ENVIRONMENTAL APPRAISAL

OF

THE MULTI-PURPOSE TEHRI DAM PROJECT

REPORT

ENVIRONMENTAL APPRAISAL COMMITTEE

(RIVER VALLEY PROJECTS)

MINISTRY OF ENVIRONMENT & FORESTS

GOVERNMENT OF INDIA

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CHAPTER-I

BACKGROUND AND CHRONOLOGY OF EVENTS

1. INTRODUCTION

1.1. Background

The Tehri Dam site was first identified in 1949, and investigations started in 1961 for constructing a dam for hydel power generation. The Tehri Dam Project envisages the construction of a 260.5 m high earth and rockfill dam, across the river Bhagirathi, downstream of the confluence of Bhagirathi and Bhilangana rivers, near Tehri town. The project, initially proposed to have an installed capacity of 600 MW, was approved by the Planning Commission, in 1972, at a cost of Rs.197.92 crores. The administrative approval for the project was given by the Government of Uttar Pradesh in 1976, but work on the project could not be taken up earnestly due to public resentment and paucity of funds.

Because of opposition to the project from the local people, a Petitions Committee of the Parliament was constituted, in 1977, to look into the matter. Its report, however, could not be submitted because of the dissolution of the Parliament, towards the end of 1979.

Persistent local opposition to the project had prompted the then Prime Minister, in March, 1980 to direct that:

> "There are several proposals which were agreed to earlier but would need to be looked into again. Amongst them

> are Silent Valley, the dam in Tehri Garhwal and the dam in Lalpur, Gujarat. It seems that larger areas of very fertile land are being submerged without any commensurate gains. There may be other such cases also. It is true that these decisions have been taken over a period of time but there is great local distress and a feeling that contractors and other such groups will be the main gainers. Hence, it is necessary to have another look in depth."

Accordingly, the matter was referred to an expert Working Group which submitted its interim report in May, 1980 and the final report in August, 1986. After due consideration of the recommendations of this Working Group and despite the fact that a sum of Rs.206 crores had already been spent on the project, the Ministry of Environment & Forests arrived, in October, 1986, at an unequivocal stand that the project should be abandoned.

However, in November, 1986, an agreement was entered into with the Soviet Union for providing technical and financial assistance for this project, to the tune of 1000 M Roubles. The need for obtaining environmental clearance, even in the absence of environmental action plans, became urgent so as to quickly complete all administrative and technical clearances. This is evident from perusal of a Press release issued by the Ministry of Environment & Forests, in January, 1987, stating that:

> "The Government have cleared the project after a thorough assessment of the impact of the project on environment and after satisfying themselves that the adverse impacts on environment can be remedied."

The Committee was keen to utilize the background data and environmental action plans which formed the basis for issuing the press release, reversing the earlier stand taken by the Ministry in October, 1986, but was surprised to note that no additional material was available.

Meanwhile, the Tehri Virodhi Sangharsh Samiti had filed a petition in the Supreme Court, in 1985, pleading that the project should be abandoned because of its economic non-viability and inherent danger to the life and property of lakhs of people. A decision is still awaited.

The Tehri Dam Project was initially being executed by the Irrigation Department of Uttar Pradesh. Subsequently, a joint-venture Company of the Government of India and the Government of Uttar Pradesh, namely, Tehri Hydro Development Corporation (THDC), has been incorporated in July, 1988 for implementation of the project.

Ministry of Finance made consideration of the revised cost estimates and the release of any further funds for the Tehri Dam Project conditional to its prior environmental clearance in July, 1989. Accordingly, the Tehri Hydro Development Corporation formulated Environmental Action Plans for consideration and assessment by the Ministry of Environment & Forests. These plans were received on 29th November and 15th December, 1989 and first discussed by the Environmental Appraisal Committee on 18th December, 1989.

1.2. Salient Features

The scope and complexion of the project, since its approval in 1972 by the Planning Commission, have undergone major changes as reflected in the salient features summarised in Table-1.

1.3. Procedure

In assessing any river valley project, the Ministry is concerned about optimising the use of natural resources towards social and economic development. To these ends, the Committee examines the social and ecological impacts of the project, including potential risks and hazards, and attempts to balance these against the anticipated benefits from the project. In order to ascertain whether a proposed project would result in optimal use of the resources, the Committee also considers alternatives to the proposed project: in terms of alternative design of the project, alternative sites of the project, and alternative methods of providing the benefits that the project promises.

This is usually done using the data provided by the project authorities, the cumulative data of other projects in the country and elsewhere, and by benefitting from the experience and expertise of the members of the Committee, and other invited experts. Site visits are also arranged for interaction with the local people, the voluntary organisations and the project authorities.

TABLE-1

SALIENT FEATURES

S.NO.	ITEM	1972	1990
1.	Height of the dam	260.5 m	260.5 m
2.	Type of the dam	Rockfill earthen dam	Rockfill earthen dam + 103.5m high RCC dam at Koteshwar.
3.	Catchment Area	6921.25 sq.km.	6921.25 sq.km.
4.	Submergence	95 villages + Tehri Town	112 villages + Tehri Town
5.	Power Generation (Installed capacity)	600 MW	1000 MW (Stage-I) 1000 MW (Stage-II) 400 MW (Koteshwar)
6.	Firm power	346 MW	346 MW
7.	Irrigation Potential	2.7 lakh ha	2.7 lakh ha.
8.	Cost	Rs.197.92 Crores	Rs.3008.08 Crores * (1989)

*In the absence of data on Koteshwar dam, this report deals only with the Tehri Dam.

The environmental assessment of the major development projects is carried out by multi-disciplinary expert committees. The Tehri Project has accordingly been assessed by the Environmental Appraisal Committee for river valley projects which has experts in the fields of water resources management, soil conservation, agriculture, ecosystems management, forest ecology, anthropology, civil engineering, etc. The Action Plans furnished by the project authorities were examined and first discussed with the project experts & consultants on 18th December, 1989.

1.3.1. A close scrutiny of the documents furnished showed that clarifications and additional details were required which could be clubbed under the following broad heads:

--Information missing altogether;
--Clarifications on disputed data;
--Incomplete details; and
--General queries.

Additional information on some aspects was furnished by the Tehri Hydro Development Corporation on 9th February, 1990.

1.3.2. A field visit to the project site was undertaken by some of the members of the Committee from 26th to 29th January, 1990. Detailed discussions were held during the field visit with the project authorities, representatives of Tehri Virodhi Sangharsh Samiti and some of the local organisations. Visits were

also made to the sites where soil conservation and afforestation works have been undertaken in the catchment as well as to the rehabilitation site at Bhaniawala.

On the basis of data collected and impressions gained during field discussions with all concerned parties and the clarifications furnished; further detailed discussions were held with the Tehri Hydro Development Corporation (THDC) experts on 10th February, 1990. Discussions on environmental aspects were held with Shri Sunderlal Bahuguna, representatives of Tehri Virodhi Sangharsh Samiti and the Indian National Trust for Art and Cultural Heritage (INTACH) on 9th February, 1990. Interaction with the experts of the concerned Directorates dealing with seismic design of structures and sedimentation of reservoirs from the Central Water Commission were also held on 9th February, 1990.

The Committee also had the benefit of the views of Dr. Harsh Gupta, Vice Chancellor, Cochin University and Dr. Vinod Gaur, Secretary, Department of Ocean Development, Government of India regarding safety aspects of the dam in a highly seismic and fragile setting.

This report is based on the discussions and the information collected by the members of the Committee individually or collectively and ,the data furnished by the project authorities, INTACH, Tehri Virodhi Sangharsh Samiti, experts knowledgable in the problems of the Himalayan region and others.

1.4. Constraints

The task to be accomplished by the Committee was to assess the environmental impact of the Tehri Dam and make recommendations regarding its viability. From the beginning, it was clear that paucity of data would pose an immense problem in arriving at conclusions. Nevertheless, the Committee embarked upon its task with the clear understanding that no useful purpose would be served by further awaiting additional data on a project which has already been under implementation since 1972. Indeed, the Committee noted with surprise that some of the vital data, sought by the Working Group constituted in 1980, had not been generated and, therefore, was not available even in 1990. Under the circumstances, this Committee has had to base its conclusions on the studies, surveys, reports and data base, albeit inadequate, made available. The Committee was also faced with inconsistent data which could not be reconciled by the project authorities despite repeated efforts to do so.

The absence of time-bound Action Plans on Command Area Development, Water Quality, Disaster Management and rehabilitation of Flora and Fauna, etc. has been a serious handicap.

The Committee has also been faced with the inadequacy of the Action Plans submitted and the inadequacy of data which formed the basis of these plans. This is especially relevant for the Action Plans relating to Catchment Area Treatment, Siltation, Human Rehabilitation and Safety Aspects of the project.

1.5. Despite the shortage of time, which forced the Committee to compress its schedule of visits, its dialogues with the concerned parties, and its deliberations, every effort has been made to examine in detail all the relevant issues which have a bearing on the role of the project in optimising the utilisation of natural resources.

CHAPTER-II

ENVIRONMENTAL MANAGEMENT -- CONCEPTS

Natural environment is man's most precious heritage and it can no more be considered a free and inexhaustible resource. Optimal utilisation, rather than maximum exploitation of natural resources, has to be ensured for achieving sustained development. Basic needs can be met only through judicious management of the natural resources which, by and large, are non-renewable and are getting fast depleted. The use of natural resources; their conversion into economically valuable commodities has to be sustainable, otherwise the very base of development would get eroded. This is all the more important to make sure that each generation functions as a trustee of the environment for the succeeding generations so that their future options are not foreclosed. A development opportunity deferred is far better than an irreversible and destructive mistake. Sustainable development, therefore, presupposes:

--Equity and social justice;
--Efficient economic system; and
--Ecological harmony.

2.1. **PANCHBHUTAS**, viz. air, water, land, energy and space are closely inter-related and interlinked in such a way that, in nature, a delicate balance is maintained among them. While considerable resiliance is exhibited by the eco-system, it would be fool hardy to apply external interventions of such a magnitude that irreversible processes are set in motion resulting in accelerated degradation of the eco-system. Therefore, the development projects have to be conceived, planned and executed within the "Carrying Capacity" of the

eco-system. Environmental Impact Assessment is a handy tool to assess the likely environmental impacts of a proposed set of development activities in a given region.

2.2. Each development project, including the river valley projects, has the following impact categories:

(a) Economic impacts;
(b) Environmental impacts; and
(c) Social and cultural impacts.

Since the objective of every development project is to contribute to the welfare of the society, it is essential that the impacts of that project must be studied in detail to ascertain whether it will achieve the stated objectives or not. Very often the environmental impacts may offset, many times over, the expected economic gains of a development project, thereby rendering it destructive rather than constructive in the ultimate analysis. In the case of river valley projects like Tehri Dam, the following components need close scrutiny:

2.3. Upstream of the Dam

2.3.1. Catchment Area Treatment:

Depending upon the extent, land use, population affected, socio-economic profile of the population, erodibility, extent of degradation, precipitation pattern, instances of cloud bursts, landslides, silt load, biotic pressures, etc., the Catchment Area Treatment plan has to be worked out to ensure that:

--Silt load going into the reservoir is maintained well within the anticipated design limits

to achieve projected life & economic viability of the project.

--Land and water resources in the catchment are optimally managed to meet the needs of the people and to improve their quality of life.

2.3.2. Rehabilitation:

When a development project is to be taken up in national interest, involving involuntary relocation of urban and rural population, it is imperative for the proponents that all possible efforts be made to ensure that:

--The oustees are relocated in such a way that their standard of living remains at least the same as before, if not improved;

--Relocation is so planned & executed that the social fabric and cultural values are maintained;

--The benefits are so distributed as to achieve social justice;

--The relocation sites and agriculture land are so chosen, in consultation with the oustees, that the families can prosper and continue to practise their traditional vocations for earning their living.

Since our economy is overwhelmingly dependent on agriculture, it should be quite clear that

a majority of the population would require suitable agricultural land for their adequate rehabilitation. A large number of landless families being dependent upon agriculture related work are an integral part of the social milieu of the rural society and they require special attention so that the trauma of relocation does not render them homeless, jobless and rootless.

Rehabilitation of the population affected by Tehri Dam deserves even more sensitive handling because of their simplicity and a lifestyle steeped in mystical, religious and spiritual values derived from long & close association with the sacred Ganges.

2.3.3. Emotional & Cultural Aspects

River Ganges is the fountain-head of our mythology and cultural heritage. Temples and shrines on its banks, and even the Ganga water, are considered sacred and holy. It is not surprising therefore, that not just the local people but almost all the Indians have a deep emotional attachment with the Ganges, transcending all cultural, regional and other considerations. Evidently, rivers, valleys, and Ganga Jal held in such esteem are to be treated with utmost care for preservation as national heritage. Development activities to be initiated in the region, therefore, must be examined in this context so that we may truly redeem our responsibility of being the trustees of natural environment to be passed, intact, on to the coming generations.

