JAPAN INTERNATIONAL COOPERATION AGENCY

THE KINGDOM OF NEPAL
MINISTRY OF WATER RESOURCES

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR CONSTRUCTION OF WATER INDUCED DISASTER PREVENTION TECHNICAL CENTRE IN THE KINGDOM OF NEPAL

NOVEMBER, 1993

KUME SEKKEI CO., LTD.

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PREFACE

In response to a request from His Majesty's Government of Nepal, the Government of Japan decided to conduct a basic design study on the Project for Construction of Water Induced Disaster Prevention Technical Centre and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nepal a study team headed by Mr. Akira Kumakura, Grant Aid Division, Economic Cooperation Bureau, the Ministry of Foreign Affairs and constituted by members of Kume Sekkei Co., Ltd. from June 5 to June 25, 1993.

The team held discussions with the officials concerned of His Majesty's Government of Nepal, and conducted a field study at the study area. After the team returned to Japan, further studied were made. Then, a mission was sent to Nepal in order to discuss a draft report, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of His Majesty's Government of Nepal for their close cooperation extended to the teams.

November, 1993

Kensuke Yanagiya
President
Japan International Cooperation Agency

November, 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of Water Induced Disaster Prevention Technical Centre in the Kingdom of Nepal.

This study was conducted by Kume Sekkei Co., Ltd., under a contract to JICA, during the period June 2, 1993 to November 30, 1993. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nepal and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

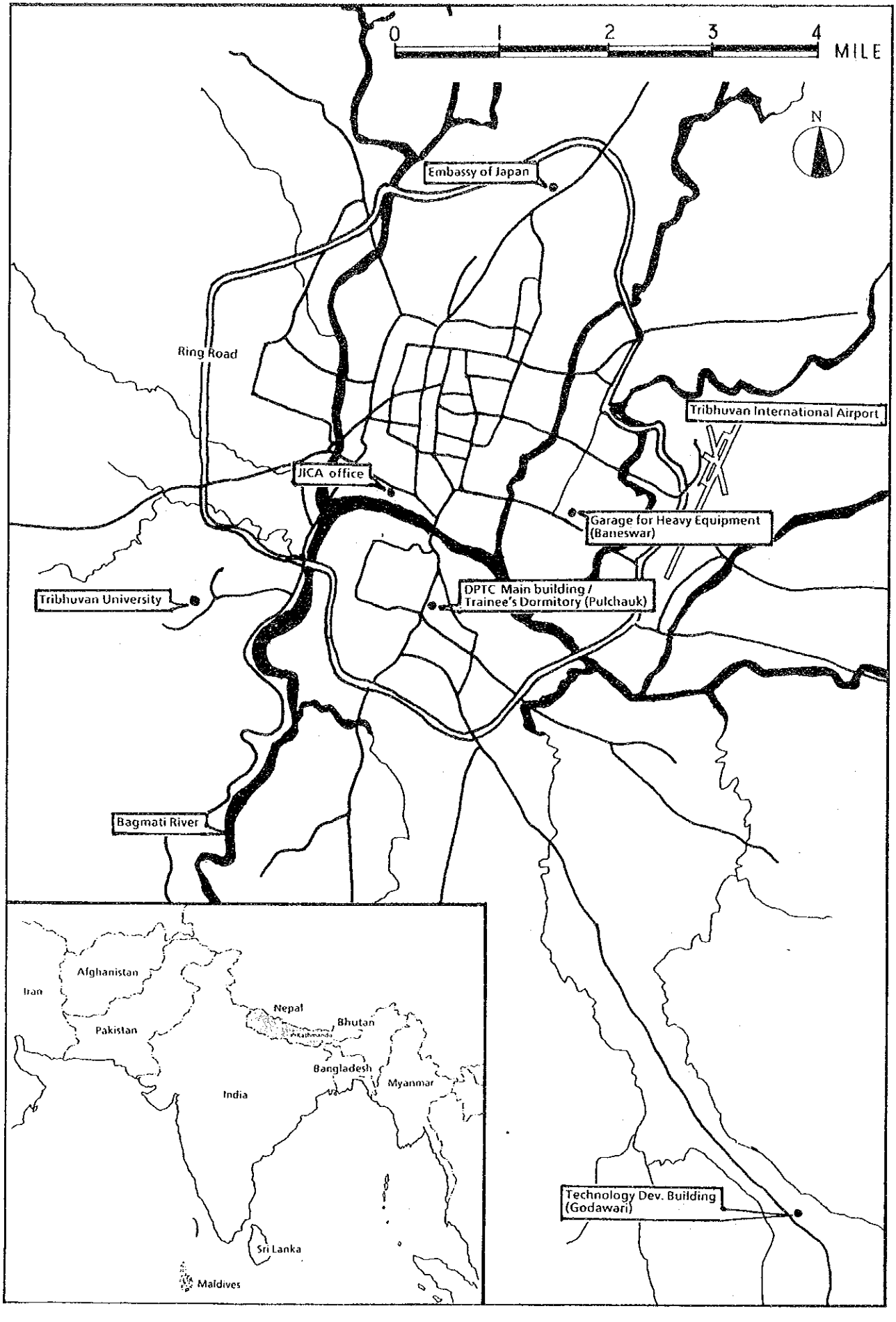
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs and the Ministry of Construction. We would also like to express our gratitude to the officials concerned of the Ministry of Water Resources, JICA Nepal office, the Embassy of Japan in Nepal for their cooperation and assistance throughout our field survey.

