/spurs	20,324,449	
		Sub-Total	**224,452,491**	65.9%
4. Labour huts etc.		*Sub-Total*	2,363,000	0.7%
5. Work in Great Himalayan Nat. Park		*Sub-Total*	25,335,420	7.4%
		TOTAL	**340,271,553**	

(Source: Catchment Area Treatment Plan: Parbati HEP Stage II (800 MW), District Kullu, Himachal Pradesh, Prepared by HP Forest Department and HP State Electricity Board. Undated document)

[1] In India Lakhs and Crores are commonly used. One lakh is a hundred thousand while One crore is ten million. Thus, 1 crore = 10 million = 100 lakhs = 10,000,000

While based on the broad guidelines proposed by the CISHME, the final CAT plan of the Forest Department gives site-specific details about implementation of biological and engineering measures. This revised CAT plan prescribes a higher amount of 34.02 crores (340 million) which is 0.87% of the project cost of Rs. 3900 crores (Rs. 39 billion). Detailed allocation of funds is summarized in Table 5.1. Nearly two-thirds of the expenses are ear-marked for engineering measures. It is targeted that the CAT plan will be implemented over a period of 8 years. The main work will need to be completed in 5 years and the remaining three years will be devoted for maintaining plantation activities.

4.2.1 Parvati-II fieldwork

The focus of fieldwork was to ascertain the status of the CAT plan which has been under implementation since 2003. It was also hoped that interactions at various levels would indicate areas where community involvement could become an integral part in the implementation process. The Forest Department, the project authorities and the upstream local communities were interviewed based on open-ended but structured questionnaires.

Discussions with the Forest Department indicated that CAT plan implementation was initiated about two years after the HEP construction started. The treatment area stretches up to a distance of nearly 35 kilometres from the dam site. A schematic map of the catchment area was made by interacting with the range officer and the forest guard for identifying the upstream villages in the catchment area, the land use, nature of vegetation, and location-specific CAT plan work that has already been implemented.

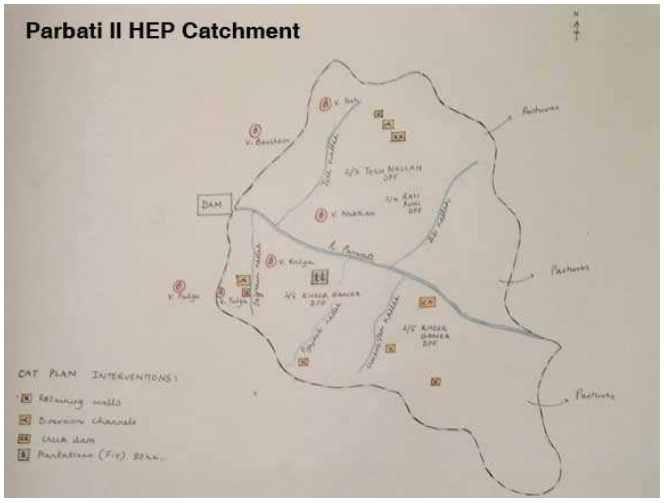


Figure 1: schematic map of the Parvati-II catchment, drawn up in consultation with the range officer and the forest guard.

There was moderate progress of engineering works. Some retaining walls, diversion channels, and check dams have been constructed in scattered locations. Pasture development work was in an early stage and fir tree plantation work has been done only in Kheerganga DPF and Tosh nallah DPF over an area of 80 hectares in all.

The forest guard indicated that in the past, the plantation zone in Kheerganga DPF had been damaged due to fire. Some damage to plantations had occurred on account of seasonal

grazers - the 'gujjars' and 'gaddis'[2] who pass through these plantation zones with their livestock en route to the high altitude summer pastures.

Overall, field evidence indicates that CAT plan progress is very slow. After two years, only 80 hectares of plantation work has been initiated, when the target as per official estimates is 577 hectares. As regards pasture development, 10 hectares had been treated, which is negligible compared to the target of 655 hectares.

Local involvement in CAT plan activities was found to be very low. According to the forest guard the daily wage for labour to implement CAT plan activities was Rs. 70 per day, which is inadequate to induce the local communities to work on these schemes. During July, when most plantation work is done, the locals are preoccupied with medicinal herb and NTFP collection which can earn them an income of Rs. 300 to 400 per day. In the early summer, tourism is a major activity. There is also a lucrative and flourishing cannabis trade in the area. Therefore it is often difficult to mobilise labour from these upstream villages.

There are six upstream villages in the Parvati-II catchment. Village Barsheini is located at the road head leading to the dam site. Some locals from this village have lost their private lands on account of the HEP, for which they have received compensation. Group meetings were organised in Tulga village where the villagers seemed to be unaware of the CAT plan. They were aware of the plantation work but felt that it was a routine intervention done by the Forest Department. They were unaware of any advantages that could accrue to them through CAT plan activities, and were indifferent about protecting the plantation work that had been done. The density of settlements was very low in comparison to the forest resources available in the region. Therefore firewood, fodder, timber, and grazing needs of the local people are adequately met from the surrounding forests. There was no conflict about plantations being established by the Forest Department, but neither was there any need expressed to protect the same.

Awareness of the public hearings ('jan sunvayi') proceedings was also very low. It appeared that only Barsheini village was losing land and hence directly affected. According to the villagers, aided and abetted by a local politician the project authorities struck a deal with a few people in this village and the project construction began. It was much later that locals of Tulga village realised that the 'head-race-tunnel' was passing under their village. They complained that the blasting was drying up their water resources, there were cracks in their houses, the noise was unbearable, and tourism prospects were threatened. They also attributed lower rainfall levels over the last two years to project construction activities. They said that for some time medicines had been given to them by the project dispensary but even that has now stopped. They have not got much benefit from the project in terms of employment opportunities. Most of the labourers working at the construction site are from outside the region.

[2] 'Gujjars' and 'Gaddis' are pastoral tribes found in parts of India and particularly in Himachal Pradesh. While some do cultivate land, their chief wealth is their livestock. Gaddis own large flocks of sheep and goat while Gujjars more commonly rear buffaloes. Forest officials often blame these tribes for forest destruction and regeneration failure.

The villagers said that the project authorities had built a new temple in Barsheini village as compensation. Over 2,000 trees had been felled for the project construction, but as these were not in areas commonly accessed by the villagers this did not cause any inconvenience to them and hence there was no protest. However they were indignant about the intrusion of outside labourers into their forest access zones, as these labourers surreptitiously lopped the forest trees for firewood. The building of the road closer to their villages generated a mixed response. While some villagers were worried that the road could increase monitoring by the law enforcement authorities and hamper their Cannabis-related activities[3] on which tourism depends, others perceived benefits through commercialisation of agriculture and enhanced pace of horticulture development, besides other advantages of good connectivity.

Informal discussions with the project authorities also indicated that the 'public hearings' were a mere formality. The forest officials reiterated the general apathy as regards the locals when it came to implementation and protection of plantation programmes. In fact, such plantation programmes are a success only when interventions are located at a distance from the village and in areas not generally accessed by villagers. As regards the CAT plan, the aim was to initiate activities as far away as possible from the villages, at least in the initial stages, so as to ensure their success.

The main problem in CAT implementation as expressed by the Forest Department is on account of fund scarcity which slows down the pace of work. This was a result of diversion of CAT funds by the State Government. At present, CAT plan implementation is well behind schedule, in large part because of the slow/incomplete release of funds.

Consequently, project authorities do not depend on the CAT plan to produce results. Mechanical devices and structures have been installed in order to prevent high silt loads from reaching and damaging the turbines. However, they were aware of the advantages that could accrue if the CAT plan was successfully implemented. Project authorities proposed their own involvement in CAT plan implementation and suggested a structure with Forest Department officials on deputation.

The Forest Department is also ill-equipped to implement the CAT plan. Due to the high altitude, the working period in this region is limited. Furthermore, the forest guard who usually has a large "beat area" to monitor has to assume additional responsibilities related to the CAT work. The flow of funds, besides being irregular, typically arrives at a time when the season is incorrect to engage in plantation work or other activities. In the view of the forest guard, the CAT plan is a one time intervention and once the stipulated period is over, nobody would care about the sustainability of the interventions that had been made.

4.2.2 Parvati-II: broad observations

[3] Growing of Cannabis is illegal in India. While the marijuana plant grows naturally as a weed, cultivation is not permitted. In villages away from the road head, it is however grown in small quantities. Marijuana is used both for local use and sale to tourists.

Overall, it was found that the locals from upstream villages are not adequately taken into confidence even when the project construction work is initiated in and around the dam site. Most of the benefits that the project authorities were offering were to downstream villages located closer to the powerhouse. Therefore the relationship between these downstream villages and the project authorities is much stronger than in villages in upstream areas where the CAT plan is to be implemented. Right from the inception phase, the upstream villages viewed project work with suspicion and were unaware of the full impacts of the projects on their livelihoods. These villagers have not benefited from the HEP in any way and were not involved with the CAT plan. In fact, most did not even know of its existence. Progress of the CAT plan implementation was slow.

4.3 Project: Allain Duhangan (192 MW)

The catchment area of the Allain Duhangan HEP is 194 square kilometres. Of this area, 24.2% is under snow, 22.3% is stony-rocky waste, 24.8% is pasture land, 19.2% is under forests, 6.4% is scrub and 3.1% is under agriculture. The main rivers in the catchment are Allain and Duhangan which are tributaries of the Beas River. Water from these small rivers (or 'nallahs') is diverted to the powerhouse located near Prini village. The project has an unusually high number of villages in the catchment and in the area between the dam/barrage site and powerhouse. The villages downstream of the dam are impacted due to a considerable reduction of flow in the Allain and Duhangan rivers. These include Prini and Aleu near Allain Nallah, Jagatsukh near Duhangan Nallah and some of the villages located between the two streams (viz. Setham, Hamta, Chalet and Shuru).

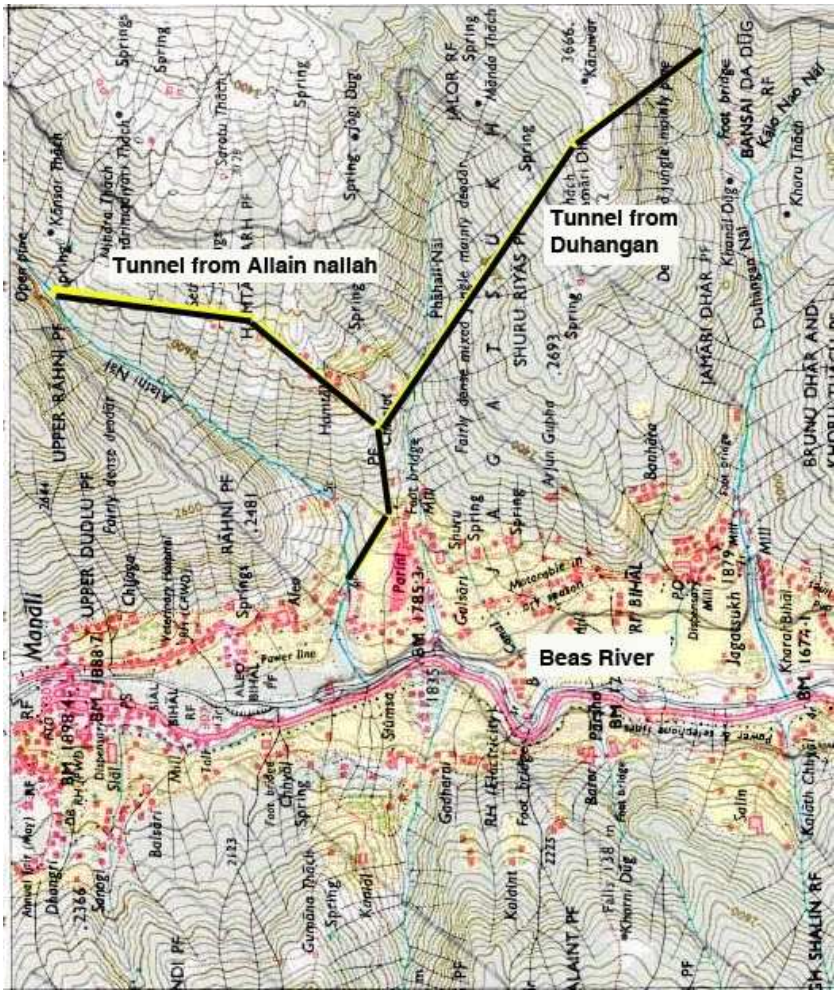


Figure 2: Catchment area of the HEP, Allain Duhangan
(Source: Survey of India Maps)

The project has been under construction since December 2003, and is likely to be completed by 2008. About Rs. 6 crores has been allocated for the CAT plan. This amounts to about 0.7% of the total project cost which is estimated at Rs. 922 crores. The CAT plan is scheduled to be implemented over a period of 10 years, which includes a 5 year maintenance phase. Allocation of funds across various activities as regards the CAT plan is summarised in Table 5. 2.