2.3.4. Ecological Impacts

Ecological impacts accompany the submersion of forests, agricultural and other land, biotic pressures and interference with the natural flow of the river. The impacts on flora, fauna, soil, micro and macro climate and the riverine eco-system are rather pronounced.

Conservation of flora and fauna is interlinked with the preservation of biological diversity, on which depends the very survival of humankind. A detailed study of the flora and fauna, especially the endangered and threatened species is, therefore, imperative so that necessary Action Plans can be formulated and effectively implemented to preserve biological diversity.

2.3.5. Health Impacts

River valley projects are not always an unmixed blessing and have usually been accompanied by a high incidence of water borne diseases. Fortunately, timely advance action can prevent incidence and spread of such diseases. Steps for this, however, have to be taken right from the screening of the labour force at the commencement of the construction work to the post construction stage of preventing formation of stagnant pools where vector borne diseases can flourish.

2.4. At the Dam Site

Safety and Risk Analysis:

The setting up of a development project may be accompanied by risks which may or may not

be within our present capability of controlling and managing. Such risks, in the case of Tehri Dam, would include:

--Risk of dam failure due to a great earthquake ($M \geqslant 8.5$).

--Risk due to failure of hill slopes;

--Risk, through reservoir surplusing, to settlements downstream;

--Excessive siltation, leading to reduced life span; and

--Extensive areas becoming water logged and saline.

The first three components require detailed analysis so that the adverse impacts can be mitigated through readiness and advance action by preparing and implementing a well conceived Disaster Management Plan. Their impacts cannot, however, be eliminated altogether.

The remaining aspects are, however, amenable to detailed Action Plans being formulated and detailed on the basis of reliable data and studies, to effectively bring the adverse impacts within acceptable limits. Very little, if at all, has so far been done in the case of Tehri Dam Project.

2.5. Downstream of the Dam

2.5.1. Command Area Development and Control of Water logging & Salinity

Construction of a dam merely helps create irrigation potential whose benefits can be realised only through proper Command Area Development. Otherwise, the irrigation potential thus created may remain either totally unutilised or under utilised, as is evident from the presently unutilised 5 m ha of irrigation potential created at an enormous cost in the country. Development of the Command Area through inputs for Land and Human Management is, thereore, a must. This is especially so in the case of Tehri Dam where the Command is already under irrigation by an existing network of Madhya Ganga Canal, Lower Ganga Canal and Agra Canal.

2.5.2. Downstream Ecology

Dam construction inevitably interferes with the natural flow of the river and traps a large proportion of the nutrients and silt that otherwise the river would carry downstream. The impacts extend to flora, fauna, water quality, soil fertility, ground water, etc. and have to be carefully examined.

2.5.3. Extended Flood Plains

A multi-purpose project is designed to control & mitigate floods. Situations may and do arise, however, due to abnormally heavy rainfall in the catchment, when the dam authorities may be forced, in order to safeguard the dam itself, to release so much water as to cause floods downstream. The attendant risks need careful scrutiny.

2.6. General

2.6.1. Cost-Benefit Analysis

Development projects taken up for the well being of the society cannot be assessed simply on their economic cost and benefits. Therefore, it is now agreed by all that the social and environmental costs and benefits also must be fully taken into account while analysing a project. Obviously, there are some difficulties in quantification of some of the social and environmental costs and benefits. Nevertheless, even qualitative assessment of these projects goes a long way in the realistic scrutiny of the proposals.

2.6.2. Alternatives

Optimization of natural resources can be achieved through analysis of a given project, not in isolation but, in the context of its alternative locations, designs and even alternatives to the project itself. Ideally, assessment of alternative project portfolios is called for within the carrying capacity of the region.

2.6.3. Basin Planning & Management Authority

In order to minimize the negative impacts, and to maximize the gains, it is important to adopt an integrated approach to the development of the valley and the command area. Since the primary objective is optimisation of the natural resources, it is necessary that a professional Management Authority be created to ensure that the stream of benefits is so designed

as to result in sustainable development. This may call for re-structuring of the existing organisational set up. But, there seems no choice except to restructure our administrative and management set up so that the benefits of the development efforts are not only fully achieved but reach the designated beneficiaries for fulfilling the avowed objectives of equity and social justice for all.

2.7. Considering that the Tehri Dam Project has been under preparation since the early 60's and construction work has been going on since the early 70's, this Committee had expected that all necessary details and Action Plans and an overall Environmental Management Plan would be available. Regrettably, the Committee has had to depend upon rather limited data and sketchy plans.

CHAPTER-III

3.0. ENVIRONMENTAL PARAMETERS AND CRITICAL ISSUES

As earlier stated, the objective of environmental assessment is to ensure that a project be taken up only if it is conducive to natural resources optimisation and leads to sustainable development. In the case of Tehri project, the critical parameters needing attention are given below:

- Hazards & Risks due to seismicity, landslides, cloud bursts and surplusing.
- Siltation rate & Catchment Area Treatment.
- Rehabilitation.
- Emotional & Cultural Aspects.
- Ecological Impacts
  -Riverine Ecology
  -Flora & Fauna
- Health Impacts.
- Command Area Development.
  -Waterlogging, salinity & drainage.
  -Training & extension facilities.
- Downstream Ecology.
- Cost-benefit Analysis.
- Basin Planning & Management Authority.

3.1. Hazards & Risks

One of the most important and basic issues related to the Tehri Dam is the hazard posed to the life and property, by locating it in a highly seismic and geologically weak setting. The Committee, therefore, examined the potential

risks and hazards which include:

--The impact of a strong earthquake on the dam;

--The impact of Reservoir Induced Seismicity;

--The impact of a strong earthquake on the surrounding hills and the reservoir rim;and

--The impact of surplusing from the reservoir.

3.1.1. Impact of an earthquake on the dam

While considering the impact of a possible earthquake on Tehri Dam, there are two distinct issues:

First, the Magnitude of the severest possible earthquake likely to occur, in the region, during the projected life of the dam; and

Second, whether the dam, as designed, is capable of withstanding the severest possible earthquake likely to occur in the region.

3.1.1.(1) The Committee has been informed, by the Tehri Hydro Development Corporation (THDC) and the Central Water Commission (CWC) that the dam structure has been designed for a maximum credible earthquake of Magnitude 7.0 on the Richter Scale at a focal depth of 20 km. and hypocentral distance of 27km. site. For such an earthquake, the effective peak ground acceleration of 0.25 g has been adopted on the basis of dynamic analysis.

The Committee did not examine, in any detail, the assertion that the current design of the dam was adequate to withstand such an earthquake. Indeed, the Committee did not go into the design aspects even though independent expert opinion was that the estimate of 0.25 g as the effective peak ground acceleration at Tehri Dam would be inadequate.

While the consultants for the project believe that an earthquake with a maximum Magnitude of 7.0 alone can occur with Himalayan Frontal Thrust of the Main Boundary Fault being the seismic source; other experts do not concur with this view. The Committee is convinced that the maximum credible earthquake that can be anticipated in this region would certainly be of a Magnitude higher than 7.0. The Committee has reached this conclusion on the basis of discussions with various experts. In fact, it is the expert opinion of Dr. V.K. Gaur, Secretary, Department of Ocean Development, Government of India and Dr. Harsh Gupta, Vice Chancellor, Cochin University that the Tehri site lies in a unique region of high seismic potential because:

--Over thrusting of the entire Lesser Himalayan belt southwards along the main Boundary Fault is the most dominant mode of continental convergence in the Himalayas capable of producing a major earthquake every 100 to 300 years or so;

--The dam site lies in a segment of the plate boundary which appears to be a "**Seismic gap**" east of the meiso-seismal zone of the 1905 Kangra earthquake (M = 8.6), which has not been ruptured by a major earthquake for a long time. Since earthquakes of Magnitude less than 8.0 do not relax sufficient strain, it is almost certain that, within the proposed life of the dam, the area would get at least one earthquake

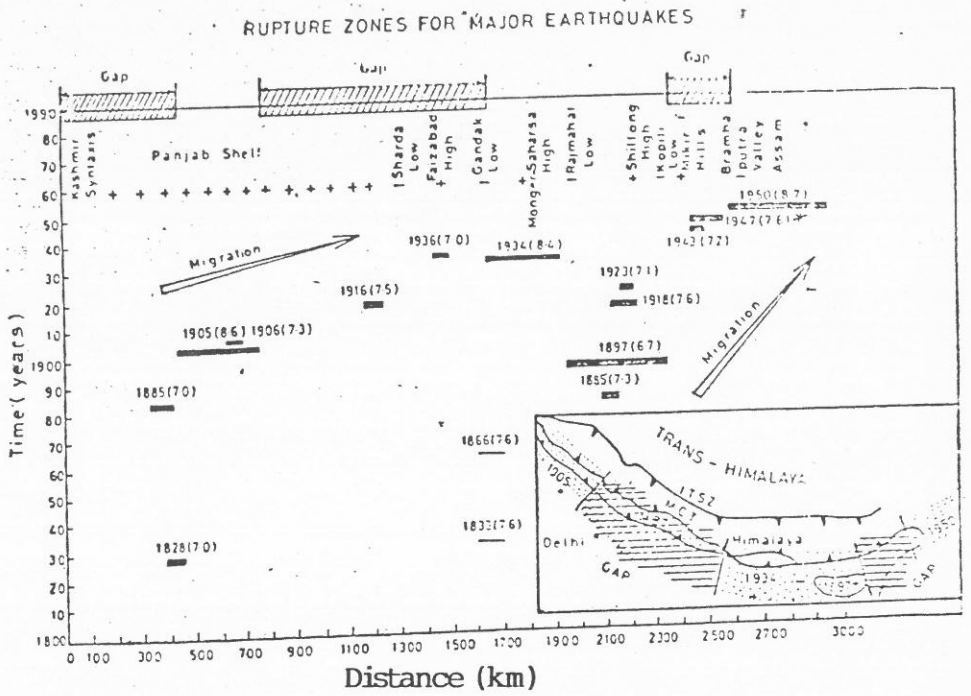
of Magnitude 8.0 and above. Therefore, any dam or other structures to be put up in this region should be capable of withstanding earthquakes of Magnitude of at least 8.5 in the vicinity of the dam site.

3.1.1.(2) The release of energy by an earthquake of Magnitude 7.0 and 8.5 is of the order of 90,700 tonnes of TNT and 287,00,000 tonnes of TNT respectively (equivalent to 10,000 atomic bombs of the Hiroshima type). Major earthquakes involve rupture zones of a few hundred kms. Since, Tehri region experienced its last earthquake, that also of Magnitude 7.6 in 1828, occurrence of a major earthquake ($M \geq 8.0$) during the anticipated life of the Tehri Dam is almost a certainity. An epicentre map of the Himalayas shows the sites of recent earthquakes and the seismic gaps. (**Figure-1**).

3.1.1.(3) The representatives of the Central Water Commission (CWC) confirmed that the Tehri dam design does not provide for an earthquake of this Magnitude. The THDC representatives, on the other hand, insist that an earthquake of this Magnitude is not likely to occur in the region even though the adjacent areas have experienced earthquakes of Magnitude 8.6 in the past (Kangra, 1905).

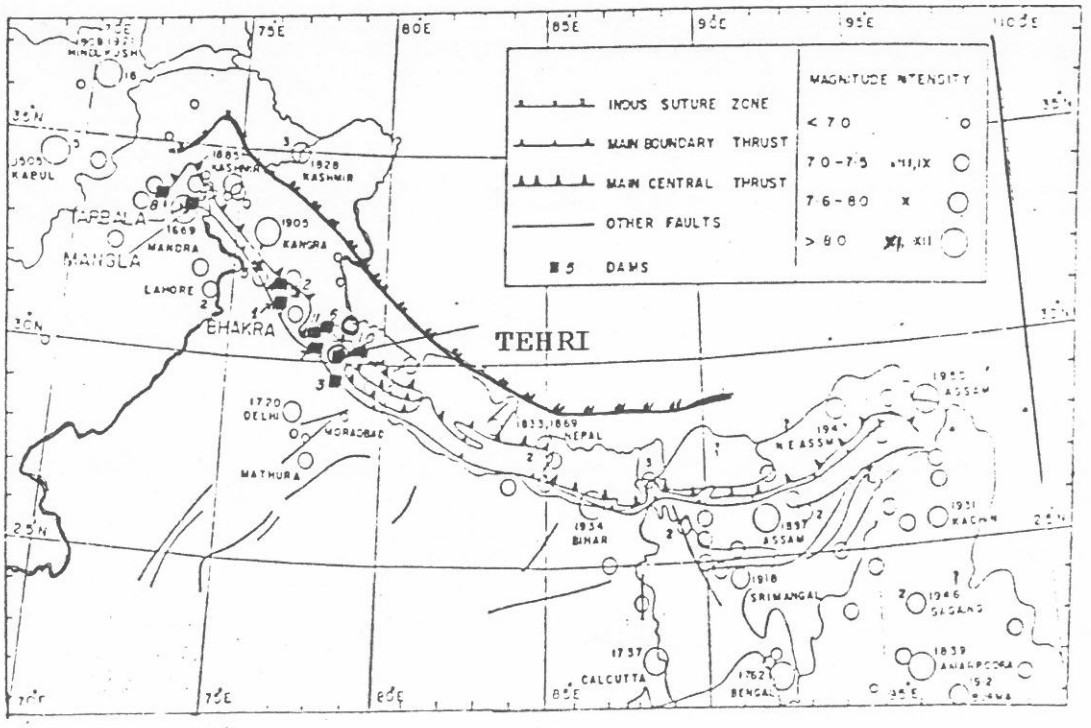
3.1.1(4) Considering that Tehri Dam failure due to an earthquake would cause unprecedented loss of life and property, it seems obvious to the Committee that all possible precautions and

FIGURE-I



Three possible seismic gaps and rupture zones of major earthquakes (M > 7.0) in the Himalayan seismic source zone.