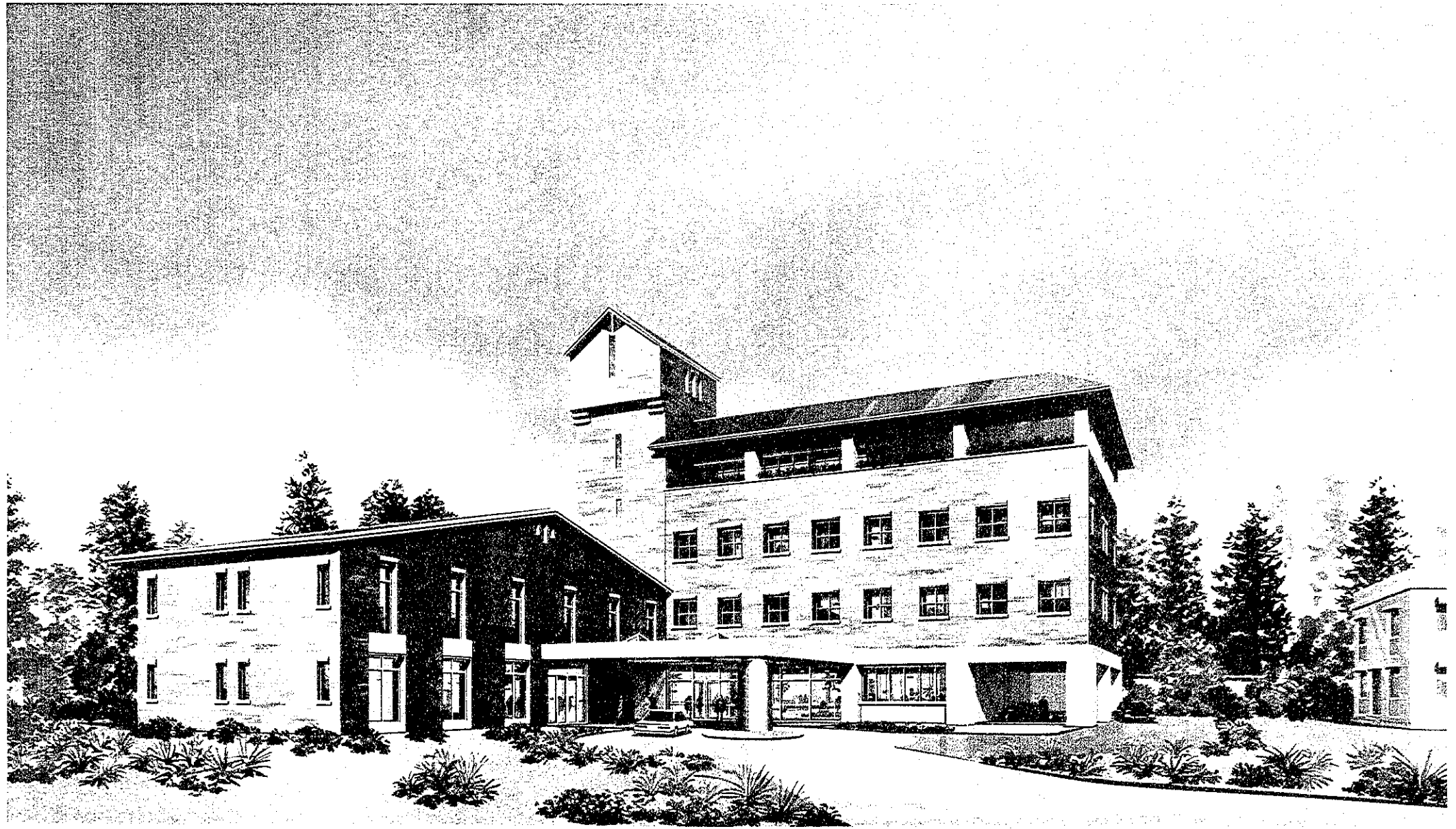
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Takeshi Hamajima
Project manager,
Basic design study team on
the Project for Construction of Water
Induced Disaster Prevention Technical Centre
Kume Sekkei Co., Ltd.