Table 5.2: CAT plan interventions for soil conservation: Allain Duhangan (192 MW)

Interventions	Area	Amount (Rs)	Percentage
1. Plantations	300 ha.	17,748,610	28.8
2. Pasture development	1,795 ha.	11,446,380	18.6
3. Engineering works		26,537,500	43.1
4. Infrastructure and development		4,457,000	7.2
5. Establishment cost		1,385,000	2.3
TOTAL		**61,574,490**	

(Source: CAT plan (Revised) Allain Duhangan HEP. 2004. HP Forest Department)

4.3.1 Allain Duhangan fieldwork

Interactions with the Forest Department revealed that the CAT plan is in its initial stages of implementation. The implementation work started in 2005 – which is nearly two years after the project construction work had been initiated. Slip-treatment work had been done over 5 hectares and grass in trenches has been planted in Hamta DPF. A plant nursery has been established in the same forest and an old nursery revived in Bansai-Dug DPF. These nurseries are expected to cater to the plantation programmes both under the CAT plan and compensatory afforestation. The project authorities have quarterly review meetings with the Forest Department for speedy implementation of the CAT plan.

According to the Forest Department, a major threat to plantations established under the CAT plan was from the migrant labourers working on the HEP who use these forests for firewood. Most of the downstream villages (such as Prini, Aleu, Shuru and Jagatsukh) are economically better off and have access to liquefied petroleum gas (LPG)for cooking purposes (as per survey by Sarkar, 2005). However, they depend on the forests for firewood especially for heating during winter months. These villages are also heavily dependent on tourism and horticulture. Although plantation work has yet to be initiated, the forest officials were confident that the locals would not object if some zones are fenced off for this purpose.

The Allain Duhangan project has also been marked by protest by villages around Duhangan Nallah against the construction of the hydroelectric project as they feel that their river is being diverted. This will have adverse consequences for irrigation since the Duhangan Nallah feeds into two of their traditional irrigation channels or 'kuhls' that are crucial for horticulture and agriculture. This loss of their water rights is being viewed as a threat to diversify their cultivation towards growing of off-season vegetables.

In the view of local villagers, one of the pradhans[4] was hasty in accepting the notification for the setting up of the project and did not take other villagers into confidence, which led to confusion and dispute. When it was realised that water rights were being interfered with, a movement built up against the construction of the HEP. During fieldwork, it appeared that villagers around Allain Nallah had been compensated and project activities were focused around Allain. Villages closer to Duhangan were unhappy with the project and had filed a court case against the project authorities. They accused project authorities of buying land at exorbitant rates around Allain so as to 'buy-out' the villagers. As a result of the litigation, construction activities around Duhangan were behind schedule.

Most locals interviewed were not aware of the CAT plan, nor did they know anything about the interventions done so far in their forests. However, people in this region seemed to be more aware of the 'public hearings' as compared to communities around the Parvati-II catchment. The common response was that during these public hearings, the project authorities made promises about setting up schools and hospitals, and providing street

[4] Pradhan or Gram Pradhan is the elected head of a village

lighting and toilets, besides assuring opening up of avenues of employment for local communities. Invariably the discussions during these hearings would also boil down to land-compensations and a bargaining process for the same. One of the respondents admitted that at the public hearings, development issues at the village level were inadequately addressed, and environmental issues were almost completely ignored. Local people were more concerned about personal monetary benefits that could accrue from this project. This had created factionalism within the region and it had become difficult to convince others to understand the importance of broader issues such as the environment.

The villagers towards Duhangan Nallah were more articulate about making demands. They indicated that besides the public hearings, there has been a continuous contact with various levels of officials on account of differences between the local community and the project proponents as well as the State Government. They had a list of demands that included significant expansion of employment opportunities, an unemployment dole of Rs. 500 per month, 1% of project earning to go to locals in the region, subsidised electricity to affected villages, the installation of an effective sewage system and a “lift-irrigation” system that would compensate for the loss of water diverted to the project. Again catchment treatment was not an issue that was given any priority.

4.3.2 Allain Duhangan: broad observations

The potential of personal monetary benefits tends to factionalise the local community in and around HEPs. Broad environmental issues are put aside for short-term benefits. Under such conditions it may be difficult to initiate collective action and collective participation of locals in implementation of the CAT plan.

It is paradoxical that while the villagers were either ignorant or unconcerned about participating in CAT plans, and felt it was the Forest Department’s responsibility, there was evidence that some of these villages (such as Prini, Jagatsukh and Gojra) were protecting their local forest patches with considerable success through their traditional institution of ‘gaon’ (village) committees. These committees had been set up in response to landslide problems that have caused damage to their fields in the past.

The villagers complained that most of the project documents were in English and even when translated were technical and difficult for them to follow. As in the case of Parvati-II it is worthwhile to note that the project authorities and the State need to take the locals into confidence before project activities can commence. This is important if cooperation is sought for implementing and protecting the CAT plan interventions.

Several communities – and in particular villagers from Jagatsukh (near Allain Nallah) opposed the construction of the HEP due to an issue that involves an environmental service from the catchment – water. While the HEP promoters appeared to have based the project on hydrological data that shows an increase in water flow in recent years, this apparently is a consequence of glacial melting. As the glaciers in the catchment of Allain Duhangan melt, after an initial increase in water flow – as is currently being envisaged – there is likely to be a severe fall in water flow levels. This does not appear to have been factored in by the HEP

authorities. The CAT plan does not aim to address this issue. In any case, there is no easy solution that can be based on catchment treatment as the glacier melt is a phenomenon linked to global warming.

Estimates of water usage seem to have been based on a formula that looks at domestic water consumption, rather than water required for irrigation. Hence the estimates do not match actual requirements. This HEP provides an example where inadequate ground-truthing and fieldwork have resulted in an EIA report that neglects ground realities.

4.4. Project: Malana-I (86 MW)

The Malana-I HEP has been constructed at a cost of Rs. 330 crores and has been in operation since July, 2001. This run-of the-river project harnesses the water of the Malana Nallah which is a tributary of the Parvati River. The steep gradient of the nallah from the diversion site to its confluence with Parvati has been used for power generation.

Photograph 2: Pipeline and Powerhouse of the 86 MW Malana HEP

The catchment area of Malana is spread over 182 square kilometres primarily consisting of forest area and alpine pasture (68%). Nearly 21% of the catchment area is permanently under snow and 9% is stony rocky waste. Private land accounts for only 2% of the catchment area. As a major part of the catchment consists of steep hills, with scanty top soil cover, surface run-off is high. The density of settlements is low in the catchment area. Malana village – which is the only upstream village in the catchment area – is located about 3 kilometres from the dam site. Jari and Chowki are the downstream villages located near the powerhouse.

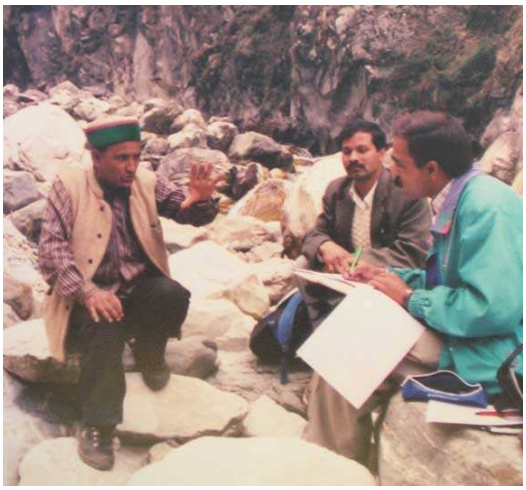
Discussions with the Forest Department indicated that the CAT plan treatment began in 2001, nearly three years after the construction work of the HEP had started. The original CAT plan has been made by WAPCOS. The Forest Department was consulted only for access to basic data. Due to lack of adequate ground-truthing, a revised plan was prepared by the Forest Department based on resources available in terms of broad heads such as pasture development, afforestation and engineering works.

Forest guards implement these measures in the field and local or migrant labour is used, based on availability. A summary of the CAT plan expenditure apportioned across different activities is given in the table below.

Table 5.3: CAT plan Interventions for soil conservation: Malana-I (86 MW)

Interventions	Area	Amount (Rs)
1. Plantations	300 ha.	3,300,000
2. Pasture development	220 ha.	2,420,000
3. Engineering works		996,600
4. Maintenance	520 ha.	3,359,500
TOTAL		**10,151,750**

Source: Revised CAT plan, Forest Department, Himachal Pradesh



Photograph 3: Interaction with villagers in Malana village

4.4.1 Malana-I fieldwork

According to forest guards grass planting (rye grass and tall fescue) has been successfully carried out in the high altitude grasslands of Chanderkhani, Nagruni and Shimshi. The guards were unable to comment on whether these varieties were suitable for these grasslands. Engineering works that were proposed have mostly been completed, especially in Bhandu Rasang DPF, and areas near Malana village. The guards indicated that two of the check dams built had been damaged by floods last year and these have not yet been repaired.

Though the CAT plan is near completion, progress as regards plantation of trees has been very low and so far only 40 hectares had been treated in Bhandu Rasang DPF, where 60,000 deodar saplings were planted. The target of 250 hectares has not been achieved. Furthermore, even where plantation efforts have been made, the survival rate of saplings was reported to be about 50-60%. Grazing of sheep and goats has been an important reason for damage in plantations.

The HEP authorities also confirmed low utilisation of funds. As per their evaluation, only about Rs. 30 lakhs has been spent on the CAT plan which is about 25% of the planned CAT expenses. Although officially the CAT plan is supposed to have been completely implemented, the project authorities did not perceive any difference in the silt load levels. The project authorities have their own mechanical de-silting mechanisms installed close to the dam site. The de-silting chamber installed just below the dam site can remove particles that are greater than 0.2mm in size. After the water passes through the de-silting chamber, it gets stored in a reservoir where an additional de-silting mechanism (a type of dredging system) is used to treat the water before it enters the head-race tunnel.

The project authorities had a limited role in implementation of the CAT plan and were unsatisfied with the results. Staffing limitations of the Forest Department and diversion of resources by the state hindered effective catchment treatment and the HEP authorities felt that they were in a better position than the Forest Department to implement the CAT plan.

With regards to the public hearing that was held before the project was implemented as per norms it was attended by the district collector, the sub-divisional magistrate, the local MLA, the pradhan [5]and other elected representatives of all the affected villages and the project authorities themselves. Besides discussing land compensation matters, the project authorities discussed benefits for villages in the vicinity of the project. There appears to have been little discussion on environmental consequences of the hydro-electric projects. As in the case of the other projects, most of the benefits seem to have gone to the villages downstream of the dam, (such as Jari and Chowki that are located in the vicinity of the powerhouse).

There is only one upstream village in the catchment area of this hydro-electric project. Village Malana is located 3 kilometres away from the dam site. There are around 220 households and the villagers are said to be descended from Alexander the Great . The village economy is dependent on sheep- and goat-rearing, medicinal herb collection, and the illegal sale of 'bhang' or marijuana. The village also attracts foreign tourists. Interactions with villagers at the dam site indicated that they were not at all aware of the HEP until construction work actually started. This was repeatedly stated during the interviews. The villagers claimed that they did not know about the 'public hearings' and nobody participated. Only one person, who was losing his water-mills near the proposed dam site, had been consulted and compensated. Other villagers had not been benefited in any way and were unaware of procedures for compensation. Some of the grazing areas had been lost due to the HEP construction and tree felling had occurred. The villagers appeared to be ignorant of the CAT plan.

4.4.2 Malana-I Broad Observations:

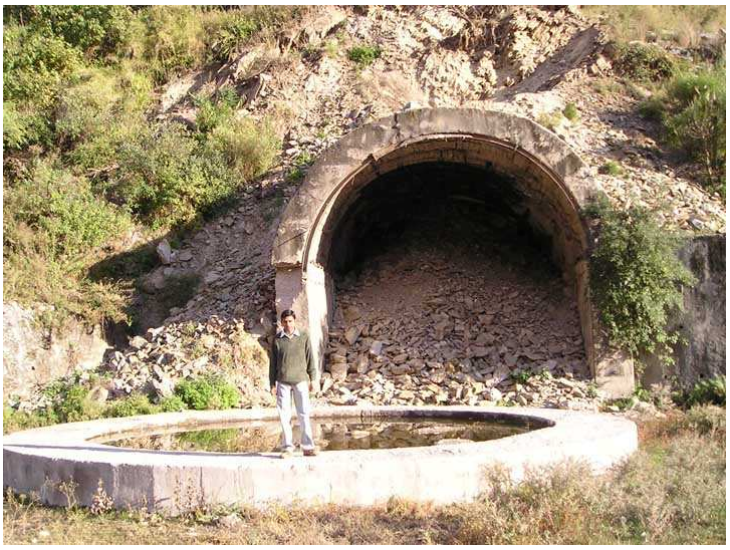
In Malana, as is the case with many of the other HEPs, the CAT plan was based on inadequate ground truthing and hence significant revisions were required and a revised plan needed to be made. Despite provisions for maintenance, damage occurring even during the construction phase of the CAT plan was not being repaired adequately. Consultation between the Forest Department and the local villagers was low leading to alienation and a lack of ownership of the CAT measures among the local populace. There was also fear among the locals that their existing means of livelihoods would be disrupted as a result of this HEP construction.