SOURCE: Khatri & Tyagi (1983)



An epicentre map of the Himalaya and vicinity showing earthquakes of magnitude > 7.0 as well as recent earthquake that claimed human lives. Dams with heights exceeding 100 m are shown by filled squares.

SOURCE: Gupta H.K. (1989)

preventive measures must be taken. Though, despite repeated requests, the THDC did not provide the Committee with risk analysis in terms of the impact of dam failure on the life, property and cultural heritage, our own tentative calculations suggest that if the Tehri Dam collapsed, it would cause a flood wave which would wipe out Rishikesh and possibly Haridwar. This wave would wash away most of the settlements around this region.

Given the anticipated velocity of this wave, there would be little time to warn the inhabitants down stream and, therefore, almost all the people living in these towns and villages would perish.

3.1.1.(5) Considering the magnitude of the potential disaster that would result from a dam break, the Committee found it very surprising that the project authorities have not attempted a risk analysis, which is essential to estimate the potential hazard of the dam. It is also surprising that, despite repeated expert opinion to the effect, the Tehri Hydro Development Corporation have not incorporated necessary modifications in the dam to make it capable of withstanding an earthquake of the magnitude that, according to experts, is almost certainly going to occur during the anticipated life of the dam. The technical and financial implications of constructing such a dam should have also been seriously examined.

In this context, it might be pertinent to mention that, in support of their statement that the Tehri Dam is quite safe, the Tehri Hydro Development Corporation have quoted examples of other

dams constructed in the Himalayas. These examples, however, do not inspire confidence as other dams built in the Indian Himalayas, like Bhakra and Pong, are located in the foothills and not in the middle Himalayas, like Tehri. Besides, all these dams were built after 1950 and have not yet been subjected to an earthquake of this Magnitude.

3.1.1.(6) It might be mentioned here that such great earthquakes have a periodicity and though there have been quite a few such earthquakes in the Himalayan belt before 1950, none have occurred since then. However, according to seismologists, the fact that there have not been earthquakes of this Magnitude since 1950 only heightens the probability of occurrence of such earthquakes in the near future. As Dr. Harsh K. Gupta states:

> "The proposed Tehri Dam site is a part of the active Alpide seismic belt. The Kangra earthquake of April 4, 1905 which occurred in immediate west of the site was of Magnitude 8.6 and caused considerable damage, claiming over 19,000 human lives. The possibility of similar earthquake occurrence during the life span of Tehri Dam (say 100 years) is imminent. In this connection it may be noted that certain cycles of high and low seismic activity seem to characterise Alpide belt. For example, during the period 1897-1916, some 15 earthquakes of Magnitude $\geqslant$ 7.7 occurred in the immediate vicinity of the Alpide belt constituting a very active seismicity phase. The period 1917-1933, however, was completely devoid of any such earthquake. The period 1934-1951 was again very active when 14 earthquakes of M $\geqslant$ 7.7 were associated with the Alpide belt. A quiet phase began from 1952, and is still continuing, since only 4 earthquakes of M $\geqslant$ 7.7 have occurred in the last 34 years in the immediate vicinity of the Alpide belt. Non occurrence of a major earthquake in India since 1950 has developed a false sense of security ."

3.1.1.(7) The examples given of dams in other countries, which have survived earthquakes, are also rather misleading as all the examples cited are of either a small earthquake close to a big dam or a strong earthquake close to a small dam. As no extrapolation from these observations can be made for the case of a strong earthquake near a high dam, these examples are not helpful for a high dam especially for a high dam like Tehri, which is located in an area expected to have a strong earthquake ($M > 8.0$) in the near future. The Committee took note of the sobering example of Auburn Dam in California, where in the mid-seventies the project was abandoned when a fault, capable of Magnitude 7.0 earthquake was discovered on digging, whereas the original estimate was only for a Magnitude 6.0 earthquake.

3.1.1.(8) Safety record of the earthen rockfill and other dams is also not very encouraging. Shri Y.K. Murthy, former Chairman, CWC writes in an article on "Safety of our Dams and Reservoirs" :

"One aspect which has increasingly engaged the attention of Engineers is ensuring the safety of dams as total failures have increased.....According to a study of failures and incidents to large dams by the International Commission on Large Dams (ICOLD), out of a total of 8925 dams in the world 535 incidents to dams were recorded out of which 202 related to total failures.

In India, 40 incidents including 13 failures were recorded in a total of 433 dams."

In the face of past experience involving 10% of our dams in incidents, one has not only to make all possible efforts to ensure that dam failure is avoided but also must remain in perpetual readiness to deal with a disaster as and when it strikes. Given the lack of readiness on the part of THDC authorities to tackle these issues, the Committee could share neither their complacent attitude to the horrific consequences nor their single-minded urge to push the project through at any cost.

3.1.1.(9) Therefore, considering the almost total certainty that a strong earthquake of Magnitude greater than 8.0 will occur in the region during the life of the dam, and considering that the dam design does not provide for such an earthquake, the Committee has no option but to conclude that construction of the Tehri Dam, as proposed, involves totally unjustified risks. The magnitude of the disaster that would follow, if the dam collapsed, strengthens the Committee's opinion that approval to the construction of this dam, as proposed, and at the present site, would be irresponsible.

3.1.2. **Reservoir Induced Seismicity (RIS):**

The Committee was informed that even if there was reservoir induced seismicity, it would, in magnitude, be much less than an expected natural earthquake in the region, for which the dam structure is being designed.

The Committee found no reason to disagree with this assertion. It has been observed, however, that tremors caused by RIS can and do pose problems to the safety and stability of civilian infrastructure and buildings which are normally not designed to withstand any earthquake forces. Frequent occurrences of tremors caused by RIS would, therefore, become a source of hazard to the population in the neighbourhood of the reservoir.

3.1.3. **Impact on Surrounding Hillsides:**

The stability of the abutments, adjacent hills and the reservoir rim have an equally important role to play. It is not clear whether an

earthquake of Magnitude 8.5 could be tolerated by the hill sides and the reservoir rim. This, in any case, has not been tested or established. The question of rim-stability is especially important because if the hillsides collapse due to an earthquake, the implications can be as bad as if the Dam collapsed. A famous example is that of the Vajont Dam, in Italy, when collapse of a hillside into the reservoir caused a huge wave which over-topped the dam and instantly killed a large number of people even though the concrete dam itself survived.

3.1.4. Hazards due to Surplusing from the Reservoir:

One of the benefits claimed from this multi-purpose project is the moderation of flood and Tehri Dam is, therefore, stated to be provided with surplusing arrangements for a discharge of about 15,400 cumecs, even after providing 5 m ht. for flood moderation. The normal flood in the valley below is now reported to be in the region of 3500 cumecs. Therefore, the release of 15,400 cumecs of water will certainly bring much larger areas under the fury of floods downstream. The situation would get further aggravated if Alaknanda also happens to be in spate at the same time.

The increased intensity of flood flow calls for a critical examination of the safety, and for remodelling, if necessary, of existing public structures like bridges, roads, regulators, barrages, etc. downstream. The Committee was not informed of any such scrutiny, for modifications to existing structures, with financial implications, by the project authorities.

Since, the Tehri Dam site is located in a geologically unstable area and has a high hazard potential, the community downstream would live in perpetual apprehension and fear for their life and property, unless all efforts are made to effectively demonstrate that such fears are totally unjustified.

Unfortunately, the project authorities have not taken these factors into consideration while detailing the project.

The project authorities have done no risk analysis for the project. They have also not prepared, despite repeated requests, any Disaster Management Plan. Consequently, the financial and other implications, in fact even the viability, of such a plan has not been worked out. The Disaster Plan claimed to have been prepared has almost no data on Tehri Dam.

3.1.5. Taking note of the unacceptable risk involved, extremely poor status of readiness to deal with the hazards, and unprecedented damage in case of a breach or overtopping, the Committee reiterates its considered view that it would be irresponsible to clear the Tehri Dam as currently proposed.

3.2. SILTATION AND CATCHMENT AREA TREATMENT

3.2.1. SILTATION AND LIFE OF RESERVOIR

The life of a reservoir depends on the rate of silt inflow and its dead storage capacity. The Tehri reservoir was initially designed for an expected sediment rate of 8.2 ha.m/100 km^2/year giving a total sediment load of 608 M m^3 over a period of 100 years. But, provision of dead storage capacity of 925 M m^3 has been made.

3.2.1(1) Silt load studies were started in 1973 at Tehri, below the confluence of Bhagirathi and Bhilangana. Data is available for a period of 14 years upto 1987. No data could be collected for the year 1979. The project authorities have calculated average suspended silt load as 12.68 ha m/100km^2/yr. to which has been added a bed load of 15% (1.90 ha m). Assuming a trap efficiency of 96% the total silt load has been calculated as 14.00 ha m /100 km^2/year. To be on the safer side, the proponents have adopted a silt load of 14.5 ha m /100 km^2/year.

3.2.1(2)' Examination of the silt data furnished, however, reveals that the calculations made by the project authorities suffer from the following:

-- The total silt load over a 14 year period comes to 190.5 instead of 190.31 ha m per 100 Km^2.

-- Average suspended silt load of 12.68 ha m has been calculated on the basis of a 15 year period while the data is available only for 14 years. Accordingly, the correct value should be 13.61 ha m /100 km^2/year and not 12.68 ha m.

-- By carrying forward this correction, the actual silt load comes to 15.01 in place of 14.00 ha m /100 km^2/year. (Allowing bed load of 15% and trap efficiency of 96% as assumed by the proponents).

It is clear from the above that the silt load adopted by the proponents in the belief that it is higher than the observed rate is, in fact, lower than the actual observed average for a short period of 14 years.

3.2.1(3). The project authorities have calculated that:

--Dead storage at EL 740 m is.... 925 M m^3
--Dead storage at EL 720 m is...600 M m^3
--Total sediment load after 100 years is (@ 14.5 ha m) .....1090 M m^3
[596.23 M m^3 in dead storage, and 493.77 M m^3 in live storage]

Even with these calculations the dead storage gets used up to the elevation 720 m in one hundred years. This level also coincides with the invert level of the Head Race Tunnel.

It is, however, much more probable that the actual silt load in the reservoir may be much higher than assumed on the basis of limited data ,as is evident from our experience in other reservoirs. The observations of the Reservoir Sedimentation Committee in its report of July, 1985 are revealing:

> "Some reservoirs in the world have silted up so fast that they have become useless. For example, the Yasuka Reservoir in Japan has lost 85 percent capacity in less than 13 years. Many of the reservoirs in India are losing capacity at the rate of 0.5 to 1.5 percent annually."