Location Map of the Project sites





WATER-INDUCED DISASTER PREVENTION TECHNICAL CENTRE IN THE KINGDOM OF NEPAL

Main Building, Dormitory

November 1993 KUME SEKKEI Co., Ltd.

SUMMARY

Nepal, with its steep geographical characteristics, is situated in a soil collapse zone in which all kinds of natural disasters occur, such as sedimentation, landslides, floods and the slope failure, bank erosion and glacial lakes outburst due to torrential downpours during the rainy season. Furthermore environmental destruction has been inflicted due to sharp increases in population by developing the farming land in the forest area and cut down of the trees for firewood. Decreased forestcover reduced the ability of the land to retain water, and this become a cause of increasing the water induced disaster.

In addition, road construction as national development projects become another factor of the water induced disaster. Due to the cost of development, all weather type road construction which is appropriate for the protection of side slope and road shoulder has not been constructed.

Because of these combined causes, water induced disaster are frequent occurrence during the rainy season, resulting in interruptions to the traffic flow and even in some cases placing humanlives in jeopardy, and also surface soil outflow stream damage the irrigation channels as well as contributing to significant degree to the occurrence of floods. And about 240,000,000m^3 of soil out flows every year to the Ganges River from major rivers of Nepal, changing the shape of the alluvial fan in India and causing floods in river mouth areas in Bangladesh.

As explained above, water induced disasters attributable to both natural and human causes are causing wide scale environment destruction, thus the implementation of comprehensive preventive measures is of the utmost urgency.

Unable to ignore the situation any longer, His Majesty's Government of Nepal decided in its Seventh Plan (1985–1990) to promote sabo and flood control work as one of its key policies but the country's technological sophistication in this field is sadly lacking. For this reason, in February 1990, His Majesty's Government of Nepal submitted a request to the Government of Japan for Project Type Technical Cooperation for the Project for Construction of a Water Induced Disaster Prevention Technical Centre (DPTC) to be used to educate engineers, develop appropriate sabo and flood technologies and collect and analyze information. In response to the request the Government of Japan dispatched a Preliminary Study Team and three times additional survey teams. As a result of a series of surveys, a Record of Discussion (R/D) for

Project Type Technical Cooperation was signed on October 7, 1991 and a long-term expert team (5 personnel) was dispatched, and they started their activities. However, there was apprehension that the operation would not proceed smoothly, because the existing facility is too small inadequate for an expanded role and has no accommodations for trainees. Also, since there was no room for storage of equipment provided through Project Type Technical Cooperation, temporary storage was constructed and this equipment is currently being stored in this way, therefore, construction of the building is urgently desired. In order to improve this situation, His Majesty's Government of Nepal submitted a request for Grant Aid for the Project for Construction of a Water Induced Disaster Prevention Technical Centre.