4.5 Nathpa Jhakri Hydro-Electric Power Project (NJHEP) (6X250 MW)

Nathpa Jhakri is a run-of-river scheme with an installed capacity of 1,500 MW (6x250 MW). The project makes use of the drop of 444 metres available in the river bed between village Nathpa in Kinnaur District and village Jhakri of Shimla District. A 60.5 m high diversion dam

[5] An MLA or Member of the Legislative Assembly is the locally elected member to the state legislature while a Pradhan is the elected head of the village.

at Nathpa can divert 405 cu metres of water per second into four intakes. The four-chambered underground de-silting complex is the largest of its kind in the world. The 27 km long head-race tunnel is also one of the largest and longest in the world. The submergence area due to the diversion dam is 16.50 ha. The project also proposes to utilise the water of an intervening stream – Sholding Khad – through a trench weir and drop shaft.



Photograph 4: abandoned tail-race tunnel near Nathpa.

The Satluj Jal Vidyut Nigam (previously known as Nathpa Jhakri Power Corporation) was incorporated on 24th May 1988 as a joint venture of Government of India and Government of Himachal Pradesh to plan, execute, operate, and maintain hydro-electric projects in Satluj River Basin in Himachal Pradesh. The Nathpa Jhakri project was the first project taken up for execution by this PSU.

4.5.1 Problems faced due to floods

The Nathpa Jhakri HEP has gained notoriety due to problems of flooding and associated damage. Three major floods in the catchment caused damage to this plant. A flash flood on the night of August 11-12, 1997 was caused by a cloudburst that impacted the Panvi, Sholding, Nugalsari, Manglad and Nogli tributaries. The floods caused heavy damage to the project site, roads, and equipment and resulted in deposition of thick debris material at the confluence of these tributaries. The flash flood damaged the bridge at Wangtoo across the Satluj, upstream of the dam site, and raised the bed level of the river by several metres for a 2 km stretch. A quarry site was damaged and isolated due to damage to the national highway (NH22) and equipment was washed away (as were as steel plates to be used for the Head Race Tunnel (HRT)). A total of 14 persons were reported washed away/missing from the project during this flood.

An even more severe flood occurred in the early hours of 1st August 2000. This was caused, most likely, due to the breaking of a temporary lake in Tibet. This flood considerably exceeded the maximum design flood discharge estimated for the site. This flood caused extensive loss to both human lives and property. The HEP de-silting chambers and tunnels were also badly damaged. Seventeen lives were lost in one contractor's camp alone. The river bed both upstream and downstream of dam and intake area had been filled with river bed material and huge boulders raising the river bed by 6 to 7 m. The floodwater entered de=silting chambers through a construction adit (an adit is a horizontal or nearly horizontal

entrance into an underground shaft built into the side of a mountain). It also entered the powerhouse cavern through the tail-race tunnel (TRT) by overtopping a flood protection wall and through an exploratory adit. Four generating units in the project that were in the advanced stage of erection were submerged under floodwater.

Finally, and most recently, according to the project authorities at Satluj Jal Vidyut Nigam at Rampur, the Nathpa Jhakri project had to be closed for the duration of almost two months between June and August 2005 following a flood-like situation attributed to the Parechu Lake formation in Tibet. The silt level crossed 80,000 parts per million (ppm) on one day in July 2005. Silt levels averaged 8,000 ppm for a period of 30 days between July and August 2005. The powerplant was shut down for about two months completely, first due to the flood for 28 days and then for about 22 days following the bursting of a labyrinth pipe in the design structure.

4.5 2 Catchment area treatment

A catchment area treatment (CAT) plan of Rs.296 million (original plan mentioned in the CAT plan gives details of Rs 287,965,170) was prepared by the Forest Department for Nathpa Jhakri Hydro-Electric Project. The Ministry of Environment and Forest, GoI, approved the same in March 2003. The details of the CAT plan are represented in the table given below:

Table 5.4: Allocations in the CAT plan of NJHEP (source: *Catchment Area Treatment Plan of Nathpa Jhakri Hydro Electric Project*, *District Kinnaur and Shimla, (2001-02 to 2010-11).*

Sr No.	Allocation head	Rs.
1..	Forest establishment and improvement	41,212,850
2.	Pasture improvement	6,024,950
3.	Subsidiary silvicultural operations	312,500
4.	Soil/moisture conservation works	100,511,200
5.	Avenue planting and landscaping	3,800,000
6.	Forest infrastructure and development	12,550,000
7.	Rural infrastructure and development	15,200,000
8.	Treatment of private land	5,300,000
9.	Wildlife Improvement	22,634,800
10.	Training awareness/extension/publicity/studies	6,734,000
11.	Operational support	27,993,800
12.	Agricultural and horticultural support	3,000,000
13.	Contingencies	26,791,070
14.	Animal husbandry	15,900,000
	Total	**287,965,170**

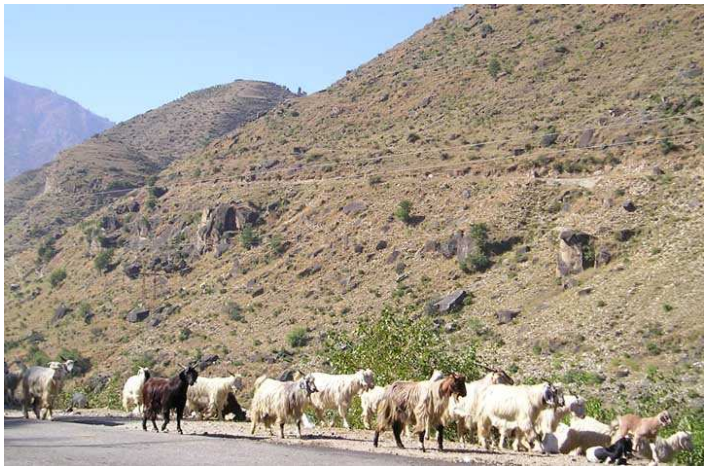
A Catchment largely untreatable

The majority of the Satluj catchment for Nathpa Jhakri HEP, almost 76% of the area, lies in Tibet and hence cannot be treated by a CAT plan. Of the remaining area, (i.e., within India), only a small proportion is treatable. A total of 26 panchayats of Nichar and Rampur divisions are covered by the CAT plan. The area is quite sparsely populated.

4.5.3 Nathpa Jhakri Fieldwork

Discussions with the local people and forest officials indicated the following rights of local people in the catchment area:

A. Grazing rights in most of the forests. There is no ceiling on the number of cattle that might be grazed. The graziers who use summer grazing facilities in Alpine pastures cannot allow their animals to graze outside *chaks* or boundaries to which they have rights, unless they have a special concession or have paid a grazing fee.



Photograph 5: Goats being herded in the catchment of Nathpa Jhakri HEP. Grazing by goats, sheep and cattle inhibits seedling growth and forest regeneration efforts

A large number of cattle were found to graze in the forest areas leading to damage to the vegetation as well as plantations. The right of grazing also comes in the way of instituting more closure so as to raise plantations as the consent of local communities needs to be obtained before plantation work can be carried out (Kumar 2006).

B. Collection of fuel wood: People have the right to collect dry and fallen wood for their domestic use as per the Forest settlement record and a large number of people are dependent on this for their day to day use. As there is insufficient dry and fallen wood, a considerable amount of lopping of green trees is also carried out.
C. Timber (TD rights): People posses the right to get timber at nominal rates for construction, repair and maintenance of their houses. The concessional rates were fixed at the time of Forest settlement. Due to the nominal fee, right holders are often very wasteful in their use of timber.

D. Cutting of grass and lopping of trees: The right to cut grass and lop trees for fodder purpose remains with the people. No fee was being paid to the Forest department for cutting of grass.

E. NTFP rights: the collection of non-timber forest products in the upper parts of the catchment is an important activity.

The CAT plan is to be implemented by Himachal Pradesh Forest Department. To improve implementation of CAT plans and to prevent money released close to the end of the financial year from lapsing a society, the 'Upper Satluj Valley Watershed Development Society' (USVWDS) has been constituted vide *H.P. Govt. Notification No. FFE-B (F) 2-73/97* dated 23-10-2002 for the implementation of catchment area treatment plans of all hydro projects at the planning phase or in existence, in the Satluj Valley basin. The CAT plan of HJHEP is also now being implemented by this society.
So far a total of Rs 45 million has been collected from the HEP promoter, of which the first two instalments (Rs 10 million each – 20 million in all) were deposited with the State Treasury. The third instalment, released on 31st March 2004 of Rs 25 million was deposited directly in the account of the USVWDS.

Utilisation of money has, as is the case with other HEPs, been fairly poor. A year by year breakdown of the money spent up to March 2005 is represented in the table below.

Table 5.5: Funds utilised in NJHEP CAT plan (source: Mr. C M Sharma, DFO *CAT Plans, Nichar)*.

S. No	Year	Expenditure incurred
1	2002-2003	9,638,900
2	2003-2004*	2,468,656
3	2004-2005	7,547,814
	Total	**19,655,370**

∗The Executive Committee of USVWDS approved an Annual Plan of Operation (APO) to the tune of Rs. 61,416,045 for the year 2003-04. Against this approved APO, the works amounting to the tune of Rs. 2,468,656 could only be carried out during 2003-04 due to non-release of funds. During 2004-05, an amount of Rs. 7,547,814 was utilised. A further instalment of Rs. 25 million deposited by Nathpa Jhakri Power Corporation(NJPC) was transferred to society account for use during the current year.

4.5.4 Nathpa Jhakri Broad Observations

Despite the large size and high degree of prominence of Nathpa Jhakri HEP, discussions with the local people in the catchment and the forest officials revealed many of the same problems that plague CAT plans elsewhere. These included:

- Impediments due to non release of funds.
- A lack of participation of the local people or their inclusion in CAT plan activities.

- Civil works in the form of check dams, gabions and gully plugs that were not combined with live planting. As a result the life of these structures is limited and according to one Forest Department official 'they end up contributing more silt than if they were not built at all'.

- Despite the vastness of the catchment, it appears that CAT plans may have an important role to play as the project authorities have identified some nallahs (small tributaries of the Satluj River) that contribute a large quantity of silt. Treatment of the micro-watersheds of these nallahs is likely to have an impact on the silt load at the HEP.

The focus of the project authorities on the CAT plan has, however, increased as a result of excessive silt loads and flood damage. This was found to be different from most other project sites. Also, the area was unique in that an autonomous agency – the Upper Satluj Valley Watershed Development Society – had been set up to use the CAT plan money. While the society does not, as yet, envisage significant people's participation, the structure of this society as an independent agency sets an important precedent which can be used for setting up similar legal entities with a greater focus on local communities.

5. Resolving the hydrological dilemma: do CAT plans work?

There exists considerable confusion and debate over the utility and function of CAT plans. A large part of the problem lies in their implementation. However, it would appear that even a well-implemented CAT plan cannot insulate a HEP from damage or closure due to large silt load. Based on the understanding of Himalayan silt loads and CAT plans, as they are made, the following generalisations can be made.

5.1 Impact of catchment area treatment on silt load and water flow

The objective of CAT plans is to reduce the silt levels that reach the HEP, and to ensure a more regular flow of water. The obvious question then is: how effective is catchment treatment, if carried out correctly, in achieving these objectives?

It would appear that catchment area treatment has limited impact on silt loads and water flow. There are several reasons for this:

A. In the case of large hydropower projects, a relatively small percentage of the catchment (often as low as 1% or less of the total catchment area) is treated through CAT plans. In any case, well above 90% of the catchment area is typically left untreated and continues to contribute sediment as before.

B. Heavy loads of silt can be caused by catastrophic events such as cloudburst or glacial lake bursts. many of the problems that have occurred in Nathpa Jhakri, for example, have been due to these above reasons or other geological faults which CAT plans will not impact.

C. An increase in events such as glacial lake formation and collapse is predicted due to global warming. This is occurring due to melting of glaciers, which releases the terminal moraine and sediments. Glacial melting, which is occurring at very high rates in the Himalaya, is also resulting in the release of higher than normal amounts of water at present. However, once the glaciers shrink in size, this excess water will gradually taper off and water paucity during the summers will become more severe. These events are occurring due to global changes and will not be influenced by catchment treatment.

D. The Himalaya are among the most geologically unstable areas of the world and have the highest natural erosion rates of any land form on this planet. The base silt load of this region is high and catchment treatment will not change this.

E. The dynamics of silt flow in a river are complex. Erosion rates from a single slope cannot be extrapolated to the entire watershed. While the sediment delivery ratio, or SDR (ratio of erosion occurring on site and that at a point in a stream –see Chapter 2) may be 90% for a 1ha catchment, it would be 20% or less for a large river basin. Given that sediment is stored in large catchments, and released gradually, the impact of catchment treatment for a large catchment will take several years to be exhibited.

F. Hydroelectric projects already have mechanical methods of reducing silt, (i.e., de-silting chambers and sedimentation ponds), that can remove a high proportion of the silt load at a relatively reasonable cost. From a project perspective investing in superior de-silting chambers may be a cheaper and more reliable method of reducing silt load than expenditure on CAT that experience shows has been largely ineffective. For example, a 'Forum of hydro power developers' recently formed in the Satluj basin, advocates the building of four upstream storage projects to trap some of the sediment that comes in from Tibet (The Tribune 2005b).

Thus, if the HEPs already have a more reliable technique of silt removal and the impact of catchment treatment is not well understood, the question remains as to why carry out catchment treatment at all.

5.2 Is there then a need for catchment area treatment?

The role of Himalayan geology in silt contribution has been acknowledged in this report. For huge catchments, such as that of the Satluj, that lie in part outside the boundaries of India, CAT plans will have limitations. For distant and inaccessible parts of the catchment, alternative silt reduction measures may be needed in addition to CAT plans. However, most HEPs have much smaller catchments which respond far better to treatment.