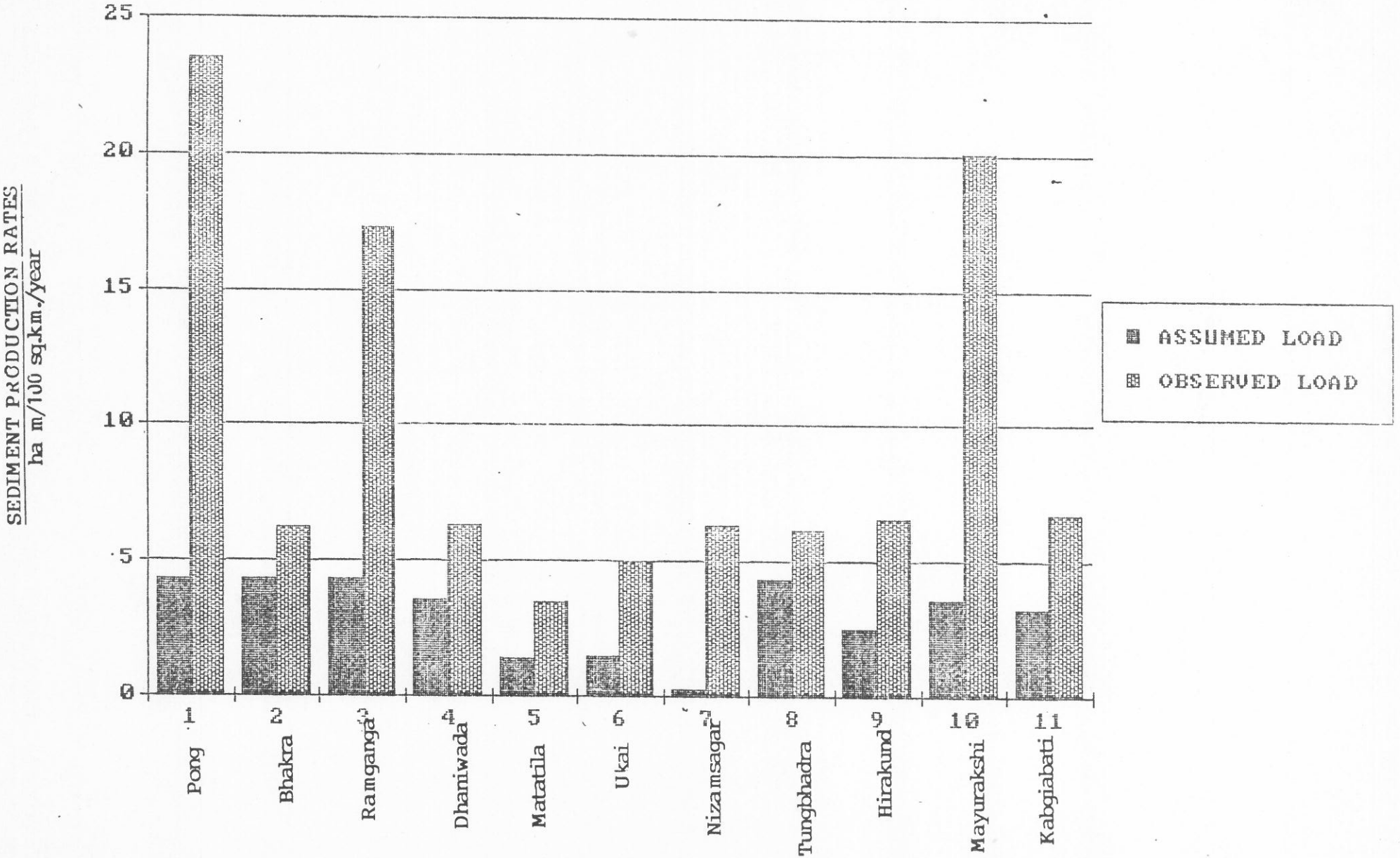
Comparative data for various dams in India is given in **Figure-2.**

3.2.1 (4) Empirical formulae are evidently of little use in predicting silt load as is clear that the adoption of a silt load factor of 8.2 ha m/100 km^2/year so derived, would have been totally inadequate. and misleading. The observed silt data itself leaves much to be desired as the 14 years data can be alternately assessed as follows:

-- Data for 5 years is consistently high (1973, 77, 78, 80 and 85) giving an average of 22.72 ha m.

-- Data for the other 9 years gives an average of 8.545 ha m which obviously is not realistic as it is much lower than the silt load carried by the river. The lower values are attributable to limited flow in the river during these years.

Fig.2: ASSUMED AND OBSERVED SEDIMENT PRODUCTION RATES (SPR) FROM SOME OF CATCHMENTS/WATERSHEDS



To be on the safer side, therefore, one has to adopt a higher silt load factor, which may be able to realistically account for:

-- Silt contribution due to receding glaciers;
-- Occurrence of landslides and cloud bursts which are a frequent phenomenon in the region,
-- Extreme degradation leaving the catchment in a critical state,
-- Expected increase in biotic pressures if development projects are taken up.

We, therefore, have the option of adopting either the observed average silt load of 15.5 ha m/100 km2 /year or the higher, but more realistic silt load of 22.72 ha m. (Corresponding silt load would be 1164 and 17.6 M m^3 respectively). The reservations expressed that the life of the reservoir may only be around ±60 years might come true if the higher silt load factor materialises.

3.2.1(5) The Committee seriously doubts the conclusions on siltation arrived at by the project authorities, because of the following:

-- The estimates of siltation rate based on data collected from only one observation station, located quite near the confluence of two rivers, is likely to give lower siltation values than actual.
-- The bed load has been calculated on an adhoc basis at 15 percent of the suspended load; this again appears to be low because of very steep slope.

-- Sediment distribution studies have been carried out using Empirical Area Reduction method recommended by CWC and the IS Code, and for the purpose of analysis the reservoir has been classified as Type-II -- Foot hills. Tehri, by no stretch of imagination, can be considered to be located in the foothills. This will be the first dam of its type in the Himalayas and the situation will be entirely different than other reservoirs in the country.

-- The dead storage needs to have been calculated upto EL 720 m rather than EL 740 m.

-- The rate of siltation of Tehri Reservoir has been adopted as 14.50 ha m/year which is reported to be higher than actual sedimentation rate observed. This is not correct. Actual average sedimentation rate is 15.0 ha.m/100 km^2 according to the data supplied by the project authorities themselves. The adopted rate has, therefore, to be higher.

-- The project authorities have repeatedly referred to low sediment rate in Bhakra and reported reduction in silt load in 1967-73 compared to 1959-65 in Bhakra. The two catchments are, however, not comparable.

-- The project authorities have taken the stand that 1978 siltation was unusual. The local population is of the opinion that 1968 flood was much worse. Even

in 1973 the silt load was 24.63 ha.m/ 100 km^2 and in 1977, 1980 and 1985 the recorded silt load was 17.84, 17.17, 17.33 ha.m/100 km^2 respectively. For such a huge dam, use of data of only about 14 years is totally inadequate to predict silt load on a long term basis.

3.2.1(6). Under the circumstances, the Committee cannot but conclude that:

-- Silt load carried into the reservoir would be much higher than assumed;

-- Under the prevailing conditions, which may further deteriorate, the life of the reservoir would be considerably reduced with commensurate reduction in benefits.

3.2.2. CATCHMENT AREA TREATMENT

The physical conditions of the catchment, particularly with respect to vegetative cover, steepness of slopes and geological conditions, govern the rate and amount of soil erosion, rate and quantity of run off and the incidence and intensity of floods, land slides and hill side erosion. This is particularly important in areas of high monsoon rainfall. The rate and amount of soil erosion (including landslides) determine the useful life of a reservoir. Studies on the actual rate of siltation of reservoirs in the Himalayan region, particularly Bhakra and Ram Ganga, have conclusively shown that the observed rate of siltation has been much higher than the anticipated rate, as is evident from **Figure-2.**

3.2.2(1). The increasing human and livestock population requires more food, more wood for fuel and timber, and more grass and tree leaf fodder. Treatment of catchment area, through improvement of terraces, development and improvement of minor irrigation, stabilizing and controlling gullies, improvement of grasslands, afforestation of degraded lands to meet timber, fuel and fooder requirements, needs to be given the highest priority for optimum utilization of our basic resources -- soil and water.

Degradation of the catchment areas has not only an impact on the dam by reducing its life and posing a threat to its safety, it is also affected by the dam. Where a certain amount of land and forests are submerged by the dam, the pressures on

these lands and forests get mostly transferred to the remaining area in the catchment, thereby hastening their degradation.

To add to this, the catchment of Tehri project has a history of cloud bursts, flash floods and huge landslides. For instance, in 1978, there was a huge landslide at Kanodia Gad resulting in creation of a temporary earthen dam, which collapsed after about 26 hours, inundating large areas in the valley downstream. Indeed, its impact was felt as far down as Haridwar.

Similarly, in 1959, a lake was formed near Dabrani, by blockage of the Bhagirathi. In 1939, a landslide near Sera blocked Jalkur, a tributary of Bhagirathi and, on bursting, washed away much of the down stream habitations. Even in 1990, upward thrust of the river bed in the region is occurring and carrying huge cracks in the neighbouring hill sides. Such an occurrence around the Tehri Dam could spell disaster.

Such occurrences are a part of the history of the region, and they significantly affect the thinking of the people there as is truly reflected in the folk songs of the region.

3.2.2(2) Tehri dam catchment has a total area of 6.92 lakh ha of which 1.92 lakh ha is snow bound and 0.36 lakh ha is rocky. (Project document also gives the catchment area as 7511 km^2). Of the remaining 4.64 lakh ha, 3.66 lakh ha is forest land, 0.88 lakh ha. is used for agriculture and 0.1 lakh

ha is reported to be submerged (It was explained to the Committee that this is the area under rivers etc.).

The Project authorities have planned to treat only 0.36 lakh ha out of a total degraded catchment area of 2.06 lakh ha needing treatment. This amounts only to 15 percent of the total degraded area being treated. The situation is further confounded by the conflicting assertions of the project authorities indicating that out of 0.36 lakh ha area needing treatment, 5,000 ha area had already been afforested by 1986 and another 10,000 ha area completed by March, 1989. This leaves only 21,000 ha area to be treated. This statement does not tally with data given in another part of the report stating that approximately 19,000 ha area has been brought under plantations from 1978-79 to 1986-87.

The project authorities have not carried out any study on the extent of erosion in the catchment since 1972. The only information that could be used to draw any broad conclusions is the siltation data recorded at only one point, about 1.0 km below the confluence of the two rivers just below the Tehri town. It is generally recognised that measurement of sediment near the confluence of rivers results in under-estimation of the sediment load. Estimation of the bed load has been done on the basis of an non-empirical assumption borrowed from U.S.A., of 15 percent of the suspended sediment. This also appears to be an under estimate.

Even with these limitations, the recorded silt load is 21 tonnes per ha per annum (including the snow covered area) and if the snow covered area is excluded, the rate of erosion comes to a little more than 31 tonnes per ha. This is a clear indicator of the highly degraded state of the catchment.

The general experience from other projects in the country is that during the execution of the project and after its completion, the biotic pressures increase leading to serious land degradation. In Tehri project this degradation is likely to be much more serious due to such added activities as road construction and tunneling etc. for other new projects upstream.

The Committee observed, during its visit to the project area, that even the small area taken up for afforestation is not based on any watershed or sub-watershed development plan. No planned and concerted effort has been made, even in afforestation -- the only activity taken up in the catchment so far. The Committee appreciates that the task of identification of critically degraded areas has belatedly been assigned to the Remote Sensing Applications Centre (RSAC), Lucknow. Its findings would form the basis of a meaningful Action Plan.

3.2.2(3). Taking note of the highly degraded status of the catchment, identification of a very limited degraded area for treatment, inadequacy of the treatment in the area already covered etc., the Committee concludes that:

-- All the critically degraded catchment areas (2.06 lakh ha and not just 0.36 lakh ha) should have been taken up for treatment. Cost of such treatment would have amounted to around Rs.286 crores in place of the projected sum of Rs.46.59 Crores. Without comprehensive treatment, no project dealing with land and water resources, least of all Tehri, would be sustainable.

-- Involvement of the local people is a must so that the twin objectives of reducing siltation and meeting the food, fuel, fodder and water needs of the locals can be met. Unfortunately, no effort has been made by the project authorities, to this end.

-- The limited afforestation work done so far lacks focus and targets.

-- Identification of hot spots, hazard zonation and requisite treatment plans are missing altogether.

-- A significant part of the catchment is covered with morainic deposits, but there is no plan to stabilise them.

Under these circumstances, unless plans for all these aspects are developed, and adequate financial provisions made, the Committee is not in a position to consider the project.

3.3. REHABILITATION

3.3.1. The primary objective of irrigation and power projects is to contribute to the welfare of the community. It stands to reason, therefore, that the population making the supreme sacrifice of leaving their homes, which are to go under submergence, should be adequately rehabilitated. The Committee is conscious of the broad national policy on rehabilitation, laying down that the living standards of those displaced should be maintained at least at the same level, if not improved, to what they were prior to their involuntary displacement. Considering the social and emotional trauma that all displacement inevitably causes, and to ensure that there is no deterioration in the living standards, it is generally expected that the following provisions should be made in the rehabilitation plan:

--All displaced agricultural families should be given suitable and adequate agricultural land;
--"Family" for the purpose of compensation, should be defined as all adult males of 18 years and above. In addition, each family should be given some ex-gratia amount, and compensation for land and other property that they leave behind;
--At least one member of the affected family should be provided employment, failing which a certain minimum amount should be provided to each family, every month, for a period of 20 years;

--All necessary measures should be taken to ensure their social, cultural and economic welfare and security;

--Basic facilities like drinking water, hospital, school, post office, access to markets, etc. should be provided at the relocation site, along with irrigation facilities for agriculture.

3.3.2. The first step in rehabilitation is to identify the affected population. In addition to Tehri town, the Tehri Dam Project is to submerge 112 villages -- 43 villages fully and 69 partially.

According to the THDC, the number of affected families would be 9600 from rural areas and 3500 from urban areas (Approx. population affected being 46,000).