In response to this request, the Government of Japan decided to conduct a basic design study for the Project and on June 5, 1993 the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team to Nepal to conduct the study, said team spending a total of 21 days until June 25 in Nepal engaged in this work. The team discussed the scope of the Project with the officials concerned of His Majesty's Government of Nepal, conducted a survey of the proposed construction site and construction circumstances, and collected data related to the Project. Upon returning to Japan, analysis and investigations were conducted in Japan and a basic design was formulated. JICA then dispatched the Basic Design Study Team to Nepal to explain the basic design study report (draft final) from October 1st to 9th in 1993.

The Project outline in the basic design is as follows.

1) Centre main building – Pulchouk site
   Operation division, technology development division, training division, information division.
   Scale: 4-story reinforced concrete construction
   Total floor area : 2,006.3 m^2
   The major rooms are as follows.
   - Administration division : Director's room, chief adviser's room, secretary's room, conference room, offices
   - Technology Development Division : Researchers' room, design and drafting room
   - Training division : Office room, training room, seminar room, seminar hall
   - Information division : Office room, data processing room, library

2) Trainees' dormitory – Pulchouk site
   Scale : 2-story reinforced concrete construction
   Total floor area : 684.6 m^2
   The major rooms are as follows.
   - Trainees' dormitory : 10 rooms (2 have a shower & toilet), pantry, canteen, etc.

3) Technology Development Building – Godawari site
   Scale : One story below and two stories above ground reinforced concrete construction
   Total floor area : 560.9 m^2
   The major rooms are as follows.
   • Technology Development division : Soil test room, concrete test room, equipment storage, workshop

4) Garage for heavy equipment – Baneswar site
   Scale : Reinforced concrete construction + Steel construction
   Total floor area : 195.0 m^2
   Heavy machines to be housed in the garage are as follows:
   • Bulldozer, dump track, backhoe, loader, concrete mixer, truck, truck with crane

As a result of evaluation and study with officials of the Ministry of Water Resources, the contents of the requested facilities have been modified as follows in accordance with suggestions submitted by the Basic Design Study Team:

1) Training division : The seating capacity of the seminar hall has been changed from 100 to 60.

2) Trainees' dormitory : The dormitory, which under the original plan was to comprise 30 rooms, has been changed to a facility consisting of 10 rooms.

3) The data processing and audiovisual rooms, which under the original plan were to be housed in the Technology Development Building (Godawari), have been consolidated in the main building.

4) The kitchen and dining rooms originally planned for the dormitory have been reduced in scope to a pantry and canteen.

5) The garage for heavy equipment has been moved from the Godawari site to the Baneswar site where the Machine Section of Department of Road, Ministry of Works and Transport is located.

With respect to construction site allocation, the Cabinet has decided to construct the main building and the trainees' dormitory of DPTC on the tract of about 2,860m^2 within the Pulchouk site in the Lalitpur district, which land owned by the ministry of Local Development and its main building is located. The Technology Development Building is planned to the build on a site owned by the Ministry of Water Resources in Godawari district on which the Hydraulic Laboratory was constructed by the JICA project infrastructural upgrading disbursements. A garage for heavy equipment will be built on the Baneswar district, which is owned by the Ministry of Works and Transport and the maintenance factories for the Machine section of the Department is located. And a letter issued from the Department of Road to DPTC for an agreement to use their land for the construction of the garage was confirmed.

Concerning the time period required for Project design and tender operations, it is estimated that 3 months will be needed for consultant engineering services including detailed design (D/D), preparation for bidding and tendering after the signing of the Exchange of Notes (E/N) between the Government of Japan and His Majesty's Government of Nepal. After an examination of bidding the construction contract will then be concluded and building construction will commence. The estimated construction period is approximately 12 months. The executing agency of the Project is the Ministry of Water Resources. The DPTC will be directly under the auspices of the Ministry of Water Resources and its functional linkages will be with the Department of Irrigation, Department of Hydrology & Meteorology, Power Development Centre and the Nepal Electricity Authority, and the operating budget will be distributed from the budget of the Ministry of Water Resources.