The question of the need for catchment treatment is an easy one: it is absolutely clear that there is a need for catchment treatment in the Himalaya. While it is true that there will occur occasional catastrophic events which cannot be controlled through catchment treatment, there are nonetheless several benefits of carrying out this activity:

A. The above point on sediment delivery ratio actually supports the need for CAT plans. If larger catchments have a lower SDR, then the need for treatment of the catchment that is close to the intake of the HEP is clear. The HEP catchment can be divided into several smaller catchments. All other factors remaining the same, catchments that are closer to the HEP will contribute more silt load per unit area than distant catchments. Silt eroded from distant watersheds is more likely to get deposited in areas where the river naturally slows. In terms of SDR, a distant catchment will per force be part of a large watershed and hence have a lower SDR. CAT plans focus on areas that are close to the water intake point of the HEP. These areas are more beneficial to treat than upstream sites.

B. Some areas, such as the Siwaliks, are known to suffer from much higher levels of erosion if the forest cover is disturbed. As per one study (GBPIHED 2002) sediment yield from the Siwaliks is estimated to increase 15 fold when deforestation occurs in this region. Such areas can be prioritised for CAT and have significant impacts on sediment yield.

C. HEPs in the Himalaya often suffer from being subject to a higher silt load than their sedimentation ponds can handle. If CAT can even moderately reduce silt load, there will be benefits accrued by the HEP. For example, despite having the largest de-silting chambers in the world, excessive silt loads have caused turbine pitting, damage to tunnels, and intermittent closures of the Nathpa Jhakri HEP in Himachal Pradesh.

D. There is some evidence that the particles eroded from the mid Himalayan sites closer to the HEP are of a size that is more damaging to turbines. Sandy soils eroded from deeper in the Himalaya settle down more easily in sedimentation tanks. Similarly, the sediment released from retreating glaciers tends to be larger in size.

And then there are several benefits of catchment treatment that extend to well beyond the HEP:

E. Catchment area treatment helps maintain forest cover and a range of environmental services that are provided at a disproportionate level by the mid-elevational forested areas, which also tend to be heavily populated. In terms of ecosystem services such as carbon sequestration, biodiversity, and impact of humans, a mid-elevational forested area is a lot more important than a cold desert in Tibet.

F. Integrated efforts at catchment treatment can develop livelihoods for local people and uplift them from a cycle of isolation and poverty. Such rural development efforts are as important for the 'greater common good' as is the generation of electricity. It can also help develop a cadre of local people who can support and provide services to the HEP.

Catchment area treatment, if correctly and sensitively carried out, is thus an essential activity that will benefit the HEP, the local people and the greater global community.

5.3 Is forest cover key to catchment treatment or are good management techniques more important?

This subsection attempts to assess the relative importance of 'land use' and 'land management'. Do forests, for example, always result in lower silt erosion and higher ecosystem services than agricultural land? Or does the kind of management of the forest – or the agricultural land – determine the quality of environmental services it provides?

CAT plans, or for that matter most watershed plans, focus on the need for high forest cover and recommend reforestation as the long-term solution for most catchment problems. In fact, there exists considerable confusion on the difference between CAT plans and compensatory afforestation, as the activities envisaged are similar. For the values that are desired by a hydro-electric project, afforestation may not be the obvious answer. As discussed in Chapter 2, forests do not increase the water yield to the catchment, nor are they the only means of cutting down silt flow. In fact, grasslands do a better job in ensuring water yield and are as good as forests in reducing silt and sediment flow.

While changing land use or converting a wasteland into a forest is a time-consuming process, influencing land management may be of greater benefit and can be achieved more easily. However, few (if any) CAT plans focus on changing management patterns without changing land use. For example, in order to check soil erosion, the undergrowth and forest litter is more important than a forest canopy. Forest litter usually results in a porous surficial layer into which water soaks, and has a higher probability of infiltration. The undergrowth

and rough surface layer also help break the flow of water and trap sediment particles. In areas where the soil has been cleared of vegetation and litter to reduce fire hazard, or where litter is collected for livestock bedding or to make compost fertilizer, soil erosion can be quite high. Thus rather than promoting afforestation, CAT plans need to put in place management regimes that prevent mineral soil from getting exposed.

The focus of the forest department is on trees. “Foresters are trained to look up - not down” is a commonly repeated saying. An obsession with canopy cover and basal area, and inadequate attention to ground cover, is a common trait seen in foresters the world over. While appropriate when the focus is on silvicultural systems and timber yield, for watershed management changed paradigms are needed. In the hills, vast areas of so called ‘good forest’ – broadleaved forests with good canopy cover – have actually lost much of their ecosystem values. Repeated removal of leaf littler to make a compost fertilizer that is used to sustain agricultural productivity results in exposed, eroded, and compacted soils (Thadani 1999). Despite the good canopy cover, these forests have a high loss of nutrients and encourage very limited water percolation.

Similarly, the slope of terraced fields can result in huge changes in soil loss. Work in the central Himalaya (Sen et al. 1997) has shown that sediment losses can be 10-100 times higher in strongly sloping agricultural terraces (6-10^{o}slope) compared to gently sloping terraces (<2^{o}slope).

Thus, land management is perhaps even more important than the type of cover. A well-managed agricultural field with soil conservation measures in place is likely to have much lower sediment yields and high water recharge values than a forest with good canopy but no undergrowth.

5.4 Payment for catchment protection

A contentious issue with the HEP promoters is the amount of money that needs to be paid for the CAT plan. The HEP promoters feel that there is little impact of the work being done through CAT and that they have little control over the use of these funds.

The issue of what costs a HEP promoter should bear is not an easy one to resolve. In addition to the direct costs of the project, it would seem fairly clear that the HEP promoter should bear the cost of resettlement of displaced people, cleanup of debris, compensatory afforestation in lieu of forest damaged or diverted, and other such costs directly related to its intervention. But should it, for example, bear the entire cost of a road that will be used equally by local people? An examination of recent government opinion on the subject of what costs, other than the direct costs, an HEP promoter should bear throws up some interesting issues.

According to the Parliament Standing Committee on Hydropower (Government of India 2005):

> '…since development of hydro projects in a State results in economic benefit to the State due to triggering of economic and commercial activities around the project site and R&R, flood moderation costs were also included in the capital cost of the project, the provision of 12% free power, needed reconsideration as the provision did not apply to thermal power projects.'

Furthermore

> 'The Committee were of the considered view that …….. the states be pursued to forgo the provision of 12% free power for initial some years so as to make the projects economically viable. '

The Government of India however responds that all costs arising as a result of project activities should be borne by the project.

As per the Planning Commission:

> 'Planning Commission has consistently maintained that all costs such as roads, mitigation of environmental or ecological damage, security, R&R etc. are directly resulting from the project should be included in the project cost. This is in accordance with the best international accounting practice and will preclude development of uneconomic and unsustainable site based on erroneous or incomplete cost numbers'.

As per the Ministry of Finance, Department of Expenditure, costs incurred 'as a direct consequence of a project' are an 'integral part of the total project cost and must be included accordingly'.

Thus, from the above, it would appear that while 'all costs that result directly from a HEP should be included as an integral part of the total project cost' at the same time, an HEP should not be burdened with unreasonable costs.
Interestingly, the cost of the CAT plan is not ever questioned as an unreasonable cost. This is perhaps because, as stated earlier, CAT plan costs are often linked together with compensatory afforestation costs – which are costs arising due to the impact of the HEP. However, much of the damage in the catchment that the CAT plan seeks to repair already existed. The HEP will normally have caused minimal if any damage in the catchment. The civil work – be it in the form of tunnels in the mountain, dumping of sediment, or activities around the powerhouse are mainly below the dam or barrage and not in the catchment of the HEP. Hence, asking the HEP to pay the entire cost for catchment treatment may not even be justified.

Typically it is the government that takes on the role of catchment protection. This model of government expenditure for afforestation and catchment treatment can be seen across the country. Loans for such watershed activities have been taken by the government and financed by the World Bank and various bilateral agencies. As the HEP benefits from the impacts of a well-protected catchment, it is justifiable to expect the HEP to contribute towards the costs of protection. However, at present the HEP is being asked to pay for costs

of catchment protection as well as to support indirect costs in terms of government expenditure to maintain its own infrastructure and organisation. It appears that CAT plan costs, rather than being an additionality, are used to offset not just the government's programmatic costs but also its fixed costs.

This appears to be unreasonable. While getting the HEP to pay for the cost of a treatment done in the catchment over and above what would normally have been done is justified, getting the HEP to pay for the cost of a forest guard who in any case would be stationed by the forest department in that area appears to be excessive. The CAT plan costs should be treated as an additionality for that catchment, rather than a substitute for government funds that were being spent on the area. This would allow for a larger pool of funds and greater coverage of the catchment area.

The need for catchment treatment and the financial losses suffered by HEPs due to excess silt loads have brought into focus the need for catchment treatment. In the case of Nathpa Jhakri, for example, between April and September 2005, three of the project's six units had to be brought to a halt due to excessive sedimentation of the reservoir. This high sediment load resulted in damage to parts like runners, guide vanes, labyrinth seat and cheek plates and a revenue loss of Rs. 2.5 billion in addition to repair costs. Thus, during the rainy season, when sufficient discharge is available, it may not be possible to utilise the full generation capacity of Nathpa Jhakri due to the high silt load.

So severe is the threat due to high silt content, that in the Satluj basin the HEP operators recently got together to form a forum, named the 'Forum of Power Developers of Satluj Basin' (The Tribune 2005a). This forum then urged the state government to formulate a comprehensive project for the ecological rehabilitation of the degraded catchment of the river. The forum has pointed out that the piecemeal implementation of catchment plans for individual projects was not proving effective. As per this forum, total funds under the catchment area treatment plans for various projects will amount to over Rs. 300 crore, which could be more effectively utilised if a comprehensive project was framed and implemented through an independent agency on the pattern of the foreign-aided forestry projects (The Tribune, 2005b).

Thus, while ensuring catchment treatment should be the responsibility of the HEP, it would be only fair if the HEP promoter is given some control over the expenditure of its funds. The CAT plan should be viewed as a means to treat the catchment to ensure improved environmental services rather than an imposed environmental tax. Suggestions are made in a later chapter on institutional mechanisms that would enable such an arrangement. While such institutions would need to protect the interests of the forest department, and thus have strong representation of the same, they would also need the independence to function towards the objective of improved environmental services.
Quantifiable monitoring mechanisms would need to be rigorously implemented to ensure that environmental services improve. A system of penalties and disincentives coupled with incentives for high quality catchment treatment could make the process be taken seriously by the implementing agency.

6. Implementing CAT plans: ground-truthing the process

While limitations do exist to the impact that CAT plans can have on erosion and water flow processes, it is clear that CAT plans can significantly reduce sediment loads and influence water percolation and flow. However, in practice, rarely do CAT plans significantly alter sediment flow characteristics and lead to benefits for the downstream HEP. Significant problems in the implementation process were admitted to by even the most optimistic officials.

The objective of this chapter is to analyse the implementation of the CAT plan. The involvement of local communities is looked at, and reasons for poor participation analysed. In order to suggest changes in the system and determine the potential to incorporate mechanisms that increase the participation of local upstream communities, the system of catchment area treatment, as it is currently being implemented, needs to be understood. The process of implementation of CAT plans can be discussed in regard to several issues:

- Perception of the CAT plan.
- Release of funds and fund utilisation.
- Coordination between the 'Forest' and Environment' sectors.
- CAT plan implementation.
- Involvement of local communities.

6.1 Perception of the CAT plan

The objective of CAT plans is to improve the quality of environmental services for the HEP. While this objective may be stated in project documents in various forms ('to provide cleaner water' or 'to buffer water flow'), rarely is it stated by any stakeholder.

Most often, it is thought of as 'a fund to plant trees' and is linked together with the compensatory afforestation (CA) fund. While both are paid for by the HEP promoters and implemented by the forest department, their objectives and *raison d'etre* are very different. While CA is a payment for diversion of forest – i.e., a payment for a decrease in forest cover caused by the hydro project, CAT is an investment in the land and its people to reduce silt. Villagers, and even some officials, were not able to distinguish between CA and CAT.

More worrying was the low expectations that stakeholders had of CAT plans. Project proponents do not view the CAT funds as investments for the future of their hydro-electric project, or even as a voluntary effort to treat catchments. Instead they view them as a regulatory payment – a sort of tax levied by the government. Problems of high silt load are dealt with by improving sedimentation pond design or making turbines more resistant to pitting. None of the HEP officials spoken to suggested further investment in catchment treatment as a practical way to reduce silt, though many said that 'in theory' this should work.

The state views CAT funds as a source of revenue. The reluctance of states in accepting the CAMPA notification, which envisages a central authority to manage the CAT funds, is indicative of this viewpoint.

Local communities are often not even aware of CAT plans and at best think of them as interventions being carried out by the forest department as per their regular workplans.