However, these figures are disputed. Other estimates place the number of affected population at 97,000. In addition, the figures of total affected population must include the families to be relocated from:

--the reservoir slopes considered unstable;
--the enlarged flood plain after the dam construction; and
--Koteshwar project, which is integral to Tehri dam project.

3.3.3. <u>Compensation proposed</u>

The proposed compensation package provides for 2 acres of developed agricultural

land, along with a homestead plot of 200 sq.m. Due to a paucity of land, some of the families are to be given a half acre plot of land near Dehradun, and still others are to be provided only cash compensation. In the case of Narmada Sagar and Sardar Sarovar projects, the allotment of agricultural land per family is two-and-a-half times the norm adopted for Tehri. A valid question to be asked is whether a two acre plot would suffice for an agricultural family even to subsist. This aspect has obviously been overlooked as is evident from the plight of the oustees rehabilitated at Bhaniawala. Initially, the project authorities had proposed to acquire forest land for rehabilitation purposes. However, with the promulgation of the Forest (Conservation) Act, 1980, forest lands earmarked for the project are no longer available. Therefore, an important aspect of satisfactory rehabilitation is to identify enough land with capability to sustain agricultural operations so that all the oustees can opt for land of their own choice.

Equally important is the need to ensure that relocation does not break down the village community, which has evolved over a long period by interweaving social, cultural and economic systems of inter-dependencies. Such a break would make the individual family vulnerable and insecure, through a loss of cultural heritage and cohesion. It is essential, therefore, to rehabilitate the families and villages, or even groups of villages, as a unit.

Rehabilitation of the rural families is proposed to be carried out in three stages. But, land to the extent of about 1900 acres is yet to be acquired for families to be relocated under Stage-I, which is to end in May, 1990. The oustees, therefore, logically ask, "Where is the land?" A satisfactory response is yet awaited.

A Regional Building Training Centre is proposed to be set up to provide occupational training to the oustees, though no studies have been done to ascertain whether the trainees would find employment in the region.

The urban settlers are to be provided plots varying in size from 60 sq.m. to 300 sq.m. at nominal rates.

3.3.4. The Committee notes with regret that the rehabilitation norms adopted by the THDC are not in consonance with the national thinking and strike at the roots of the traditional joint family system. Surprisingly, situations have arisen where the living great grand father along with his sons & their families, etc. were all considered as "one family unit" for providing compensation.

3.3.5. To assess the effectiveness of rehabilitation carried out so far, the Committee held discussions at site with the relocated families. On the basis of field visits to the rehabilitation sites and discussions

with officials of the State Government and the THDC, and with the persons rehabilitated, the Committee notes with anguish that the condition of the rural population so far rehabilitated is apalling, even though a sum of Rs.1117.15 lakhs is reported to have been spent upto March, 1989 on rural rehabilitation. Some of the major problems are listed below:

3.3.5 (1). The families we met (at Jolly Grant and Bhaniawala) had been resettled over ten years back, but still do not have a legal title to their land. This was confirmed by the Divisional Commissioner of Garhwal, and by officials of the THDC, and is attributed to some legal and procedural problems in transferring the land to the rehabilitated families, who now rightly perceive themselves as legally landless.

Some of the plots on which these families were rehabilitated are next to the Jolly Grant airport. It is understood that the airport authorities are now proposing to acquire this land for expansion of the airport, thereby rendering these families from Tehri once more refugees. Besides, as they do not yet have legal rights on these lands, it is not clear what compensation etc. they would be entitled to.

3.3.5 (2). The plots given to the displaced persons are mainly rocky and sandy, and not conducive to productive agriculture. Since, the strata is highly permeable, it takes many

hours to irrigate the fields and, as the oustees reported, their electricity bills for the tube wells go as high as Rs.5000/- a month.

3.3.5(3). Most of the families did not have access to tubewell waters, for the first seven or eight years after being shifted. Even now, the existing tube wells do not always work and damage to crop, and other hardships, are common. Also, as the ground water is available only at 150 feet and below, hand pumps are not functional.

3.3.5(4). Whereas many of these families, formerly living near Tehri town, could easily find additional employment there, they are now isolated from avenues of employment.

3.3.5(5). The oustees have been provided 2 acres of land at the rehabilitation site, but no other common or grazing land. However, in their former villages they had rights over the surrounding common lands and forests and, therefore, even those who had smaller actual land holdings had access to the resources of a much larger area.

3.3.5(6). Various other facilities like security, education, community centres, market facilities, etc. are also woefully inadequate. Even after staying for more than 10 years, these people still feel threatened in their new environment.

3.3.6. The Commissioner, Garhwal Division, informed us that at present land was not available to rehabilitate the remaining families. However, the Government proposed to acquire some abandoned tea-gardens in the Doon Valley for the purpose, though the process of acquisition had not yet started.

3.3.7. It is well recognised that unless planning, identification of land and provision of sufficient resources for rehabilitation are done before a project is cleared, it becomes very difficult to ensure that the people ousted by the Project would get justice.

The Committee is, therefore, convinced that the rehabilitation package needs to be improved, adequate and appropriate land for resettlement identified, and sufficient provisions made for rehabilitation in Project budget, before the project can even be considered.

3.4. CULTURAL AND EMOTIONAL ASPECTS

3.4.1. CULTURAL ASPECTS

The river Ganges and its waters have been revered and held sacred by successive generations through the millenea. Our mythology and cultural heritage has been shaped by the mighty Himalayas and perennial rivers like the Indus, the Ganges and the Brahamaputra - each one contributing to our legends and folklore. Indeed, the river Ganges, worshipped as the holy Ganga, represents an apex of human experience through times immemorial based on the symbiosis between humankind and life support systems. Conservation and preservation of this unique heritage is, therefore, a national responsibility.

The culture of a people forms the basis of the social fabric on which all human endeavours are based. Economic and social development presupposes the existence of a harmonious and dynamic social structure, which can absorb, and benefit from, economic and social inputs.

Unfortunately many development projects strike at the very cultural and social roots that are essential for development to succeed. This may result in a superficial growth in economic indicies, but a decline in social and human welfare. Despite this, the cultural disruption such projects cause are never reflected in the calculated costs of the projects.

The Tehri Dam, as proposed, threatens the cultural fabric of the region in at least three ways.

First: By dislocating nearly a hundred thousand people, and rehabilitating them, as has been done so far, in a haphazard and insensitive manner, the project contributes to the burtalisation and isolation of the age-old cultural traditions of these people.

Second: By significantly disrupting the ecology of the region, through the dam, its reservoir, the attendant infrastructure, etc., it threatens to disrupt even for the remaining population, their historical and cultural continuity and the cohesive fabric of the society. As earlier stated, any accident resulting in overtopping or breach of the dam will spell disaster to the historical & religious centres of Rishikesh, Haridwar, etc. Disappearance of culture could mean death of the spirit of India.

Third: Rehabilitation of the works of art through relocation of a few selected monuments cannot justify the belief that justice is done to restore cultural setting by just shifting the brick and mortar structures.

The people of the region deserve economic opportunities and have a right to rapid development, provided all efforts are made to make such development compatible with the social and cultural ethos of the region.

The Tehri Dam project does not show any sensitivity to this very important aspect.

3.4.2. EMOTIONAL ASPECTS

It is well recognised that involuntary displacement of individuals and communities causes intense

emotional trauma and can even result in higher mortality rates. This was discovered recently, by the Tata Institute of Social Sciences, while studying families rehabilitated under the Sardar Sarovar project. The mortality rate among the oustees was found to be much higher than that in the control sample.

The Tehri Dam, as proposed, also poses a threat of emotional trauma, especially for the oustees. This is aggravated by the fact that most of these oustees have been very poorly rehabilitated.

Another source of emotional trauma is the risk posed by the Tehri Dam, especially the risk of failure. It is impossible to calculate, in financial terms, the emotional cost that would be paid by the people downstream who would continue to fear the worst every time there was a tremor, or exceptionally heavy rainfall.

3.4.3. Water Quality

Maintenance of quality of Ganga Jal after impoundment is another important aspect contributing to the emotional factor. Impoundment in deep reservoirs generally results in deterioration of water quality due to:

--Stratification.
--Tremendous increase in bacterial growth.
--Depletion in dissolved oxygen especially in thermocline and hypolimnion regions.
--Decay of bio-mass releasing harmful gases like ammonia (NH_3), hydrogen sulphide (H_2S), methane (CH_4) etc.; and
--Turbidity.

Impoundment of water may result in thermal, chemical and biological stratification. The upper warm layer is separated by thermocline, a transition zone acting as a barrier to diffusion, from the cooler lower layer. Even in tropical conditions, there is considerable temperature, difference between the upper and bottom water layers. Thermocline restricts the movement of salts and gases but organic material can sink through it. Decomposition in hypoliminion region results in decreased dissolved oxygen and, eventually the absence of aquatic life at lower levels.

In the case of deep reservoirs, mixing of lower and upper layers of water may take place only during monsoons. The process of inflow and outflow of water would lead to limited mixing in the top layer only.

Chemical analysis of water samples at Tehri Dam site as reported covers only inorganic constituents, while details of some important water quality parameters closely linked with impoundment, such as turbidity, dissolved oxygen and bacteriological constituents, have not been studied at all. Data on these critical aspects is missing even in the examples of other projects quoted. In the absence of consideration of these important parameters, inferences derived by the project authorities on water quality due to impoundment are not valid, and lead the Committee to apprehend that there might be a serious deterioration in water quality as a result of the Tehri project.

3.4.4. Unfortunately, the current location and design of the dam does not justify a sense of security. The threat perception is aggravated by the fact that there is no disaster management plan which could reassure the people that, even if the dam failed, they would be warned and evacuated in time.

The Committee, therefore, is forced to conclude that the cultural and emotional impacts of the project are immense, and that they have neither been taken into consideration while earlier assessing the project, nor has any planning been done to minimise or mitigate them.

3.5. ECOLOGICAL IMPACTS

3.5.1. RIVERINE ECOLOGY

The Himalayan river ecology has to be viewed in relation to geophysical perspectives of the tectonic activity, glacial action, snow melt, spells of monsoons which in an integrated manner has given rise to the river systems which transport the denudation products in the form of assorted masses of aggradations. In addition, large quantities of eroded mateial from exposed slopes of varying steepness by natural or due to human activities are added to the river. The Himalayan rivers, inclusive of Bhagirathi, as they traverse Tethyan, Central Crystalline and lesser Himalayan domains of different lithology, are transporters of enormous quantities of silt and life supporting minerals. During the annual spells of heavy monsoon, the large quantities of water flood the valleys, submerging for a varying period of time the areas lying along the river channel forming the flood plains. Periodically, under exceptionally high flood conditions the waters inundate lands far beyond the normal flood plains thereby fertilizing the flood plains and adjoining lands. Replenishment of the swamps and lakes and, recharge of the ground water through aquifers and seepage is also facilitated.

The creation of a reservoir will submerge a vast area of agriculturally rich terraces and fans. The large body of water may

may also lead to:

--Reworking of some parts of the slopes;
--Modification of fluvial activity; and
--Accelerated sedimentation due to combination of the above two.

Interposition of the lake with the drainage system of the area will affect its fluvial activity because of hinderance to the normal flow. As a consequence, erosional and depositional trends may be augmented especially in moderate and high gradient streams.

Apart from accelerated siltation, the changes in the riverine regime will adversely affect the aquatic life, and especially the migratory species which breed & thrive in selected niches. Creation of a large water body is invariably accompanied by microclimatic changes, which have a long term impact on the flora and fauna in the neighbourhood. Arrangements have to be made for monitoring long term changes.

3.5.2. FLORA AND FAUNA

Various physical and geographical features in the catchment area are accompanied by considerable diversity in its floristic composition. Accordingly, as the altitude rises, one comes across belts of chir, deodar and blue pine, oaks, fir and spruce and finally birch and Rhododendron representing the following major type of groups of vegetation and their various degradational stages:

--Tropical dry deciduous forests;
--Subtropical pine forests;
--Himalayan moist temperate forests; and
--Sub-Alpine and Alpine forests.

3.5.2(1). The present forest cover in the submergence area is of very poor quality. Surveys conducted have shown a density of 26 and 18 trees per ha in Reserve and Civil-Soyam forests respectively. About half the number of these trees are less than 10 cm in diameter. Th density of good mature forests in the higher reaches of the catchment is about 80-90 trees per ha with trees over 40 cm in diameter.

3.5.2(2). Local people have traditional rights and concessions in these forests with regard to fuelwood, fodder, timber etc. which would be lost to the population to be dislodged by the execution of this project. Since, the partly affected families will

be left with limited land for grazing, collection of fuelwood, timber etc. the pressure on the adjoining forests will get further intensified leading to accelerated degradation in an area which is already in a critical state.

3.5.2(3). Botanical Survey of India have reported that out of 462 species (99 families) recorded in submergence area and its vicinity, there are 12 rare and endangered species which will be affected by inundation. These species have to be protected, conserved and multiplied.