The activity plan of the DPTC will be decided by an joint committee consisting of representatives from Ministries related to sabo and flood control technologies and a annual report will be prepared at the end of each year. The plan calls for the DPTC to be operated by a total of 24 personnel from such divisions as administrations, training, technology development and data processing. These staffs will be counterpart personnel of Japanese expert and each will be give lectures during training. Because the total number of flood and sabo engineers in related ministries in Nepal is about 100, so the Project Type Technical Cooperation training plan specify that the number of sabo and flood control engineers to receive direct training shall only about 20 persons in a year in the three courses: general, advance, and intensive. However, the implementation of the Project Type Technical Cooperation is expected to provide the following effect and this Project will greatly support their activities.

1) Through the introduction of previously unimplemented sabo and flood control technologies, it is now possible to prevent or alleviate disasters such as erosion and flooding.
2) It is possible to upgrade the level of engineers; by transferring knowledge and technologies necessary for sabo and flood control survey methods, projects and design through conducting training.
3) It is possible to collect basic data on water induced disasters (river-related measurement data and dynamic measurement of mountain landslides, etc.), an area where improvement can be seen in Nepal in sabo and flood control, and it will be possible to create future disaster prevention measures and sabo and flood technical standards.
4) It is possible to develop sabo and flood control technologies and methods appropriate for Nepal through training and exercises using pilot projects. The use of such new methods can be promoted through training conducted by the DPTC.

Besides the above, improvement of sabo and flood control technologies and the expansion of the use of these technologies will make it possible to aggressively pursue measures designed

where possible to prevent water induced disasters, or after the fact, to better handle such emergencies. With 17.4 million people (94% of the population) living in rural areas subject to natural and man-made disasters, this plan is expected to prevent erosion and sedimentation of farm and residential land and contribute to improving the economic efficiency of Nepal through such applications as water induced disaster prevention technology for maintaining roads supporting domestic transportation of goods.

Furthermore, soil erosion from Nepal is thought to cause flooding in India and Bangladesh. Thus, because such neighboring countries will accrue great economic benefits if sabo and flood control technologies can help reduce this erosion, and they also, eagerly await the completion of DPTC.

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ABBREVIATIONS

HMG/N	His Majesty's Government of Nepal
DPTC	Water Induced Disaster Prevention Technical Centre
MOWR	Ministry of Water Resources
DOI	Department of Irrigation
NEA	Nepal Electricity Authority
DHM	Department of Hydrology and Meteorology
WECS	Water and Energy Commission Secretariat
MOLR	Ministry of Land Reform
DOS	Department of Survey
MOWT	Ministry of Works and Transport
DOR	Department of Roads
SBD	Suspension Bridge Division
MOLD	Ministry of Local Development
MOSC	Ministry of Forest and Soil Conservation
DOSC	Department of Soil Conservation and Watershed Mangement
ICIMOD	International Centre for Integrated Mountain Development
NWSC	Nepal Water Supply Corporation
NTC	National Tuberculosis Centre
NTC	Nepal Telecommunication Corporation
UNDP	United Nations Development Programme
OJT	On the Job Training
ESCAP	Economic & Social Commission for Asia & Pacific
IAHR	International Association for Hydraulic Research

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

In Nepal, there is a lack of engineers with experience in the sabo and flood control field. For this reason, His Majesty's Government of Nepal made a request to the Government of Japan in February 1990 to provide Project Type Technical Cooperation for the Water-Induced Disaster Prevention Technical Centre (DPTC) with the intention of educating engineers, developing sabo and flood control technologies appropriate for the country and collecting and managing data. In response to this request, the Government of Japan conducted a pre-survey and supplemental survey. Following this the Project Implementation Survey team visited Nepal for 13 days from September 29, 1991, holding discussions with Project-related Ministries and the chief Project Coordinator of the Ministry of Water Resources and formulating the final R/D, with signing taking place on October 7, 1991. Because the Record of Discussion (R/D) was signed by the Study Team, the activities of the Project Type Technical Cooperation were started on this day as a 5-year plan. However, because residential rooms are currently being rented for use as offices, there is little space, with no accommodations for the trainees. In this condition, it is of concern that smooth operation is being hindered. For this reason, His Majesty's Government of Nepal planned to construct a Water Induced Disaster Prevention Technical Centre and made a request to Japan for the provision of Grant Aid to improve this situation. In response to the request, the Government of Japan decided to conduct a basic design study and JICA dispatched a Basic Design Study Team for 21 days from June 5 to June 25, 1993, said group being led by Akira Kumakura, examiner of Grant Aid, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs to Nepal.