6.2 Release of funds and fund utilisation

Several problems with release of funds have been reported at the field level:

A. Delays in release of funds and diversion: a timely release of CAT funds seemed to be rare. Funds are either diverted for other purposes, or those that are released are typically made available very late in the financial year which restricts the opportunity to utilise these funds as per plans. For afforestation work, a planned and regular release of funds is required as funds need to be available at critical junctures such as during nursery establishment and planting. These activities are seasonal in nature. Irregular release – especially if it is close to the fiscal year end – leads to the need for rapid expenditure, and activities such as engineering measures, capital purchase, and infrastructure get prioritised. Thus, often, a significant proportion of the money that reaches the forest department gets utilised in overheads and administrative expenditures. CAT funds are also apparently used for the forest department as a substitute for plan funds and regular budgets may be reduced in areas where sufficient CAT funds are being given.

B. Partial release of CAT money from project authorities: when funds are not released in time and cannot be properly utilised, they lapse and hence utilisation certificates cannot be presented to the project proponents. As a result the hydro-electric authorities often stall the further release of funds leading to incomplete implementation of the CAT plan.

These issues are well recognised and prompted the Supreme Court to recommend a centralised fund. This led to the creation of the CAMPA in 2004 as described in this paper (Chapter 3 and Annexure 1). Resistance from states has, however, prevented the operationalisation of CAMPA. Recent statements (Government of India 2005) made by the Parliaments Standing Committee on Energy are instructive on these funding delays and diversion:

> ‘It has been brought to the notice of the Committee that the preparation of the Catchment Area Treatment (CAT) Plan is being routed through the State Government which has made the entire process a complicated one. At times, the cost of community halls, rest houses, liaison offices, rural infrastructure development (construction and repair of roads, improvement of religious places, construction of village crematorium) and other infrastructure works are loaded on the project cost under this head.’
>
> Recommendation (Sl. No. 33, Para No. 5.97).

Furthermore, it is noted that:

> 'The Committee find that the States have been unable to meet the projected targets and at times the money transferred to State Governments has been diverted to the general revenue budget of the State. As regards achievement under CAT and Compensatory Afforestation Plan, it may be noted that as against 7 lakh hectares, only 4 lakh hectares have been put under Compensatory Afforestation and CAT Plans. Of Rs.850 crore earmarked to States, the utilization has been only Rs.500 crore.'
>
> Recommendation (Sl. No. 34, Para No. 5.98)...

Case studies of CAT plans presented in Chapter 4 of this report also attest to this problem of low fund utilisation and availability.

6.3 Coordination between the 'Forest' and 'Environment' sectors

Sectoral differences and a lack of coordination hinder the efficacy of implementation of CAT plans. While many of the activities connected to the approval of the EIA are linked to the Ministry of Environment and Forests, sectoral divisions within this ministry need to be mentioned.

MoEF has within it two major divisions – Environment and Forests (wildlife is treated as distinct from forests, but for the purpose of this discussion, it need not be mentioned). Other than a common secretary at the apex, the divisions are fairly well separated and often differ on issues. The fact that most of the officers who deal with CAT plans – from the Divisional Forest Officers (DFOs) on the ground, to the Inspector General and Director General at the apex – are from the forest service, distinguishes them from most officers in the Environment wing and further accentuates the differences in opinion. The dichotomy of these two wings of the MoEF were recognised by the Standing Committee on Energy, which commented: 'there is a need to have a better coordination between the two wings of MoEF so that there is neither any duplication of work nor any undue harassment to the project proponent' (Government of India 2005).

At the state level too these differences persist. In Himachal Pradesh for example, 'Forests' and 'Environment' are completely separated. The State Pollution Control Board, which is entrusted with the EIA process, is headed by the Principle Secretary (Science and Technology). Members of the board include the Urban Development, Industry, Power and Health Secretaries. However, the Forest Secretary is not represented on this board.

The EIA notification is for a large number of projects. Most of these projects are of the kind that can potentially create pollution or lead to population aggregation. Most of them do not involve any significant diversion of forest lands or need for activities such as catchment treatment. The hydropower project is thus an unusual case where the main environmental

impacts are on forest lands, and where forested area can have a major impact on the functioning of the project.

While having the State Pollution Control Board (SPCB) as a nodal agency for EIA is appropriate for most kinds of projects, the need to involve the forest department in EIA appears not to have been envisaged. So much so that even the panel constituted for public hearings does not officially consist of a single forest department representative despite the fact that most of the impacted 'public' in a HEP lives on and around forest lands and is dependent on these lands. These apparently inadvertent omissions have led to generally poor sharing of information between the representatives of the Environment (often the SPCB) and the forest departments.

6.4 CAT plans on the ground

The largest set of problems appeared to be in the way in which CAT plans are implemented. A critical issue, that of involvement of local people, is intentionally left out of the discussion at this stage as it is taken up separately in the next point.

A. Lack of recognition of ground realities: there is limited time available for the technical consultant to make the EIA/EMP report. These reports also contain several plans other than the CAT plan. While the inputs of the forest department are usually taken, the plans often do not recognise many of the ground realities. One CAT plan for an Uttarakhand HEP, for example, showed a workable area of 330 sq km, but subsequent analysis by the forest department found that only 100 sq km was workable. More disturbingly, against a plantation target of 12,300ha, it was found that only 257 ha were available for plantation – a mere 2% of what was envisaged in the CAT plan. These factors, as well as realities of fund release, usually result in the forest department making its own revised CAT plan which may have priorities very different from those envisaged by the original plan.

B. The implementation of the CAT plan is usually not an additionality: CAT plan works are usually the responsibility of the existing forest department infrastructure. It is implemented by the DFO and other forest department staff, in addition to their normal duties. Most of the work on the ground is actually done by the forest guards and deputy rangers of the concerned beats. Also, many of the CAT plan works are done in place of work that would normally have been done by the forest department in that area.

C. Work schedules are driven by availability of funds: rather than following a time schedule and plan, in practice, the availability of funds drives the implementation of activities. As a result, as mentioned above, time insensitive activities – such as engineering measures – tend to get prioritised, while vegetative interventions with longer lag times and seasonal specificities get neglected.

D. Sectoral expertise for integrated plans: the CAT plan is not a forest development plan but rather a plan to reduce silt. It is, however, implemented by an agency, viz. the forest department, that quite naturally prioritises forests. Thus, forest plantation tends to get a

lot more focus than is needed. Activities such as pasture development are sometimes neglected though they may be more appropriate to achieve the objectives of the CAT plan.

E. Technical rigour lacking in some areas: another issue in this regard is that junior officials of the forest department, with little expertise in civil construction, are often in charge of the engineering work. Structures created may be simplistic and not appropriate to the needs of the catchment. In fact structures that may, over a period of time, increase rather than decrease silt flow were also evidenced.

   Civil structures are often not bolstered with planting of shrubs and grasses that will stabilise them. Civil engineering structures age and decay with time and have a limited life span. Planting of appropriate shrubs and grass species can help sustain the function of these structures. A gully plug or check dam may, for example, increase availability of moisture and topsoil in its vicinity. Planting done in this area is more likely to succeed and show rapid growth. These shrubs and grasses can then take over the function of the gully plug and reduce soil erosion, break the flow of water and increase infiltration. However, if such planting is not carried out, the civil structure will within a few months or years get filled and either collapse or cease to be of much benefit.

F. Weak monitoring mechanisms: the CAT plan is both implemented and monitored by the forest department. While in theory an independent evaluation is coordinated by the MoEF at periodic intervals this may not take place, or is often too perfunctory to be of any significant value. While checks and counterbalances have been evolved by the forest department to prevent misuse of funds, the lack of accountability limits the quality of work that is normally carried out. There are typically no systems of reward for good quality work and neither any significant checks for failures that occur at the departmental level, for example due to late release of funds.

Hence, it is difficult to pick out any one weak link in the implementation process. Financial resources are not made available when needed, technical experts are not included, those who implement the CAT plan already have a full work load, monitoring mechanisms are weak, and incentives are almost non-existent.

6.5 Involvement of local people in CAT plan implementation

Finally, but most importantly from the perspective of this report, the involvement of local people is discussed. Again, it is almost universally acknowledged that local people have very little role in CAT plan implementation. This is a critical point and it dooms the CAT plan to failure in populated catchments. Several issues need to be looked at to understand the reasons for inadequate participation by local people:

- Regulatory Mechanisms: does existing legislation provide for people's participation?

- Participatory planning processes: is the participation of people encouraged while developing the CAT plans?

- Participation during implementation: does the implementing agency encourage or provide space for the participation of people?

6.5.1 Regulatory mechanism for involving people

The environmental public hearing is the main forum in the EIA process for the involvement of local people. While as per the 1997 *Amendment* to the EIA act, holding a public hearing is mandatory for all projects to which the EIA notification applies, there is very little in the legislation that would encourage people's participation in catchment treatment. The public hearing procedure itself has been criticised (Sinclair and Diduck 1999). There is no legal provision of follow-up or means to encourage the participation of local people. The hearings occur at the *operational* level of planning, which limits the types of issues raised and considered by the public. Hearings at an earlier stage of planning in the process (the normative level), when strategic decisions are to be made, would help the process.
While the CAT plan takes up a major share of the EMP budget, there is no provision for ensuring forest department participation. The officials present at the public hearing are from the SPCB – which is the nodal agency for these hearings, the district administration, other state government officials, and municipal or panchayat representatives. The forest department is neither mandated to attend and nor is it usually represented. Thus, at the only forum in the entire EIA process where the participation of the public is sought, the agency that implements the CAT plan is usually not represented at all.

6.5.2 Participatory planning

In practice, the public hearing is the only forum where the concerns of the public are heard. However, limited field visits and a survey of the literature (e.g., Sinclair and Diduck 1999) indicates that these are not very effective. Some of the problems identified with public hearings are:

- Information that could help the public understand the purpose and objective of the public hearings is generally not provided prior to the hearings.

- The summary documents of the EIA are typically hard to access for the public The full EIA report is even more difficult to access (though this is changing through access via the internet) and the general public are often told that they first need to have written permission.

- In many cases, summary documents are available only in English, despite the legal requirement for translation into local dialects.

- The venue of the public hearing is sometimes changed at the last minute and may not be the most accessible site for the villages that are impacted.

- The 'hearings' are more in the nature of 'consultations' with the panel usually being 'willing to listen' but unwilling to make any commitments. There is no decision-making power in the hands of the public hearing committee or general public.

- Follow-up is almost non-existent so the public has no means of ensuring, or even ascertaining, that their suggestions have been recognised or incorporated in the EMPs.

The focus of these public hearings is on the individual rather than the collective and issues discussed are typically related to relief, resettlement, compensation, livelihoods and the building of infrastructures. Concerns of forest damage or conservation rarely get discussed. Despite their large share of the EMP budget, CAT plans are rarely discussed as they do not have an immediate bearing on the lives of the local people. Thus public hearings are at best a means for concerned citizens to air their concerns. They are not a forum that encourages participation in planning processes.

The CAT plans themselves also do not usually build in any provision for public participation. They are seen more as technical plans and typically very little space is allocated to encouraging public participation. While the plans identify the agency to carry out the work, and usually list the kinds of civil structures and species of trees and grasses that are recommended for planting, they are silent on institutional mechanisms. Exceptions to this do exist; for example, while the original CAT plan for Vishnuprayag HEP made almost no mention of people's participation, the revised CAT plan made by the forest department and approved in Dec 2003 has a strong focus to strengthen village institutions and involve local communities in implementation.

There are relatively few rules that govern the making of CAT plans. There are a large number of technical consultant groups in the market and each of these follows a slightly different procedure and subscribes to different values. Most of these CAT plans, in turn, go through very extensive revisions by the forest department prior to implementation. The DFO and Conservator of Forests (CF) in charge of the division may introduce several new elements, and sometimes complete paradigm shifts, to reflect their priorities. The few very progressive plans that encourage community participation appear to be a reflection of concerned forest officers. Thus while the process of CAT plan making is flexible enough to allow for the introduction of community participation and developing community ownership, these are not prioritised in most plans. In general, therefore, opportunity for community participation is lacking.

6.5.3 People's participation during CAT plan implementation

As described above, there is little provision made for community participation either through legislation or during the planning phase. There is consequently little need or incentive to include participatory processes during implementation. While there are isolated instances where a proactive forest official makes a lot of effort to include community participation, this is normally the exception rather than the norm.

Community involvement in CAT plan implementation is normally limited to wage labour. However, even this rudimentary level of participation may not occur. Many of the HEPs in the Himalaya are at higher altitudes and in sparsely populated areas rich in forests and

grasslands. In the summer and monsoon months there is an abundant crop of medicinal plants, morels and various other lucrative NTFPs which are collected by the local people. The income derived from these is much higher than wage labour from working in CAT implementation. Consequently, in many cases, the forest department is forced to hire labour from outside the region.

For implementation activities, the existing forest department infrastructure is usually used. The DFO has the added responsibility of a CAT plan to implement, and the forest guards are required to execute and monitor implementation activities in addition to their regular beat duties. Thus the implementation of CAT plans is an added responsibility on existing infrastructure. Implementation is hence easiest to achieve when work is done through a simple contractual process. Building up consensus and participation, while more effective in the long run, is more time consuming and requires considerably more effort. It also requires a greater amount of flexibility than a target driven approach.

Given the lack of additional manpower, unpredictable budget releases, and the lack of any incentive to ensure participation, it is perhaps only to be expected that community participation will be kept to a minimum.