Measures to that effect will have to be taken, so that these species are not lost permanently. The Zoological Survey of India have identified five species of wild animals and food fishes and two species of environmentally valuable tree frogs, as endangered species. Measures need to be taken to conserve these threatened species which have almost been lost as a result of deforestation and other biotic pressures.

3.5.2(4). Action Plans for conservation & rehabilitation are not yet available.

3.5.3. **MIGRATORY FISHES**

The Ganga, with its two tributaries Alaknanda and Bhagirathi, is the home of Mahaseer - an endangered species under serious threat in the Himalayan region - and a few other

species. These biologically highly specialized species have evolved to adapt to the challenging existence under torrential river conditions. The Mahaseer is a migrant species which ascends to higher elevations, twice in a year, to breed in river and spawns in the boulder filled stream channels. Construction of low as well as high dams in the river channel will interfere in the spring - summer migration of the species, and would seriously affect its population structure. scientific information concerning their migration, feeding and reproduction is inadequately known. Even though some efforts have been made to raise Mahaseer in lakes and ponds, the results have so far been unsatisfactory. In Western Ghats, Tata Hydroelectric project has successfully raised Mahaseer stocks by hormone induced breeding. But the results are not necessarily repeatable in the Himalayan region as these two species belong to different genetic stocks and have followed different evolutionary histories in the two river ecologies.

The assertion in the report of the Fisheries Department that Mahaseer would not ascend to higher elevations is not correct. This species is known to migrate much beyond Tehri Dam site at least upto Dharasu.

Already, there has been an alarming decline in the population of Mahaseer in the Ganges due to the development activities. Mechanised

fish lift could provide a practical solution for the survival of migratory species. No such provision has, however, been made in the dam design.

3.5.4. RESIDENT FISH

Upstream of the proposed Tehri dam site, the rivers Bhagirathi and Bhilangana harbour resident fishes in their boulder filled highly turbulent stream channels. The snow and hill trouts are highly specialized fishes which survive in the fast current of foaming, cascading streams. Species of two endemic genera Schizothorax and Schizothoraichthys occur in the cold torrents and have evolved suctorial or adhesive organs to gain a firm grip on the boulders. Their feeding and reproductive habits are also adapted to the requirements of the ecological niche. Any drastic change in the water and temperature regimes in their habitat and the micro flora and fauna on which they feed, will create a serious threat to their very existence.

No scientific studies have so far been done by the project authorities for preparing viable Action Plan for the survival of aquatic life downstream due to trapping of micronutrients, etc.

The low water discharge results in changed temperature regime and limnology. Preliminary investigations in the river stream near

Maneri-I barrage site have indicated increase in Coliform count, growth of blue-green algae etc. which are undesirable for the survival of resident fish.

Appropriate studies have not yet been done, nor action plans drawn up, by the project authorities.

3.6. HEALTH IMPACTS

The Tehri Dam reservoir is located below 1,000 m in elevation. Therefore, the reservoir, along with the attendent canal system is conducive to mosquitogenic conditions. Preventive measures to control water borne diseases in general and, antimalarial activities in particular, need to be taken right from planning through construction and operational stages. Seepage of water and water logging in the neighbourhood of the project must be prevented to inhibit mosquitogenic conditions. An antimalaria unit, as a part of the project, could help in the control of vectors, in screening of labour, and timely treatment of patients.

Adequate provision for preventive and curative health services needs to be made. Proposed setting up of a hospital is a positive step as a curative measure only. The project authorities should also provide basic amenities such as potable water supply, sanitary disposal of wastes, housing etc.

It is also important to assess the chances of the project contributing to the spread of malaria, and other vector borne diseases, despite all these measures.

3.7. COMMAND AREA DEVELOPMENT

3.7.1. WATER LOGGING, SALINITY & IRRIGATION

Tehri Dam Project envisages use of regulated releases for stabilizing Rabi irrigation in an area of 6.04 lakh ha. and providing irigation to an additional area of 2.71 lakh ha (2.50 lakh ha wheat and 0.21 lakh ha sugar-cane) in the existing command areas of Lower Ganga Canal (LGC), Madhya Ganga Canal (MGC), Parallel Ganga Canal and Agra Canal in the districts of Meerut, Bulandshahar, Aligarh (MGC), Aligarh, Etah, Mainpuri, Etawaha, Kanpur, Farrukhabad, Allahabad (LGC+ PLGC) and Mathura and Agra (Agra Canal). Details regarding Command Area Development have not been provided by Tehri Hydel Development Corporation because it is claimed that:

(a) Their mandate does not include canals and that they have only to release water according to irrigation requirement;

(b) A separate project report on utilization of Tehri water has been prepared by Irrigation Department, U.P, and submitted to the Central Water Commission, which is still under examination.

The Committee was not provided any information about releases from Koteshwar Dam.

3.7.1(1). Details regarding Command Area Development have not been provided. The following comments

are based on whatever information was available to the Committee in the documents.

The observations recorded about the non-monsoon (October 1-June 10) flow of water in the river Bhagirathi below Tehri show that the flow of water during this period varies from 1.7 to 3.6 million ha m. Information about the current use of the river flow downstream has not been provided. A significant portion is used for irrigation in the valleys till the Bhagirathi joins Alaknanda at Dev Prayag. Assuming the current river flow of non-monsoon season is not tampered with, the only water available to augment the supplies of Lower Ganga Canal, Madhya Ganga Canal, and Parallel Ganga Canal will be the releases from the reservoir. The total water releases, excluding normal river flow, (during the period November to March when wheat is grown) will be 1.85 lakh ha.m. During this period sugar-cane needs very little irrigation except for presowing irrigation. Water losses in the existing canal systems is reported to be around 0.77 lakh ha m thereby, reducing the net available water to only, 1.00 lakh ha m. The irrigation requirements for wheat, as estimated by the project authorities, vary from 48 cm to 58 cm. On this basis the maximum area that can be irrigated will be 2.00 lakh ha under wheat.

Thus, there is little likelihood of achieving the stated objectives viz. stabilizing existing irrigation in 6.04 lakh ha. and providing irrigation to new areas to the extent of 2.71 lakh ha.

3.7.1(2). It has been the general experience that introduction of canal irrigation results in rise of watertable . In Sarda Sahayak canal area the problem of water-logging is reported to be extremely serious. Same has been the experience in many other commands. The cost of providing effective drainage in the canal irrigated areas is rather high, but is fully justified to prevent large chunks of the command becoming unproductive. Water table in many of the areas is already high, and it is likely that about 20,000 ha will get affected (about 10 percent of irrigated area).

In relatively low rainfall areas with saline ground water, the problem of water-logging and salinity will assume serious proportions. In the alkali areas, reclamation of the soils would be difficult because of rising water-table.

Even in the absence of complete information about command are development, it is apprehended that provision of canal irrigation will lead to adverse environmental consequences, particularly with respect to soil degradation. The irrigation benefits envisaged in the project are not, therefore, likely to be achieved.

3.7.1(3) Irrigation is invariably accompained by heavy inputs of chemical fertilizers, insecticides and, pesticides etc. which affect both the surface and ground water quality. A comprehensive survey of the existing status of the pollutants contributed by farm run-off and leachates is necessary to devise adequate preventive measures. No such study has, however, been done and made available.

3.7.2. **TRAINING & EXTENSION**

Effective utilization of the irrigation potential created can be ensured only through:

--Readiness of On-Farm works like levelling, grading and drainage;

—Provision of a package of inputs, including good quality higher yielding seeds, fertilizers, Integrated Pest and Disease Management etc.

—Training of the farmers in the On-Farm practices, conjunctive use of water, suitability of cropping pattern on the basis of land capacity etc.

It is not clear whether the works required in command area to utilise the additional water have been planned and budgeted for. The CWC representative informed the Committee that a proposal received for the utilisation of Tehri water was currently under their examination. Until such a plan has been finalised and assessed, it is not possible to give more specific comments regarding its viability.

3.8 DOWN STREAM ECOLOGY

3.8.1. IMPACT ON LAND FERTILITY & WATER

As a consequence of impoundment and subsequent diversion of water into the canal systems, the altered river flow will result in reduced discharge and shrinkage of flood plains in the lower reaches. Even thouh surplusing from the dam would increase flood affected areas near the foothills, they would be deprived of the fertile silt and ground water reacharge. This effect will be most conspicuous until major tributaries join the Ganges in eastern U.P.

The Diarra lands along Ganges are treasured patches, given on annual patta, to peasants for seasonal agriculture. Reduction of flood plain would have adverse impact on the socio-economically back-ward segment of the society, by depriving them not only of agricul- tural out put but also grazing lands. Grasses, natrually growing on flood plains, have been found to be much more nutritive to those growing in nearby areas not nurished by silt. If the reservoir does succeed in containing the floods, the result will be drying up of the lakes and swamps affecting adversely the migratory and resident aquatic and bird populations.

3.8.2. WATER QUALITY & AQUATIC LIFE

Flowing water has a self cleansing capacity due to the combined effect of aeration

3.9. COST-BENEFIT ANALYSIS

The Committee is aware of the controversy surrounding the anticipated costs and benefits of the proposed Tehri Dam Project. It has also taken note of various comments made by the Comptroller and Auditor General of India, in his report of 1986-87. Among other things, the CAG has observed that the cost benefit ratio of the project, which was initially 1:11.7, had been reduced by 1986 to 1:3.49. Other reports by independent economists have shown the cost-benefit ratio to be even more adverse.

3.9.1. Whereas, the Committee is not concerned with assessing the financial and economic viability of the project, per se, this aspect nevertheless has to be examined in the context of resource optimisation. The following observations are, therefore, considered pertinent:

First : Considering the large number of observations the Committee has made regarding preventive, mitigative and compensatory works in relation to various aspects of the environment, it would be essential to make adequate financial provisions for these in the project plan. Arguments sometimes advanced that incorporation of the cost of environmental safeguards might affect the economic viability of the project are not valid because, in their absence, the project in any case is not likely to be socially and economically viable.

and dilution. Reduction in discharge in the main channel, therefore, adversely affects the water quality as a result of inflow of untreated sewage and other wastes from human settlements. The consequent undesirable changes in the population of aquatic life, like on a variety of fish which have not only an important ecological role to play but are also an important source of proteins, needs to be seriously examined so that biological diversity is maintained.

Care also has to be taken to ensure that, even during the lean season, no river stretches are allowed to go completely dry.

Second: There are a large number of issues, including the impact on the flora and fauna, on riverine ecology, on water quality, on downstream ecology and, concerning the risks and hazards posed by the project, which have not found mention in the cost-benefit analysis. The cost-benefit analysis, as calculated by THDC today, does not reflect the true cost of catchment area treatment, stabilisation of the reservoir rim, an adequate disaster management plan or even an acceptable rehabilitation package. All these costs have to be realistically calculated and properly reflected in a modified cost-benefit analysis.

3.9.2. As already mentioned, many of the ecological and social costs are not quantifiable in terms of rupees and paise. These cannot, therefore, be taken into consideration while working out a financial and economic cost-benefit analysis. The fact that no detailed plans exist regarding command area development and the development of the river basin, add to the Committee's conviction that many of the costs have not been calculated, or inadequately calculated, and at least some of the benefits have been exaggerated. The Committee, therefore, has noted with concern whether the realisable benefits of the project justify the non-quantifiable ecological and social costs that the project will inevitably incur.

It has been repeatedly stated before the Committee that this project will contribute to the economic development of Tehri Garhwal. However, despite the Committee's best efforts, it could not discover anything in the project proposal which would contribute directly to the economic and social welbeing of the people of this region. In fact, the electricity generated, which is the main benefit of the project, would go from the national grid to the industrial centres. The irrigation and flood control benefits, if any, would also be available only to those living downstream of the dam.

In contrast, the ecological and social costs of the project would have to be borne almost entirely by the people of Tehri Garhwal. Even the potential employment generated by the project would only be temporary. As of today, the project has not significantly benefitted the local people.

3.9.3. The Committee is, therefore, of the opinion that the social and economic viability of the Tehri Dam project needs to be reassessed and evaluated, taking into consideration all the recommendations made by this Committee and the realistic costs and benefits of the resultant project.

3.10 BASIN PLANNING & MANAGEMENT AUTHORITY

In conformty with the objective of achieving sustainable development in the Bhagirathi Basin, including its tributaries, it is imperative that a project port-folio is devised within the Carrying - capacity of the basin. The carrying capacity would provide guidelines for protection zones and zones for development so that the twin objectives of maintaining ecological balance and meeting the needs of the local people can be simultaneously met. Prosperity of the local people depends on development plans which make optimal use of the scarce natural resources and in which they are the direct beneficiaries. Equity and social justic demands that investments are made for sustainable development of the hilly region, per se.

Maintenance of ecological balance in the crucial Ganga catchment is critical for the welfare of the entire Gangetic plain in terms of perennial water supply as well as fertility of the flood plains. Accelerated degradation in the Himalayan catchments would only lead to a vicious cycle of flash floods & droughts.