The major items of the basic design study conducted in Nepal are as follows.

1) Confirmation of the contents of the request by His Majesty's Government of Nepal and its background.
2) Study of Project executing agency and related organizations.
3) Confirmation of the activities of the DPTC.
4) Study of DPTC organization structure and personnel arrangement plan.
5) Study of the contents of the DPTC maintenance and operation plan.
6) Conducting of construction site reconnaissance and the condition of related infrastructure.
7) Study of facility functions, scale and construction related technologies.
8) Study of related facilities and equipment.
9) Discussion with Ministries related to the construction.

10) Study of the Project implementation schedule and the construction budget of His Majesty's Government of Nepal.
11) Collection of data necessary to estimate the Project cost.

Through the above study necessary for basic design and discussions with the concerned officials from His Majesty's Government of Nepal, the Study Team and the Nepal side reached an agreement on the scope of the Project, the executing agency, construction site, DPTC facility plan and an outline of equipment to be supplied, and the scope of construction cost borne by each country. Those basic items are summarized in the minutes of discussions and were exchanged between Mr. K. B. Chand, Superintendent Engineer, Ministry of Water Resources and Mr. Kumakura, leader of the Study Team dispatched by the Government of Japan. The contents of the discussions after Mr. Kumakura returned to Japan were written in a technical note and it was given to the Nepal side by the Study Team. Based on the results of the above study, an analysis was conducted in Japan and a basic design was prepared, then the Government of Japan dispatched the Basic Design Study Team (leader : Mr. Kuniyuki Nakahara, Grant Aid Division, Bureau of Economic Cooperation, Ministry of Foreign Affairs) for 9 days from October 1 to 9, 1993 to explain the contents of the basic design with the concerned officials from the Nepal side and summarize the items agreed upon as the minutes of discussions in the Basic Design Report (Draft), and this document was exchanged between Mr. R.L. Kayastha, Joint Secretary, MOWR and team leader Kuniyuki Nakahara on October 7, 1993.

This report is a summary of the above results.

The members of the team, study schedule, list of interviewees, minutes of discussions and a copy of the technical file are attached in Appendices.

CHAPTER 2 BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Background of the Project

2-1-1 Environmental destruction and soil disaster

Nepal, with its steep geographical characteristics, is situated in a soil collapse zone in which all kinds of natural disasters occur, such as sedimentation, landslides, floods and the slope failure, bank erosion and glacial lakes outburst due to torrential downpours during the rainy season. The characteristics of geography and soil disasters in Nepal are described in Table 2-1-1.

In addition to natural causes, the construction of roads has become a serious cause of water induced disasters. When the first national development plan (1956~1961) was commenced, total road length was 624 km. In the 30 years since, to 1984, the road network has been extended about 5,000 km to 5,717 km. Since Nepal has steep geographical characteristics, about 1 meter wide roads are used by mules and humans to cross steep slopes. As development projects have proceeded, vehicular-use roads that provide an efficient distribution network have been constructed. However, due to the cost required for development, weather proof roads with bridges and tunnels have not been constructed. General road construction matched to current geography is not appropriate for the protection of side-slopes or the retention of road shoulders. Water induced disasters are frequently occurrences during the rainy season, resulting in the cutting off of traffic along the affect roads and even placing human lives in jeopardy. Construction of new roads will be continued in the future in steep terrain areas, thus it can be expected that this will be accompanied by an increase in the difficulty of the associated engineering technology required.

Furthermore, environmental destruction has been inflicted due to sharp increases in population. The population of Nepal has been growing at a record-setting pace, with an increase of 7,300,000 in the past 20 years, and a total population of 18,920,000 in 1990. The geographical features of Nepal are basically that areas along riverbanks (at the bottom of gorges) are very steep, with mountainsides and ridges, where the degree of slope is milder, being more appropriate for dwelling and farming. Terraced fields and paddy fields have been created on slopes appropriate for forest production toward

the bottom of gorges. Moreover, according to a report, the forest in areas surrounding villages have been cut down for firewood, which accounts for 92% of the energy supply, and are disappearing at rate of 3.5% per year. The free pasturing of livestock in mountainous areas accelerates the destruction of the ecological system, causing harmful effects on the Himalayan mountains.