Finally, the forest department is the legal guardian of forest lands and the laws of India are preservationist rather than management oriented. In the early 1980s concerns about the impact of ‘out of control’ logging on the provision of watershed services like silt control and biodiversity conservation led to a few states and the centre instituting logging bans on green felling, especially in hilly areas. Currently the forest departments have to demonstrate the existence of a valid working plan and financial resources for regeneration prior to timber harvesting. In this scenario, despite Joint Forest Management (JFM), we still have a long way to go before local communities have a significant say in forest management decisions.

Given all of the above, it is perhaps unrealistic to expect community participation mechanisms to be developed or encouraged during CAT plan implementation on their own. The next chapter looks at options for involving communities in CAT and specifically, the scope for IBM-type mechanisms for securing watershed services.

7. Involving local communities in CAT plans: IBMs and beyond

Reasons for the low success of CAT plans have been analysed in previous chapters. CAT plans have had little impact in reducing silt flow to HEPs. Arguably, the greatest drawback of the CAT plans is their failure to acknowledge the presence of humans in catchments and recognise their impact. Most plans offer biophysical solutions to the problem of degradation.

While CAT plans aim to treat degraded areas, they typically fail to look into the causes of degradation. Forests are usually planted in areas where they previously existed. Degraded forests are usually not a 'natural' phenomenon – they are the result of human activities. The failure of regeneration to establish after a forest has been damaged or destroyed can often be attributed to the nature of local use, and lack of incentives for local people who use these forests. Thus high levels of grazing of cattle, forest fires, or continuous removal of the regenerating saplings all affect regeneration and plantation 'survival'. Replanting trees in these areas will often not succeed, all other conditions remaining equal. Continued grazing by domestic cattle or unsustainable extraction practices will result in the mortality of these seedlings. Fences offer little protection on their own. It takes little effort to breach them, and repairs rarely happen. Forest departments across the country have experienced plantation failures due to non-cooperation of the local people.

Civil engineering measures also have limitations. Firstly, a significant proportion of the gullies or stream banks that need to be treated are not naturally erodable, but have been damaged due to human activities. Treating these gullies or stream banks is perhaps akin to putting a band-aid on an elephant being bombarded by bird-shot. While the gully may be treated – if only temporarily – new eroded areas will keep appearing as the root problem is not being tackled. Also, much of the engineering work appears to be done independent of biotic measures. Unless grasses or shrubs are planted to stabilise the civil work, the solution will not be long lasting.

Thus, there is a need to acknowledge and address the impact of human interventions in the catchments. As has been discussed, the Himalaya are heavily populated and there are few areas below the snow line where human use does not exert considerable influence. This may range from permanent settlements and agricultural fields, to less obvious interventions – migration of nomadic herders with their cattle and sheep, for example, can change the ecosystem attributes of a forest without significant visible evidence in the canopy.

It is imperative, therefore, to recognise these causal agents of degradation and to try to alter their impact. People cannot be excluded from forested areas. Even if habitations are sparse, the impact of graziers alone can be significant (Ahmad et al. 1990; Gupta 1978; Tashi 2004). These local user populations must be included in plans for catchment treatment if good results are desirable. Thus the focus of CAT plans needs to be as much social as it is biophysical.

The success of any soil conservation programme in populated areas depends on the active involvement of hill farmers. However, unless the investment in conservation can be demonstrated to be worthwhile to the farmer – either in increased productivity or direct

compensation – the programme will fail (Kattelmann 1987). This has been demonstrated repeatedly across the Himalaya.

One of the first and most well known examples of people-motivated watershed development in India is the case of Sukhomajri. Sukhna is an artificial lake constructed in 1958 as a recreational facility for Chandigarh. In the early 1970s the very high siltation rates of this lake were attributed to acute degradation in the hills upstream of the lake, near Sukhomajri village. Studies revealed that technical work in soil and water conservation would have little impact, and the only way to reduce silt to Sukhna was to convince villagers in the Sukhomajri area, which was responsible for a large part of the silt inflow, to stop free grazing and tree felling. Earthen check dams built in the catchment of Sukhomajri gave irrigation benefits to the villagers which led to four-fold higher agricultural productivity. To protect these small reservoirs, local villagers started catchment protection work – social fencing of forests, planting of trees and grasses, and a cessation of free grazing. A remarkable innovation made was to give tradable water rights to all residents of the village, irrespective of land holdings. This particularly benefited poor households with little or no land, and which were more dependent on biomass-based incomes from the commons. Giving them a share in water provided the landless with an incentive to participate in sustainable use of the commons. Thus, indirect incentives of water rights and irrigation benefits to the villagers resulted in their active participation in catchment treatment. As a consequence of these activities, the average siltation of Sukhna Lake came down from 141 tonnes/ha during the 1960s and 70s to 13-19 tonnes/ha during 1979-92 – an almost 90% reduction in silt. Therefore, while the villagers were not concerned about the siltation of Sukhna Lake, local benefits in the form of greater agricultural incomes gave them the incentive to initiate catchment protection activities.

By the 1990s, programmes that worked towards treatment of watershed catchments began to recognise the importance of local communities, and orientate a considerable part of their efforts towards ownership building among the local community. For example, the guidelines to the ‘haryali project’ (Ministry of Rural Development, GoI 2003) clearly state the emphasis on ‘community based watershed development’ as being the ‘guiding principle for rejuvenation of natural resources’. Funding agencies have also recognised the central role played by local people in natural resource conservation. This is one of the central paradigms adopted by the Sir Ratan Tata Trust-funded Himmothan Pariyojana, which works on catchment treatment in micro-watersheds in Uttarakhand and Himachal Pradesh (SRTT project documents).

Such watershed treatment projects subscribe to a common set of principles to maximise community involvement. These include:

The project recognises and uses the services of local village level institutions (VLIs) such as the Gram Panchayat.

- Planning and decision making are decentralised and the VLI is involved in micro-planning processes.

- Implementation is managed by the VLI or a community-based unit such as a watershed committee. However, the donor monitors the quality of implementation and works with the VLI to ensure timely execution of works.

- Often, a dedicated unit such as a project management unit (PMU) is created to help manage the project, provide technical expertise in critical areas, and catalyse local capacity building.

- Transparency is a key feature. Accounts and expenditure patterns are open and discussed in meetings. Often, the project budget is prominently displayed as a wall painting and implementation progress updates are similarly widely circulated. This process is essential for building broader ownership of the project.

- An ecosystem approach that addresses environmental, economic and social benefits is advocated. Thus, in addition to afforestation and civil works, several confidence-building measures and activities that benefit local communities are initiated.

- A withdrawal strategy that focuses on community ownership and good resource management is envisioned.

Current paradigm in watershed development recognises that the process is critical in determining outcome. The importance of local knowledge is recognised. A stakeholder-based approach, which is inclusive from the beginning to the end of the process of project implementation, is followed. Of course, the above principles are not always adhered to and many watershed projects fail. However, if guiding principles such as the above are put in place, the chances of the project meetings its objectives is significantly increased.

Principles such as those outlined above, if used for CAT plan implementation in areas where local communities influence resource management, will increase the impacts of the CAT plan. While a review of the guidelines of any of the community-based watershed projects will be indicative of implementation methodologies developed for this kind of activity, the differences between community based watershed plans and CAT plans must also be recognised. While both have a similar objective – that of improved natural resource management and higher quality ecosystem services, there is a difference in priorities. Most watershed projects focus on improving the livelihoods of watershed communities while CAT plans prioritise the environmental services – lowered soil erosion and buffered storm flows. To this extent, activities may be differently prioritised. For example, off season vegetable cultivation is promoted as a means of livelihoods enhancement in community-based watershed projects. However, certain kinds of cultivation techniques may increase silt yields, and hence are best avoided from CAT plans.

Examples of activities not typically seen in CAT plans, but which boost community participation while meeting CAT plan objectives include:

A. Decentralised village nurseries: the forest department usually relies on large centralised nurseries, often with over 100,000 seedlings. For community participation however, women-managed, small decentralised nurseries, even with just 1,000 saplings, are

appropriate. Making nursery-raising a household activity increases ownership and forest users are more likely to protect the saplings they helped raise and plant. Local villagers also get paid for nursery raising thereby getting economic benefits. If coupled with awareness programmes, and if monitoring and grading procedures are rigidly adhered to, decentralised village nurseries can considerably boost seedling survival and are vital in community forest programmes. This has been repeatedly demonstrated by NGOs in the Himalaya (for example see CHIRAG 2004). An increase in monitoring and training costs is offset by lower seedling transport costs as nurseries can be distributed in areas where plantation is required. Nursery raising costs, as budgeted in CAT plans that were studied are more than adequate to adopt such an approach.

B. Involving local stakeholders in protection: innovative solutions to empower local communities and involve them in forest protection can be developed. For example, in North Tripura, the forest department gave motivated youth of the JFM committees uniforms and a title of 'Green Guards' and encouraged them to patrol forests. Such measures led to a dramatic reduction in green felling.

C. Integrated animal husbandry programmes: open grazing of cattle is one of the major reasons for regeneration failure, forest degradation, and soil compaction and this is acknowledged in many CAT plans. Integrated animal husbandry programmes that encourage fodder plantation along field risers and wastelands, breed improvement to raise milk yields, and biogas plants to use cow dung, have been shown to decrease open grazing. Better variety cattle with higher milk yield are more likely to be stall fed. If a biogas plant is operationalised, then the need for cow dung will be further incentive for stall feeding. A family biogas plant is shown to help save 16 kg of firewood per day thereby reducing impacts on forest degradation. Such biogas plants can be constructed by locally trained masons, and operate at high efficiencies at altitudes up to 2,000m in Uttarakhand where several thousand plants have been built. The presence of well-trained masons and small transport subsidies would greatly enhance their spread.
D. Recognition of tenurial rights: a 'Tragedy of the Commons' type scenario, as envisioned by Hardin (1968) in his famous paper plays itself out repeatedly across the Himalaya. Local communities access particular areas for fuelwood, fodder and NTFP collection and have done so sometimes for generations. Legally, most of these areas belong to the forest department and the communities that use them have little or no use rights and can rarely exclude outsiders. This has resulted in the depletion of many high altitude pastures where powerful contractors send outside labour for NTFP collection. Traditional gatherers who came in small numbers are powerless to stop this large scale extraction. Similarly, forests have got degraded because many villages use the same patch, and no group has any incentive to protect it. Recognition of the usufruct rights of local communities can help improve resource management. If only a small group accesses a resource, the probability of sustainable use is significantly increased. Strengthening of local institutions of resource management (such as 'van suraksha samitis' or 'van panchayats') also decreases the likelihood of resource degradation. These institutions, especially when linked to panchayats, can also provide an appropriate local-level institutional basis for undertaking CAT investments and changes in land use and management activities on a sustained basis.

These are merely indicative activities. A full analysis of possible activities and their description is beyond the scope of this report. Also, catchments vary greatly in terms of human use and activity, and there is no blueprint approach to boost community participation. While general principles apply, solutions will differ. The important point here is that at very little addition cost, several activities can be incorporated that contribute significantly to the objectives of the CAT plan, and at the same time would involve local communities and help increase the chances of success of the CAT plan.

Implementing most of these measures does not require any major structural changes in the mechanism of CAT plan implementation. There already exists a high degree of flexibility in CAT plan implementation mechanisms and an interested DFO has the powers to initiate some of these measures. There are cases, both in Himachal and Uttarakhand, where CAT plan money has been used to mobilise local communities for better catchment protection.

However, it is not a viable mechanism to expect already overextended officials to voluntarily institute changes that at the very least will require greater time commitments. Given the current mechanism of CAT plan implementation, it is optimistic to expect community participation to be enhanced unless some of the constraints to effective implementation are first dealt with. Hence, some select suggestions are made in the next section on structural changes that would give the process of CAT plan implementation a higher probability of success.

7.1 Increasing the benefits of CAT plan: suggested institutional changes

Clear and established property rights, (in terms of who owns the source of ecosystem services, and who uses these services and is thus responsible for compensating for their production costs), are key elements in the success of many payment for environmental service (PES) programmes (Perrot-Maitre and Davis 2001). Ambiguity on this count exists in the Himalayan catchments since land is largely controlled and owned by the forest department, but its conservation is dependent on local people. At present the forest department and the state government benefit, as HEPs pay for ‘services’ provided by forest. However, local people do not gain from this arrangement and as a result, there is very little catchment protection as the local communities attach little value to downstream ecosystem services.

For CAT plans to have a significant impact, it is essential that mechanisms that include participation of the local community be incorporated. However, before this can be done, a recognition of the role that communities play in watershed conservation is essential. The CAT plan lends itself to the use of the PES approach. The HEPs are already paying a significant amount of money, and in return expect an ecosystem service – low silt and dampened storm water flows. The local communities, as users of the resource, can help manage the lands in a way that promotes these ecosystem services. However, they lack the mandate to manage these resources. Structures and systems thus need to be created that give incentives to local communities to use and manage the catchment in a way that benefits the HEP. At the same time, the role of the forest department and its ownership of the forest

land must be recognized. While it is possible to do so, and has been demonstrated in Central American countries, no suggestion to directly link the community with the HEP promoter is being made. Neither is it realistic to expect the forest department to give up control of its forests, and nor may it be advisable as vested interests within communities may absorb most of the benefits of such a system. However prioritising JFM in HEP catchments may provide the missing institutional basis for engaging with local communities in the catchment.