Integrated management & development, therefore, demands a Basin approach - a concept now enshrined in our National Water Policy, 1987. The Committee noted with appreciation that setting up of a Basin Management Authority for this region, on the lines of Narmada Control Authority, had been mooted early in 1987, but, the proposal

is still under consideration. A draft proposal to set up the Authority, under the special Area Development Act, 1986, or through an administrative order, is under consideration of the Uttar Pradesh Government. Considering the ecological fragility of the region, the accelated pace of development projects with increased biotic pressures it is imperative that a professional Basin Management Authority, dealing not merely with water resources, for the integrated and sustainable development of basin is set up on priority.

CHAPTER-IV

ALTERNATIVES TO THE PROJECT

In assessing any project, it is important to consider its optimality as related to other alternatives. These alternatives could be to the project, or to the specific site. Keeping this in mind, the Committee has looked into the alternatives which could be categoried as follows:

(i) Alternative design of the project at the same site by reducing its height;

(ii) Separate dams, near the present site, on the two rivers;

(iii) Various run of the river projects on this river system;

(iv) Supplementing any one of these with solar power generation;

(v) Constructing an appropriate dam at some other site, on a different river system.

4.1. The Committee would like to record that these alternatives should actually have been considered before the initial decision on the Tehri Dam Project was taken in 1972. In reality, these alternatives were only considered during 1982, by which time the project construction had already started. Considering that the power generation potential of the initial project was only 600 MW, it seems almost certain that at least some of the alternatives would have

proved more desirable than the Tehri Project. The Committee also feels that consideration of alternatives, subsequently done by the project authorities, could not have been carried out in the right spirit. As can be expected, given the fact that the project authorities appear convinced of the viability and desirability of the proposed Tehri Project, the alternatives seem to have been looked at with a view to establish their non-viability.

4.2. The Committee, on the other hand, feels that given the risks and potential environmental damage that the Tehri Project implies, it would be far better to go in for run-of-the-river projects which promise firm power in excess to what the proposed Tehri Project promises. The Committee also feels that the option of investing money into generating solar power should be seriously considered, as it has no attendent risks or environmental damage.

However, in case the Government of India feels that there is a compulsion to produce the peaking power promised by the proposed Tehri Dam Project, the Committee recommends that the investment to be made here should be diverted to another project, in a lower seismic zone, involving less environmental and social destruction.

4.3 The Committee was informed by representatives of the Central Electricity Authority that there exists a plan of all possible sites in India where hydro-electric projects could be constructed. The Committee strongly urges that the concerned authorities may urgently consider identifying from among these a suitable alternative site.

4.4. It might be stressed here that environmental and social costs, as also potential hazards and risks, cannot be easily converted into rupees and paises. Therefore, even when a particular project might appear preferable on purely economic terms, it is only reflecting those few parameters that can be quantified. The Committee, therefore, is convinced that a project like the proposed Tehri Dam is not viable for optimal resource utilization.

4.5. Considering the imperatives of sustainable development, the Committee feels that the problem of meeting peaking power requirements should be looked at not merely in the context of new projects but in conjunction with such alternatives that may be far more sustainable and environmentally acceptable. In addition, serious consideration must be given to conserve and utilize power in the most optimal manner. After all, one unit of energy saved is equivalent to at least one unit of energy generated. The options needing serious attention, therefore, are:

--Improvement in the plant load factor;
--Upgradation of the transmission and distribution system to reduce losses;
--Staggering of load demand by adopting differential tarrifs;
--Speedy completion of projects already in hand by increased financial inputs, if required;
--Adoption of energy saving devices & appliances.

CHAPTER-V

5.0 CONCLUSIONS

5.1 In its deliberations to assess the environmental viability of the Tehri Dam Project, the Committee has taken note of the following facts:

-- The Tehri Dam site is located in an ecologically fragile and highly active seismic zone, where an earthquake of magnitude 8.0 on the Richter Scale, is considered imminent;

- The catchment area, especially in the Bhagirathi Basin, is highly degraded and is vulnerable to excessive erosion and landslides. The situtation is further aggravated by biotic pressures, the receding glaciers, morain deposits, and frequent cloud bursts;

- Maintenance of ecological balance in the Himalayan eco-system is crucial not just for the sustainable development of the Tehri-Garhwal region but the wel-being of the entire Indo-Gangetic belt.

5.2 The Committee has, therefore, been guided by the following concerns:

(a) Whether the risks and hazards attendant to the projec are acceptable in terms of their magnitude, and in terms of the level of preparedness of the project authorities either to prevent them altogether or at least to minimise them to an acceptable level.

(b) Whether the ecological and social impacts of the project have been adequately studied, and the Environmental and Rehabilitation Action Plans adequately developed for prevention and mitigation of adverse impacts ; and

(c) Whether the project, as proposed, is conducive to the optimal use of natural resources for economic development and human welfare.

5.3. From the Assessment of the data furnished and detailed discussions held with concerned agencies & experts, it became evident that answer to all these questions is in the negative.

The Committee is convinced that the consequences of dam failure are too horrific and, the risk of dam failure is clearly unacceptable.

The ecological and social impacts have not been adequately studied or planned for. The Status of rehabilitation and catchment area treatment done so far is apalling and, the cultural and social aspects have been ignored altogether.

The adverse environmental implications of the project are not commensurate with its potential benefits. The project has

not clearly established that it can result in optimal use of natural resources.

5.4. The Committee is conscious of the fact that the project has been under execution since 1972, and yet, the requisite data and Action plans are either not available or are too sketchy. The Committee, therefore, concluded that no purpose would be served by waiting any longer for further data and formulation of Action Plans to arrive at a decision.

Therefore, taking into consideration the geological & seismic setting, the risks & hazards, ecological and social impacts accompanying the project, the costs and benefits expected; and after a careful examination of the information and data available, the Committee has come to the unanimous conclusion that the **Tehri Dam Project,as proposed, should not be taken up as it does not merit environmental clearance.**

D.R. Bhumbla
(D.R. BHUMBLA)
CHAIRMAN

T. Shivaji Rao
(T. SHIVAJI RAO)

(K. SRI RAMA KRISHANAIAH)

(H.S. PANWAR) **(SHEKHAR SINGH)**

M.V.V.L. N

(M.V.V.L. NARASIMHAM)

Virendra Kumar
(VIRENDRA KUMAR)

Shyam Chainani
(SHYAM CHAINANI)

Subrata Sinha
(SUBRATA SINHA)

O.N. Kaul
(O.N. KAUL)

S. Maudgal
(S. MAUDGAL)

Nalini Bhat
(NALINI BHAT)

ANNEXURE-I

COMPOSITION OF THE ENVIRONMENTAL APPRAISAL COMMITTEE FOR RIVER VALLEY AND HYDROELECTRIC PROJECTS

1.	Dr. D.R. Bhumbla, Former Vice-Chancellor, Agricultural University, Hissar, Village Palnagar, Karnal, (Haryana).	Chairman
2.	Dr. B.K. Roy Burman, Centre for the Study of Developing Society, Delhi-54.	Member
3.	Dr. H.S. Panwar, Director, Wildlife Institute, Dehradun.	-do-
4.	Shri O.N. Kaul, Former Secretary (Environment), Mizoram, New Delhi-48.	-do-
5.	Dr. K. Srirama Krishanaiah, Adviser (Irrigation), Hyderabad.	-do-
6.	Dr. M.V.V.L. Narasimham, Director, National Malaria Eradication Programme, New Delhi.	-do-
7.	Dr. Subrata Sinha, Director, Centre for Earth Sciences, Trivandrum (Kerala).	-do-
8.	Dr. Shekhar Singh, Indian Institute of Public Administration, New Delhi.	-do-
9.	Prof. Shivaji Rao, College of Engineering, Andhra University, Vishakhapatnam-530003.	-do-
10.	Shri Shyam Chainani, Bombay Environmental Action group, Bombay-400020.	-do-
11.	Prof. Virendra Kumar, Department of Botany, Zakir Hussain College, Delhi.	-do-

12. Dr. S. Maudgal, Member
Adviser,
Ministry of Environment & Forests
New Delhi-3.

13. Dr (Mrs) Nalini Bhat, **Member Secretary**
Scientist 'SE'
Ministry of Environment & Forests,
New Delhi-110003.

2. **The Terms of Reference of the Committee are as follows:-**

i. Scrutiny of the environmental impacts and the Environmental Management Plans prepared and submitted by the project authorities.

ii. To suggest safeguards, where feasible, to mitigate the adverse environmental impacts,

iii. To recommend clearance or rejection of the projects from the environmental angle, with or without safeguards,

iv. Monitoring of the observance of suggested safeguards.

ANNEXURE-II

LIST OF EXPERTS, CONCERNED ORGANISATIONS, PUBLIC REPRESENTATIVES AND OTHERS WITH WHOM THE COMMITTEE INTERACTED

I. EXPERTS OF THE GOVERNMENT OF INDIA MINISTRIES

Central Water Commission (CWC)

1. Dr. C.D. Tnatte, Member (D&R)
2. Shri A.B. Joshi, Chief Engineer
3. Shri M. Gopalakrishnan, Director
4. Shri S.K. Jain, Deputy Director

Project Appraisal Directorate

5. Shri Z. Hasan, Chief Engineer
6. Shri P.C. Lau, Director (PAD)

Reservoir Sedimentation

7. Shri A.K. Shangle, Director (Res.Sed.)

Central Electricity Authority (CEA)

8. Dr. H.R. Sharma, Chief Engineer (HPA)
9. Shri B.K. Aggarwal, Director (HPA)
10. Shri S.M. Dhiman, Deputy Director

II. ENVIRONMENTALISTS AND INDEPENDENT EXPERTS

11. Dr. Vinod Gaur, Secretary, Deptt. of Ocean Development.
12. Dr. Harsh K. Gupta, Vice Chancellor, Cochin University
13. Shri S.K. Roy, Chairman, Working Group
14. Shri Sundarlal Bahuguna
15. Ms. Neeru Nanda

III. EXPERTS AND CONSULTANTS OF THDC

16. Dr. R.S. Chaturvedi, Director, Remote Sensing Applications Centre, Lucknow
17. Dr. Afzal Ahmed, Director, Centre of Development Studies,
18. Shri K. Madhavan, Ex-Member, Central Water Commission
19. Dr. J. K. Srivastava, Consultant (Design)
20. Prof. Asthana, JNU, N. Delhi
21. Shri V.A. Davydov, Russian Consultant

IV. TEHRI HYDRO DEVELOPMENT CORPORATION

22. Shri S.P. Singh, CMD
23. Shri J.N. Gaur, Director (T)
24. Shri B.L. Jatana, G.M. (D)
25. Shri Vikram Baldev Raj, Senior Manager (D)
26. Shri S.C. Sharma, DGM (C)
27. Dr. B.N. Asthana, DGM (D)
28. Kunwar Fateh Bahadur, Director (Reh.)
29. Shri R.N. Singh, Engineer

V. INDIAN NATIONAL TRUST FOR ART AND CULTURAL HERITAGE (INTACH)

30. Shri B. K.Thapar, Chairman
31. Shri N.D. Jayal, Director
32. Prof. Vijay Paranjpe, Economist
33. Shri Sanjeev Prakash, Environmental Adviser
34. Prof. J. Bandopadhyay, Natural Resources Management Expert

VI. TEHRI BANDH VIRODHI SANGHARSH SAMITI

35. Shri V.D. Saklani, President
36. Shri V.S. Nautiyal
37. Shri S.P. Dobhal
38. Shri Shailendra Saklani

VII. PUBLIC REPRESENTATIVES

39. Chairman and others of Bandh Visthapith Sahayata Evam Punarvas Samiti, Tehri

40. President and others of Vyapar Mandal, Tehri

41. Shri Gautam Singh Chauhan, Advocate, Tehri

42. President and others of Tehri Nagar Navchetna Samiti

43. Jan Jagran Manch, Tehri

VIII. U.P. OFFICIALS

44. Shri S.S. Pangte, Commissioner, Garhwal

45. Shri P.C. Navani, Senior Geologist, GSI, U.P.

46. Shri S.K. Shome, Director

47. Shri Lepcha, DFO, Tehri

48. Shri Bakshi Singh, Director, Land Survey

MINISTRY OF ENVIRONMENT & FORESTS

TEHRI DAM PROJECT - MEETING HELD ON JANUARY 22,1990

PRESENT

1. Smt. Maneka Gandhi, **Chairperson**
   Minister of State for
   Environment & Forests.

2. Shri Reoti Raman Singh,
   Minister for Irrigation & Environment, U.P.

3. Shri Sunderlal Bahuguna,
   Tehri Bandh Virodhi Sangharsh Samiti.

4. Shri Mahesh Prasad,
   Secretary (Environment & Forests).

5. Shri S. Rajgopal,
   Secretary, Department of Power.

6. Shri M.A. Chitale,
   Secretary,
   Ministry of Water Resources.

7. Shri Maheshwar Dayal,
   Secretary,
   Department of Non-Conventional Energy Sources.

8. Shri R.B. Shah,
   Chairman,
   Central Water Commission.

9. Shri J.C. Gupta,
   Member (HE), CEA.

10. Dr. C.D. Thatte,
    Member (D&R), CWC.

11. Shri A.B. Joshi,
    Chief Engineer (Dam safety),
    CWC.

12. Dr. S. Maudgal,
    Adviser (IA-I),
    Ministry of Environment & Forests.

13. Shri D.K. Biswas,
    Adviser (IA-III),
    Ministry of Environment & Forests.

14. Shri V.K. Khanna,
Joint Secretary,
Department of Power.

15. Shri J.D. Mehtani,
Director (Hydel),
Department of Power.

U.P. Government Officials :