Deforestation in turn reduces the ability of the land to retain water, thus causing the loss of topsoil and contributing each year to a rise in the occurrence of such disasters as mud avalanches and landslides. The lost topsoil accumulates at the lower reaches of rivers and the river bed is raised 15 cm ~ 30 cm every year. This causes a deterioration in the function of irrigation canals and facilitates the occurrence of floods. Moreover, 240,000,000 m^2 of industrial soil is carried away each year from the major rivers of Nepal to the Ganges river, changing the shape of alluvial fans in India and inducing floods at river mouth areas in Bangladesh.

These phenomena have seriously affected water resource development projects and the construction and maintenance of other public facilities as well as Nepal's key industry, agriculture, results in a loss of human life and assets and hinders social/economic development. In view of these conditions, the necessities for measures to control floods in areas along rivers and the protection of dams, roads, irrigation facilities, farming areas and forests—the foundation of people's lives—from soil disasters is now recognized. Disaster records (1983 ~ 1992) and soil disaster records (1992) in Nepal are shown in Appendix 6.

Table 2-1-1 Geography and soil disasters in Nepal

	Geography/ nature of soil	Earth & sand disasters	Description of damage
Himalayas, 4,000 m and higher	Mountainous areas where glaciers develop. Physical weathering dominates and the soil is stony.	At rivers having glacier in their basins, mud avalanches (GLOF) due to the collapse of glacial lakes are the greatest danger, with a maximum scale and distribution power.	• Occurrence of mud avalanches due to the collapse of glacial lakes • Destruction of power generation facilities • Floods at the lower reaches of rivers
High mountainous areas, 2,000 m and higher	Mountainous areas at the foot of the Himalayas. Soil is easily weathered and is generally thin.		• Soil erosion and the development of gullies on mildly sloping mountainsides • Loss of farming area • Loss of livestock feed
Central mountainous areas, 1,500 m and higher	The Mahallabert mountainous area and basins to the north such as Kathmandu and Pokkara have suffered extreme weathering and the surface soil has become red. A large percentage of the population has been concentrated here for centuries.	Forests have disappeared due to deforestation for firewood and the development of farming areas. In particular there is a lot of gully erosion, and landslides and collapsing is found on bald slopes. In mountainous areas, the collapse of mountainsides in valleys and erosion is conspicuous on gravel terraces developed on the plain at the bottom of gorges. On mildly sloping mountainsides the flooding away of soil of farming slopes and pasturing areas occurs frequently. Paddy fields are often carried away in basin areas. Trunk roads are frequently cut off by the collapse of side slopes and mud avalanches.	• Soil erosion and the development of gullies on mildly sloping mountainsides • Collapse of the mountainsides of valleys • Erosion and collapse of gravel terraces • Floods due to raised riverbed • Destruction of facilities such as roads and bridges • Collapse and covering of farming areas
Siwalik Range, 1,000 m and higher	Due to the weak soil features of the New Third period and the steep slope conditions, this area is susceptible to extreme surface erosion even though the rather weak base rock is covered by plants.	The frequent slope failure fills up river beds, destroying farming areas or covering them. Slopes along the South to North trunk roads frequently collapse during the rainy season.	• Erosion of valleys and flooding due to raised riverbeds • Collapse of mountainsides • Collapse and covering of roads, farming areas • Severing of trunk roads
Terai Plain, 100 m and higher	This mild slope plain, a part of the Ganges plain, consists of an alluvial fan and a soil plain that has been carried from mountainous areas to the north.	A large-sized alluvial fan has formed at the outlet of the river in the Siwalik mountain area. The carrying away of or covering of farming areas due to soil floods or changes in the course of the river have occurred. The functionality of irrigation canals has decreased in many places due to soil accumulation.	• Flooding of soil at large-scale alluvial fan • Covering of irrigation canals by soil • Accumulation of soil in farming areas

2-1-2 Administrative problems due to water induced disaster prevention

In addition to natural causes of water induced disasters, as national development proceeds human induced disasters have become a frequent occurrence due to deforestation or road construction. These human induced disasters emerged as problems around the time of the Fourth Plan (1970 ~ 75), thus His Majesty's Government of Nepal began to take appropriate measures.