Suggesting radical changes in policy is also not the objective of this study. While some suggestions for policy changes are being made, it is acknowledged that it will take more than a single study to bring about policy changes. Instead, the aim of these suggestions is to throw up issues for further discussion.

The major suggestion for improving the implementation of CAT plans is the creation of an exclusive structure to handle the implementation of these plans. This does not involve any radical innovation, but merely builds upon structures that already exist or are being created in various areas.

7.1.1 Creating a distinct project management unit (PMU) for CAT plan management

There is a need to treat CAT funds as being distinct from all other funding. These are funds that are paid for upgrading ecosystem services and should not be considered as a tax. Already, several steps have been taken that recognise the distinct identify of CAT funds. While these have been discussed earlier, a brief mention needs to be made of the following initiatives:

A. The establishment of CAMPA: created in 2004 by the Government of India (MoEF) to act as a custodian of CAT funds, delays in operationalising CAMPA are due to objections put up by some of the states. It is possible that state-level CAMPAs will be formed instead of a centralised agency. In either case, it is clear that the GoI recognises that CAT funds should be used only as designated. The enactment of CAMPA, or a CAMPA-like fund, appears to be imminent and will, it is hoped, ensure that CAT fund money will not be diverted.

B. The Upper Satluj Valley Watershed Development Society: this is an autonomous body registered under the *Societies Act* (1860) and formed with the objective of implementing CAT plans. This society will have access to Rs 2,660 million from the Nathpa Jhakri, Baspa, and other projects being developed in that area. Rs. 1,090 million have already been released as per a press report (The Tribune December 2005). The society consists of serving forest department officers and other senior officials and has been formed so as to prevent money released towards the end of the financial year from lapsing. However, the legal structure of this society sets a precedent which can be used to create autonomous agencies to implement CAT plans.
C. Project Management Cell (PMC) Vishnuprayag HEP: the revised CAT plan of the Vishnuprayag HEP, made by the Forest Department of Uttarakhand, envisions the

creation of a PMC which has additional staffing over and above the normal forest department staff of the area. In addition to an Assistant Conservator of Forests (ACF), this cell is staffed by a Senior Project Coordinator who is independently responsible for planning and execution of village based eco-restoration and livelihood improvement works. A horticulture specialist, livelihood specialist, and engineering specialist are also envisioned in this PMC. An excellent structure, designed for close linkages with the village community, has been formulated for this cell. Hiring of staff from the open market is mandated where suitable staff are not available on deputation from line departments.

The above examples represent the formation of bodies established for improved utilisation of CAT funds. They also demonstrate that it is possible to create a distinct entity to manage CAT funds. In fact the PMU-type cell being proposed below has a legal structure similar to the Upper Satluj Valley Watershed Development Society, while the operational structure of the Vishnuprayag Project Management Cell has been closely followed. The following are the salient features recommended for such a body:

- Project management units (PMUs) can be formed at the catchment level and include two or more HEPs where appropriate. If catchments are small, two or more nearby catchments could be managed by the same PMU.

- The chief executive would normally be a forest officer, typically of Deputy Conservator of Forests DCF rank, on deputation from the forest department.

- A project coordinator, with demonstrated experience and skill in community mobilisation would be in charge of day to day operations. Such a person could be hired from the NGO community in case a suitable candidate is not available for deputation.

- An engineer with knowledge of soil and water conservation measures would assist in the planning of civil engineering works. Experts in livestock, agriculture and livelihoods could be deputed from various line departments, or hired if needed.

- A monitoring team, which could be headed by a HEP representative and also consisting of a technical expert from the technical agency that drew up the CAT plan would carry out 6 monthly monitoring visits and make recommendations.

- The governing board of the PMU would consist of officials from the forest department as well as the HEP.

Such a structure would broaden the expertise available. An independent monitoring team would help ensure accountability. Provision can be made for some representation of local village communities which can be gradually increased as communities get oriented to the purpose of the plan. Incentives for the local communities could be tied into the implementation of the plan. Community works should include, where possible, structures that benefit from catchment treatment and are adversely impacted by siltation or flood damage – water tanks and check dams would be examples of such structures. Financial incentives for

hamlets or groups that show a good track record of watershed protection could be considered.

Such measures combined with innovative training tools – such as environmental education programmes for schools, soil and water conservation measures for fields aimed at increasing productivity, training on terrace construction and drainage techniques, and grass seed plantation by cattle grazers – can help improve ecosystem function without incurring heavy capital expenditure.
Such an institutional structure could help make the payment for catchment treatment issue less contentious. Firstly, it would reduce the diversion of funds, and all administrative or infrastructural costs made by the PMU would be towards catchment protection and could be monitored. Secondly, and more importantly, such a structure could apply to government agencies for funding for watershed programmes which could be used to supplement the money that is received from the HEP promoter. Thus a well-managed PMU could significantly enhance the funds available to it. Finally, if the CAT plan is treated as an 'additionality' then regular forest department funds would also get used in the watershed which would also leverage CAT funds as some of the plantation and SWC works could be carried out by the forest department under its regular programmes.

Further suggestions for improving CAT plan outputs are:

7.1.2 Involving local communities in planning

Conservation practices must be consistent with local customs and traditions to be successfully implemented (Kattelmann 1987). The impact of community participation is greatly reduced if they are not included in the planning processes. A baseline survey and participatory rural appraisal (PRA) exercises to obtain the communities view on environmental degradation-related issues can be invaluable as it may capture the impacts of occasional catastrophic events and also identify areas most prone to landslides.

While environmental concerns may not be extensively discussed at forums like the public hearings, an understanding nonetheless exists in the local people. For example, in their study of public hearings in the Kullu areas, Sinclair and Diduck (1999) conclude that: 'public at the Malana hearings not only raised concerns about specific environmental problems, they expressed concerns about linkages among various ecosystem components'. Also, they found that residents in Kullu and Manali were 'aware of the potential environmental implications of development'.

Increasing the focus of public hearings on community-level issues and environmental concerns would help develop better CAT plans. At present, the lack of participation from communities is a lost opportunity.

7.1.3 Community-based monitoring for determining the impact of CAT plans

Community-based monitoring systems can be used to track changes in silt flow level. The turbidity of water is easy to measure, even with simple devices which can be distributed to school children for regular measurement of estimated silt flow. This data could provide valuable information that would help identify micro-watersheds that contribute high silt loads. These could then be prioritised for treatment.

These measures, along with growth and survival of planted seedlings, and visual measures of lopping intensity or cattle dung counts (to estimate free grazing levels) could help form a simple but effective and transparent monitoring system based on which any incentives or rewards could be calculated. While various data can be collected by the community, the responsibility for developing monitoring mechanisms and further collating and analysis of data would be with the PMU which could provide useful data to the HEP promoter. Interestingly, while technology such as satellite imagery is extensively used during the planning phase, few, if any examples of simple GPS technologies used for monitoring were evidenced.

Thus for enhanced implementation of the CAT plans, it is critical to include local communities during the planning and implementation. While strong coordinating agencies, composed of a mix of forest department and external experts is suggested, this agency will need to be mandated to include community participation. Strong monitoring mechanisms need to be put into place. While difficult and time-consuming, getting communities involved is the only sustainable method of treating catchments to improve environmental services in the Himalaya.

7.2 Conclusions

This report looks into improving the efficacy of CAT plan implementation and suggests changes for including incentive-based mechanisms. IBMs – a broader form of PES schemes – provide a useful tool to enhance the effectiveness of CAT. A ‘buyer’ of environmental services, the HEP, can create incentives for communities (the ‘seller’) either as a direct payment, indirect payments (via the forest departments), or through mechanisms such as increased access to certain resources. Forest departments, the formal custodians of the forest lands, already receive most of the money but are at best monitored for activities undertaken in the catchment, and not for watershed service outcomes. The components needed to develop IBMs are in place. Most importantly, a payment is already being made through money committed for the CAT plan – in essence an environment services improvement plan.

However, there is no simple solution that can be proposed to develop IBMs. In large part this is because a system for implementing CAT plans is already in place. This system has some issues:

- The current system to route CAT funds that involves various levels of the government (central, state, forest department) and which does not recognise the additionality of this fund.

- The perception of CAT funds as being a kind of environmental tax rather than a PES both by the payer – the HEP – and the current receiver, the state governments.

- The presence of a third vital player – the forest department – which is the legal custodian, manager, and regulator of forest land.

The first two issues need to be addressed before any attempt to develop IBMs is made. Whether the CAT plan is treated as a tax or a PES payment, it needs to reach communities that influence the provision of watershed services in the catchments. However, if the money allocated to CAT plans reaches the catchment only erratically, it will be very difficult to build community interest and involvement. Creating distinct structures to handle CAT plans is one of the suggestions made which can potentially improve CAT implementation.

Finally, IBMs can facilitate the interaction of forest departments with communities. Working with communities is no longer new for the forest department. While there have been varying degrees of success several projects, most notably JFM, have sensitised the forest department to local community needs. IBMs can be developed that increase opportunities of partnership between the forest department and local communities.

The suggestions made in this chapter thus do not focus only on developing incentives for communities, but also on developing mechanisms to improve problems of fund flow and create a space where IBMs can fit into the system. As stated earlier, processes are critical in determining outcome. This is an attempt to suggest processes that will lead to IBMs developing as an outcome.

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Acknowledgements:

This study was commissioned and financially support by Winrock International India (WII) and is a component of a project on 'Developing incentive based mechanisms for watershed protection services and improved livelihoods in India' being executed by WII in collaboration with International Institute for Environment and Development (IIED), UK.

Several staff of WII provided critical comments and suggestions. The roles of Mr. Chetan Agarwal (Senior Program Officer) and Mr. Sunandan Tiwari who developed the initial concept and provided many very useful comments, suggestions and advice are gratefully acknowledged.

Infrastructural support was provided by the Centre for Ecology Development and Research (CEDAR), and field support in Kullu from Dr. Rinki Sarkar (CEDAR) and in Kinnaur from Mr. Saurabh Kumar (Indian Institute of Forest Management). Ms. Ritika P. Thadani provided editorial help.

Annex 1: The *CAMPA Notification*

Ministry of Environment and Forests
(Forest Conservation Division)
ORDER
New Delhi, the 23rd April, 2004

S.O. 525(E) – Whereas, a Central Empowered Committee (hereinafter referred to as CEC) was constituted for examining the issues relating to compensatory afforestation, net present value of diverted forest land, other monies recoverable received and utilized in this regard; and

Whereas, the CEC has inter-alia observed that it is desirable to create a separate fund for compensatory afforestation etc. wherein all the monies received from the user agencies are to be deposited and subsequently released directly to the implementing agencies as and when required; and

Whereas, the recommendations of the CEC have been accepted by the Hon'ble Supreme Court and the Hon'ble Supreme Court in its order dated: 30-10-2002 in Interlocutory Application No. 566 in Writ Petition (C) No. 202 of 1995 directed the Central Government to take necessary steps required for implementing the recommendations of the CEC;

And whereas, the Central Government considers it necessary and expedient to constitute a body for the management of compensatory afforestation funds; now, therefore,

In exercise of the powers conferred by Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986) (hereinafter referred to as the said Act), and in pursuance of the Hon'ble Supreme Court's order dated the 30th October 2002 in IA No. 566 in Writ Petition (Civil) No. 202 of 1995, the Central Government hereby constitutes an authority to be known as **Compensatory Afforestation Fund Management and Planning Authority (hereinafter referred to as CAMPA) with effect from the date of publication of this order for the purpose of** management of money towards compensatory afforestation. Net Present Value and any other money recoverable in pursuance of the Hon'ble Supreme Court's order in this regard and in compliance of the conditions stipulated by the Central Government while according approval under Forest (Conservation) Act, 1980 (69 of 198 0) for non- forestry uses of the forest land.