16. Shri R. Bhargava,
Chief Secretary.

17. Shri C.M. Vasudev,
Secretary, Irrigation.

18. Shri Jag Mohan,
Joint Secretary, Irrigation.

19. Shri S.S. Pangti,
Commissioner, Garhwal.

20. Shri K.L. Gupta,
Additional Resident Commissioner.

21. Shri Rajeev Gupta,
District Magistrate,
Tehri Garhwal.

Tehri Hydro Development Corporation :

22. Shri S.P. Singh,
Chairman & Managing Director.

23. Shri Y.P. Singh,
General Manager.

24. Shri B.L. Jatana,
Executive Director
(Design & Engineering).

25. Shri J.N. Gaur,
Director (Technical).

26. Kunwar Fateh Bahadur,
Director, Rehabilitation,
Tehri Dam.

27. Shri S.C. Sharma,
Deputy General Manager.

28. Shri B.S. Sharma,
Sr. Engineer.

INTACH

29. Shri N.D. Jayal,
    Director, Environment.

30. Prof. Vijay Paranjpye.

31. Shri Sanjeev Prakash,
    Environmental Adviser.

32. Shri J. Bandyopadhyay,
    Natural Resources Management Expert.

Tehri Bandh Virodhi Samiti :

33. Shri V.D. Saklani,
    President.

Ministry of Environment & Forests :

34. Dr. Y.P. Kakar,
    Scientist 'SF'.

35. Dr. (Mrs.) Nalini Bhat,
    Scientist 'SE'.

36. Dr. (Ms.) Meenakshi Kakkar,
    Scientist 'SC'.

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ANNEXURE-III

ENVIRONMENTAL APPRAISAL OF THE TEHRI DAM PROJECT

REPORT ABSTRACT

ENVIRONMENTAL APPRAISAL COMMITTEE
FOR
RIVER VALLEY PROJECTS
MINISTRY OF ENVIRONMENT & FORESTS
GOVERNMENT OF INDIA

FEBRUARY, 1990

D.R. BHUMBLA
Chairman
Environmental Appraisal Committee

February 15, 1990

Dear Sh. Mahesh Prasad,

I submit herewith the Report Abstract on **"Environmental Appraisal of the Tehri Dam Project"**, prepared by the Environmental Appraisal Committee, as desired.

Needless to mention, the recommendations in the report are unanimous.

The full report of the Committee will follow shortly.

With kind regards,

Yours sincerely,

D.R. Bhumbla

(D.R. BHUMBLA)

Encl: as above

Shri Mahesh Prasad,
Secretary,
Ministry of Environment & Forests,
Paryavaran Bhawan,
CGO Complex,
Lodi Road,
New Delhi-110003.

A. INTRODUCTION

The Committee took up the assessment of the Tehri Dam Project, as proposed, from 18th December, 1989. The Committee was made aware of the long history of the project, including the facts that the project, with a much smaller cost and power generation, had been approved by the Planning Commission in 1972. Subsequently, at the initiative of the then Prime Minister, the project was referred to the Ministry of Environment in 1980, for environmental review. The Ministry, based on this review, recommended, in 1986, the abandonment of the project.

2. Towards the end of 1986, a protocol was signed with the USSR for financial and technical assistance to this project. However, work continued on the project, without obtaining any environmental clearance. This fact was noted by the PIB of the Ministry of Finance, Government of India, in July, 1989, when they made consideration of the revised cost estimates for the project conditional to the obtaining of the required environmental clearance. Hence the reference, in end 1989, to the Environmental Appraisal Committee for River Valley Projects.

3. In assessing any river valley project, the Committee is concerned about optimising the use of natural resources towards social and economic development, and human welfare. To these ends, the Committee examines the social and ecological impacts of the project, including potential risks and hazards, and attempts to balance these against the anticipated benefits from the project. In order to effectively assess whether a proposed project represents an optimal use of the resources, the Committee also

considers alternatives to the proposed project: in terms of alternative designs of the project, alternative sites of the project, and alternative methods of providing the benefits that the project promises.

4. Much of this is done using the data provided by the project authorities, the accumulative data of other projects in the country and elsewhere, and by benefitting from the experience and expertise of the members of the Committee, and other experts invited to give their views. For certain projects, like Tehri, the Committee also visits the site of the proposed project and talks to the local people and the voluntary organisations concerned with the project.

5. In assessing the Tehri Project, the Committee has been forced to work within certain constraints that must be listed at the outset.

First, for reasons outside the control of the Committee, the time available to the Committee for assessing the project was short, and this forced the Committee to compress its discussions, study and deliberations.

Secondly, despite the Committee's repeated efforts, the data and information finally made available to the Committee, by the project authorities, were incomplete.

Finally, within the documents provided by the project authorities, there appeared various inconsistencies, many of which could not be resolved to the satisfaction of the Committee .

B. ENVIRONMENTAL ASSESSMENT OF THE TEHRI DAM PROJECT

1. From a study of the Tehri Dam Project, as proposed, it became clear to the Committee that the decision on its environmental viability and optimality would depend on the following factors:

1.1. The ability of the dam structure, as designed, to withstand the maximum credible earthquake that can be expected in the region during the anticipated life of the project.

1.2. The ability of the hillsides and reservoir rims, in the project area, to withstand such an earthquake.

1.3. The implications of dam failure on life and property downstream.

1.4. The rehabilitation package being offered to the oustees, in terms of what is proposed and how well it has been implemented so far.

1.5. The ecological damage that the project would cause, and the planning and implementation of preventive and mitigative measures.

1.6. The costs and benefits of the project, especially in terms of adequate financial provisions for all the issues listed above, and keeping in mind the need to ensure that the benefits anticipated are realisable. It must also be ensured that the benefits go to deserving sections of the society, especially to those regions and individuals who are being negatively affected by the project, and justify the non-quantifiable social and ecological costs that all such projects inevitably have.

Our findings and recommendations regarding these points are given below.

2. Aseismic Design of the Dam

The project authorities, and experts from the Central Water Commission, all assured the Committee that the Dam has been designed to withstand a maximum earthquake of the Magnitude of 7.0 on the Richter scale, with the epicentre 27 km from the Dam site.

The Committee did not examine this assertion in any great detail, for it considers the Magnitude of the earthquake, taken as the maximum credible one, to be inadequate.

The Committee is of the opinion that the maximum credible earthquake for which the Dam should be designed is M $\geqslant$ 8.5 on the Richter scale, 27 kms. from the Dam site.

The Committee has come to this conclusion on the basis of discussions with various experts, including

Dr. V.K. Gaur, Secretary, Department of Ocean Development, Government of India, and Dr. Harsh Gupta, Vice-Chancellor, Cochin University. The facts and arguments offered by these experts make the Committee believe that there is almost a certainity that, during the anticipated life of the project, an earthquake of the Magnitude of 8.0 and above would occur in the region.

The Committee is aware of the differing view points on this question, but is convinced that given the facts, the experience and stature of the experts consulted, and the horrific implications of a Dam failure, it would be irresponsible to clear the Tehri Dam, as it is currently proposed.

3. **Stability of the Rim and Hillsides**

The reservoir rim and hillsides have been tested, if at all, for an inadequate level of seismicity. They should also be re-tested for the seismic level indicated. This is especially important because, if the hill-sides collapse due to an earthquake, the implications can be as bad as if the Dam collapsed.

4. **Implications of Dam Failure**

Though no risk analysis had been done by the project authorities, the Committee's calculations, albeit preliminary, showed that if the Dam collapsed, or was over topped due to collapse of the hillsides, the resultant water wave would wipe out Rishikesh and possibly Haridwar. The loss to life and property is incalculable, but can be imagined.

These calculations strengthen the thinking of the Committee that it would be very irresponsible to construct, at Tehri, a dam which is anything but

safe. It also highlights the necessity to prepare a detailed Disaster Management Plan, based on a risk assessment: something that has not yet been done.

5. **Rehabilitation**

The Committee noted that the rehabilitation package being proposed for the Tehri Project is inadequate, and much inferior to that accepted for other similar projects, like Sardar Sarovar in Gujarat.

The Committee also noted that planning and execution of the rehabilitation programme was very poor. The total number of people to be affected was in dispute, land to rehabilitate all those affected had still not been acquired, legal title for the land had not been transferred to even those shifted ten years back. Most of the land given to the oustees is sandy, stoney and of low productivity.

The condition of those shifted ten years back was apalling and did not augur well for those to be rehabilitated.

It is well recognised that unless planning, identification of land and provision of sufficient resources for rehabilitation is done before a project is cleared, it becomes very difficult to ensure that the people ousted by the project get justice.

The Committee, therefore, is convinced that the rehabilition package should be improved, adequate and appropriate land identified, and sufficient provisions made for rehabilitation in the Project budget, before the project can be considered.

6. Ecological Damage

The damming of any river has significant ecological impacts. The damming of a hill river, and especially the Bhagirathi which already has three existing and proposed run-of-the-river projects, has even greater than normal ecological impacts.

Unfortunately, no study has been done on the ecological impact of all these projects on the river, on its water quality, its flora and fauna, and its ability to survive as an eco-system.

Considering the impact of ecological degradation of this riverine ecology will not only affect the local area, but will have an accumulative impact on the Ganga, there is even greater urgency to study and prevent this.

The Committee does not think that, in the absence of adequate studies and action plans on this aspect, the project merits environmental clearance.

7. Cost Benefit Analysis

Apart from the cost implications of the various recommendations made above, there are various other unresolved issues which need to be mentioned.

7.1. Catchment Area Treatment:

Only 15% of the degraded catchment has been proposed for treatment. Considering the implications the state of the catchment has on the life and safety of the dam, and considering the very unstable state of Tehri Dam's catchment,

the entire degraded portion of the catchment needs treatment, with a much higher financial outlay than presently proposed.

7.2. Siltation Rates:

The current measurements of suspended and bed-load silt are not satisfactory. The Committee anticipates that the actual rates of siltation would perhaps be higher, and certainly different, to what have been currently calculated. Therefore, the implications of this have to be considered on the life of the Dam, and on the resultant cost-benefit ratio.

7.3. Bhagirathi Development Authority:

In conformity with the objective of achieving sustainable development in Bhagirathi Basin, the Committee reiterates the recommendation that a Basin Management Authority must be set up so that professional inputs are available to devise and implement a project portfolio, within the carrying capacity of the basin, for its integrated development, and to maximise the flow of benefits to the local people. The Committee was informed that the formulation of such an authority had been mooted by the Ministry early in 1987 but it has not yet materialised. It is considered imperative that a Basin Management Authority dealing not just with the water resources but for the integrated development of this basin should be set up on priority, and its cost implications worked out.

7.4. Command Area Development:

Despite repeated requests, the Committee was not provided details regarding releases of water from Koteshwar dam for utilisation in the command area, even though it is claimed that irrigation requirement would be governing such releases. In the absence of these details, it is not clear whether the releases would be governed by the requirement of power generation, or irrigation or both.

An area of 2.7 lakh ha. is proposed to be irrigated in the existing command of Upper Ganga, Lower Ganga and Madhya Ganga canal systems. In view of the substantial rainfall supplemented by surface and ground irrigation in the Upper and Madhya Ganga canal commands it has not been established to what extent additional irrigation would be required. Additional water released in this command is likely to create problems of water logging and salinity if extensive drainage facilities are not carefully planned and executed. No such details are, however, available.

The Central Water Commission representative informed the Committee that a report on the utilisation of Tehri water in the Command Area is still under their consideration. Until such a plan has been finalised and assessed, it is not possible to assess the impact of the project on the command and, therefore, its benefits and even viability.

For all these reasons, the Committee feels convinced that the economic viability of the Project has to be re-examined, and that the cost-benefit analysis, as presently done, is not adequate.

C. CONCLUSION

Taking into consideration the geological & seismic setting, the risks & hazards, ecological and social impacts accompanying the project, the costs and benefits expected; and after a careful examination of the information and data available, the Committee has come to the unanimous conclusion that the **Tehri Dam Project, as proposed, should not be taken up as it does not merit environmental clearance.**