2. The CAMPA shall consist of the following Chairperson and Members and shall function through a Governing body and an Executive body namely:

2.1 GOVERNING BODY:

(i) Minister for Environment and Forests, Government of India — Chairperson

(ii) Secretary, Ministry of Environment and Forests, Government of India — Member

(iii) Director General of Forests and Special Secretary, Ministry of Environment and Forests, Government of India — Member

(iv) Addl. Director General of Forests (Forests) Ministry of Environment and Forests, Government of India — Member

(v) Addl. Director General of Forests (Wildlife) Ministry of Environment and Forests, Government of India — Member

(vi) Joint Secretary and Financial Advisor, Ministry of Environment and Forests, Government of India — Member

(vii) Regional Chief Conservator of Forests (Bangalore, Bhopal, Bhubaneswar, Lucknow and Shillong regions) and Regional Conservator of Forests, Chandigarh — Members

(viii) Six Principal Chief Conservator of Forests one each from six regions to be nominated annually by MoEF on rotation basis — Members

(ix) Inspector General of Forests (Forest Conservation) Ministry of Environment and Forests, Government of India — Member

(x) An eminent professional ecologist, not being from the Central and State Government, for a period of two years at a time, for up to two consecutive terms — Member

(xi) Chief Executive Officer (CAMPA) — Member Secretary

2.2 EXECUTIVE BODY

(i) Director General of Forests, and Special Secretary, Ministry of Environment and Forests, Government of India — Chairperson

(ii) Addl. Director General of Forests (Forests), Ministry of Environment and Forests, Government of India — Member

(iii) Addl. Director General of Forests (Wildlife) — Member

(iv) Inspector General of Forests (Forest Conservation), Ministry of Environment and Forests, Government of India — Member

(v) Joint Secretary and Financial Advisor, Ministry of Environment and Forests, Government of India — Member

(vi) Chief Executive Officer (CEO) — Member

(vii) A professional ecologist, not being from the Central & State Government, for a period of two years at a time, for up to two consecutive terms. — Member

2.3 The Chief Executive Officer (CEO) shall be an officer of the rank of Inspector General of Forests.

2.4 In addition to the CEO, there shall be one Joint CEO of the level of Conservator of Forests and two Deputy CEOs of the tank of Deputy Conservator of Forests to assist the Executive Body. These officers shall be appointed b y the CAMPA on deputation basis for a period not exceeding five years after obtaining required clearances from the competent authority in the Ministry of Environment and Forests. The Governing Body can create posts in CAMPA at the level of Deputy Inspector General of Forests and Assistant Inspector General of Forests to be filled on deputation. They shall be appointed for a period not exceeding five years on terms and conditions to be decided by the CAMPA with the concurrence of the Central Government in Ministry of Environment and Forests:

3. POWER AND FUNCTIONS OF THE GOVERNING BODY:

The Governing Body shall —

(i) review the broad policy framework of the CAMPA;
(ii) monitor the progress of the utilization of funds released by the CAMPA;
(iii) approve the annual budget of CAMPA for expenditure subject to overall ceiling of 10% of the average income from interest etc. on establishment and capital expenditure excluding income from funds received as per para 6.2(iii);
(iv) appoint the CEO, Joint CEO and Deputy CEO;
(v) be empowered to create posts in CAMPA equivalent to the level of Deputy Inspector General of Forests and Asstt. Inspector General of Forests;
(vi) approve the annual reports and audited accounts of the CAMPA.

4. MEETINGS:

The Governing body shall meet at least once in six months.

5. POWERS AND FUNCTIONS OF THE EXECUTIVE BODY:

The Executive Body shall decide –

(a) deployment of staff on contractual basis or on deputation;
(b) financial procedure;
(c) delegation of financial or administrative powers;
(d) other day-to-day working in respect of receipts of funds;
(e) investment of funds;
(f) expenditure on establishment and other overheads including office accommodation subject to the approval of the annual budget by the Governing Body

6.1 The CAMPA shall be custodian of the Compensatory Afforestation Fund and shall have the following functions and powers relating to the Fund, namely:

6.2 There shall be constituted a fund to be called the Compensatory Afforestation Fund and there shall be credited thereto –

(i) Receipt of all monies from user agencies towards Compensatory Afforestation, Additional Compensatory Afforestation, Catchment Area Treatment Plan or for compliance of any other condition (s) stipu1ated by the Central Government while according approval under the Forest (Conservation) Act, 1980.
(ii) The unspent funds already realized by the States/Union Territories shall be transferred to the CAMPA by the respective States/Union Territories or user agencies within six months from the date of the issue of this Order and any Compensatory Afforestation Funds which have not yet been realized shall be realized by the States and Union Territories and transferred to the CAMPA.
(iii) The funds recoverable from the user agencies in cases where forest land diverted falls within the protected areas i.e. areas notified under Sections 18, 26-A or 35 of the Wildlife protection) Act, 1972 (53 of 1972) for undertaking activities related to protection of biodiversity and the Wildlife shall be maintained separately.
(iv) Net Present Value (NPV) of the forest land diverted for non-forestry purposes which may be realized pursuant to the Hon'ble Supreme Court's order dated 30-10-2002 in I.A. No. 566 in Writ Petition (C) No. 202 of 1995

(v) Money receivable in pursuance of the orders of the Hon'ble Supreme Court or the Central Government or any other competent authority authorized in this regard by the Central Government.

6.3 MANAGEMENT OF THE FUND:

(i) The amount collected by the CAMPA shall be invested in Reserve Bank of India, Nationalized Banks, Post Office, Government Securities, Government Bonds and deposits.

(ii) The Non-recurring as well as recurring cost for the management of CAMPA including the salary and allowances payable to its officers and staff shall be met by utilizing a part of the income by way of accrued interest on the funds invested by the CAMPA excluding income from funds received as per para 6.2(iii).

(iii) The expenditure incurred on independent monitoring and evaluation shall be borne by the CAMPA out of the income by way of interest on the funds invested by the CAMPA excluding income from funds received as per para 6.2 (iii).

(iv) The CAMPA shall get the annual accounts audited internally as well as externally through chartered accountant(s) who are on the panel of the Comptroller and Auditor General of India and the auditor(s) shall be selected on the approval of the Governing Body.

6.4 DISBURSEMENTOF FUNDS:

(i) The money received for compensatory afforestation, additional compensatory afforestation may be used as per the site specific schemes received from the States and Union Territories along with the proposals for diversion of forest land under the Forest (Conservation) Act, 1980.

(ii) The money received towards Net Present Value (NPV) shall be used for natural assisted regeneration, forest management, protection, infrastructure development, wildlife protection and management, supply of wood and other forest produce saving devices and other allied activities.

(iii) Monies realized from the users agencies in pursuance of the Hon'ble Supreme Court's orders or decision taken by the National Board for Wildlife involving cases of diversion of forest land in protected areas shall form the corpus and the income there from shall be used exclusively for undertaking protection and conservation activities in protected areas of the States and the Union Territories and in exceptional circumstances, a part of the corpus may also be used subject to prior approval of the CAMPA.

(iv) CAMPA shall release monies to the concerned State and Union Territory in predetermined instalments through the State Level Management Committee as per the Annual Plan of Operation (APO) finalized by the concerned State and the Union Territory.

(v) The monies received in CAMPA from a State or the Union Territory as per para 6.2 and the income thereon after deducting expenditure incurred by the CAMPA on its establishment cost, monitoring and evaluation on a prorata basis shall be used only in that particular State or the Union Territory.

6.5 MONITORING AND EVALUATION OF THE WORKS:

(i) An independent system for concurrent monitoring and evaluation of the works implemented in the States utilizing the funds released by the CAMPA shall be evolved and implemented to ensure effective and proper utilization of funds and services of the Regional Offices of the Ministry of Environment and Forests in this regard may also be utilized.

(ii) The CAMPA shall have the powers to order inspection and financial audit of works executed by utilizing CAMPA funds in any State or the Union Territory.

(iii) On being satisfied that the funds released to a particular State or the Union Territory are not being utilized properly, the Executive Body of the CAMPA shall have the power to withhold or suspend the release of remaining funds or part thereof .

6.6 OTHER FUNCTIONS:

(i) The CAMPA may establish Special Purpose Vehicles (SPV) for undertaking Compensatory Afforestation particularly by involving large public sector undertakings which frequently require forest land for their projects, in consultation and as far as possible with the concurrence of the CEC.

(ii) The CAMPA may also consider evolving new mechanism to generate additional sources of fund for forest conservation works and to create capacity and data base for better conceptualization and management of fund.

7. Every State or the Union Territory shall have a Steering Committee and a Management Committee consisting of the following Chairperson and Members namely :

7.1 STATE LEVEL STEERING COMMFITEE:

(i)	Chief Secretary	Chairperson
(ii	Principal Chief Conservator of Forests	Member
(iii)	Principal Secretary (Forests)	Member
(iv)	Principal Secretary (Finance)	Member
(v)	Principal Secretary (Planning)	Member
(vi)	Chief Wildlife Warden	Member
(vii)	Nodal Officer	Member
(viii)	An eminent Non-Government Official to be nominated by the State Government for a period of two years at a time who shall be eligible for renomination	Member
(ix)	Chief Conservator of Forests (Plan/Schemes)	Member Secretary

7.2 STATE MANAGEMENT COMMITTEE:

(i)	Principal Chief Conservator of Forests	Chairperson
(ii)	Chief Wildlife Warden	Member
(iii)	Chief Conservator of Forests (Plans/Schemes)	Member
(iv)	Financial Controller/Financial Adviser in the Office of the Principal Chief Conservator of Forests	Member
(v)	An eminent Non-Government Official to be nominated by the State Government for a period of two years at a time who shall be eligible for renomination	Member
(vi)	Nodal Officer	Member Secretary

8. POWERS AND FUNCTIONS OF THE STATE STEERING COMMITEE:

The Steering Committee shall -

(i) facilitate and be responsible for policy decisions;

(ii) ensure inter departmental co-ordination;

(iii) take steps for grant of special sanction for procurement;

(iv) accord concurrence to the Annual Plan of Operation (hereinafter referred to APO).

8.1 MEETINGS:

The Steering Committee shall meet at least one in six months.

9. POWERS AND FUNCTIONS OF THE STATE MANAGEMENT COMMIITTEE SHALL BE AS UNDER:

(i) Preparation of the Annual Plan of Operation (APO) of the State for various activities in conformity with para 6.4.

(ii) (a) Submission of the Annual Plan of Operation (APO) to the CAMPA after obtaining concurrence of Steering Committee for release of fund giving break up of the proposed activities and estimated cost.

(b) The Annual Plan of Operation (APO) may include the expenditure on overhead and contingency expenses up to a maximum of 2% of the Total annual expenditure.

(iii) (a) Qualitative and quantitative supervision of the works being implemented in the State out of the funds released from CAMPA.

(b) It shall also be responsible for proper auditing of both receipt and expenditure of funds.

(iv) Development of the code for maintenance of the account at implementing agency level.

(v) Submission of reports or clarifications to CAMPA.

10. The mechanism for receipt and disbursement of funds by the State Management Committee shall be decided by the CAMPA in consultation with the States or the Union Territories concerned.

11. The CAMPA shall function under the supervision of the Central Government in the Ministry of Environment and Forests.

12. The jurisdiction of the CAMPA shall be the whole of India.

13. The Headquarter of the CAMPA shall be at New Delhi.

[F. No. 5-1/98-FC]
Dr. V. K. BAHUGUNA, Inspector General of Forests (Forest Conservation)

Annex 2: Glossary of Terms

CAMPA (Compensatory Afforestation Fund Management and Planning Authority): a body created to manage the funds earmarked for compensatory afforestation.

CAT plans: the catchment area treatment plan is a part of the EMP funded by the authorities of a large HEP. The objective is to treat the critical parts of the drainage basin or watershed of a river on which the HEP is situated.

Cloudbursts: an event of extreme rainfall which typically lasts for a short period of time (generally less than an hour) but is capable of creating local flood conditions. Technically, a cloudburst is defined as a shower type with a fall rate equal to or greater than 100mm per hour. They occur most commonly in deserts and mountainous regions.

Compensatory afforestation: afforestation typically carried out on non-forest land in lieu of forests that need to be cut, removed, submerged or otherwise destroyed due to development projects.

Dam-type HEP: a dam is a barrier across flowing water that obstructs, directs or slows down the flow, often creating a reservoir, lake or an impoundment. The water head created by impounding this water is used to generate electricity.

DPF (Demarcated Protected Forest): a category of protected forest found in Himachal Pradesh. DPFs constitute almost one-third of the total forest area of the state and extend over an area of over11, 000 sq km.

Dunne flow or saturation overland flow: this occurs when rainfall is less than the saturated hydraulic conductivity and there is a relatively shallow water table. Surface saturation occurs due to a rising water table and lack of availability of soil moisture storage which leads to ponding and overland flow.

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EIA (Environment Impact Assessment): an assessment of the likely influence a project may have on the environment. It is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made.

EMP (environment management plan): a plan created to study and mitigate the adverse impacts of a large development project.

Free draining catchment area: the area from which the water comes directly to the dam without being intercepted by any other upstream dams.

Head-race tunnel HRT: a relatively flat and long tunnel connecting the water intake to the pressure shaft in HEPs with a high head.

Horton flow: Horton overland flow is the tendency of water to flow horizontally across land surfaces when rainfall has exceeded infiltration capacity and 'depression storage capacity'. When rainfall occurs, water initially permeates into the ground or accumulates in shallow depressions on the surface of soil. Once the pore spaces near the soil surface get filled and depressions are also filled with water, the water flows in sheets over the soil surface and is capable of eroding the soil. Commonly seen in steep terrain on rough dirt roads.

IBMs (incentive-based mechanisms): the use of incentives – cash or kind, typically to local communities, in order to ensure protection of natural resources or ecosystem services. Unlike regulatory efforts, IBMs are designed to help ensure community participation and voluntary efforts to protect resources or services.

NTFP (non- timber forest products): previously the terminology of 'minor forest products' was used to describe a variety of medicinal plants, lichens, mushrooms, and products such as honey and lac that are extracted from forests.

Run-of-the river hydro-electric projects: a type of hydroelectric generation whereby the natural flow and elevation drop of a river are used to generate electricity. As a large body of water does not need to be impounded, such projects can have lower environmental impacts than dams. However, these often neccessitate drilling of long tunnels through mountains which can also have various adverse impacts. Compare with 'dam-type HEP', above.

'Sponge' theory: propounded by foresters at the end of 19th century, it suggests that the forest floor (soil, roots and litter) acts as a giant sponge, holding up water during rainy spells and releasing it gradually. It has been criticised as being too simplistic.

Tail-race tunnel (TRT): a tunnel downstream of the power generating turbine, through which the water re-enters the outside in a run-of-the-river project.

Watershed: also known as a drainage basin, catchment, or river basin, a watershed is a geographical area from where all rain or snow melt is channelled through a single point.