In 1974, the Department of Soil and Water Conservation was established in the Ministry of Forests to tackle erosion control and undertake comprehensive watershed management. From the beginning, the activities of this Department focused on planting and small scale collapse prevention measures with the participation of the local population. From the viewpoint of the protection of people's lives, the Department placed the emphasis on educating the local population concerning improving farming areas and how land should be used. The name of the Department of Soil and Water Conservation was changed to the Department of Soil Conservation and Watershed Management in 1980, the Ministry of Forests was changed to the Ministry of Forests and the Environment, and the Water Conservation Law was established in 1982. As a flood control measure, a small scale water groyne construction using gabion works was implemented and this was transferred to the Ministry of Water Resources around 1980.

The Ministry of Water Resources established a Water and Energy Commission Secretary in 1976 to study and suggest comprehensive plans for water resource development and energy policy. The Department of Irrigation planned the Riverbank Protection Project and has implemented bank protection/groyne construction using gabion works and the government supplies equipment to the inhabitants so that they can do small scale construction on their own.

The Department of Roads of the Ministry of Works and Transportation is instituting measures to prevent the slope failure along the roads and the collapse of bridges due to the inability to control mountain streams. The contents of the related projects in each Ministry are shown in Table 2-1-2. The projects implemented by each Ministry, however, are focused mainly on relief activities aimed at small areas which have been hit by water induced disasters, thus they do not contribute to fundamental water induced disaster prevention. In addition, unlike Japan, legal systems such as the following law have not been prepared in Nepal:

- Forest Law - Erosion control works
- River Law - River control works
- Erosion Control Law - Sediment control works

Therefore, at this stage, there is still a lack of readiness which would allow the taking of administrative disaster preventive measures which cover entire drainage areas. Furthermore, a system which accumulates disaster related data indispensable to taking administrative sabo and flood control measures has not as yet been prepared.

Table 2-1-2 Administrative classification of sabo and flood control works in Nepal

Organization	Content of works
Ministry of Water Resources (MOWR) Department of Irrigation (DOI)	• Planning of river-bank protection project • Implementation of bank protection groyne construction using gabion works • Small construction is done by inhabitants based on their petitions
Water and Energy Commission Secretariat (WECS)	• Planning of water resource development projects and a study of the concerned legal system • Improvement of sabo and flood preventive technology • Training of engineers
Nepal Electrical Authority (NEA)	• Taking measures for water induced disasters with respect to power generation facilities
Ministry of Forests and Soil Conservation (MOSC) Department of Soil Conservation and Watershed Management (DOSC)	• Planning of water management programs focused on environmental conservation • Implementation of small scale preventive works for flooding and water induced disasters • Implementation of planting and measures for collapsing areas with the participation of inhabitants. 4 central and 22 local projects have been implemented. • Establishment of the Water Conservation Law (1982)
Ministry of Works and Transportation (MOWT) Department of Roads (DOR)	• Taking measures for water induced road disasters • Taking measures to prevent the slope failure of roads and torrent soil
Ministry of Land Reform (MOLR) Department of Survey (DOS)	• Survey changes of erosion, sedimentation and soil fertility • Study of the relationship between the above conditions and land use (with the cooperation of Canada)
Ministry of Home Affairs (MOH)	• Establishment of a Disaster Relief Countermeasures Committee

2-1-3 Necessity of training for sabo and flood control technique and its technology development

Many graduates of Nepal's only university, Tribhuvan University, are working in the agriculture field, Nepal's major industry. However, there are few graduates with civil engineering and forestry degrees. (Refer to Table 2-1-3 for the curriculum of and number of graduates from schools and departments of Tribhuvan University that are related to sabo and flood control.) Curriculums dedicated to erosion engineering related to sabo and flood control cannot be found in those departments. Academically,

sabo and flood control technology has not been established and in a way, it is a matter of trial and error. For this reason, as shown in Table 2-1-4, there are only about 100 personnel (engineers) engaged in sabo and flood control related work (excluding in the Ministry of Works and Transport).

Table 2-1-3 Curriculum and number of graduates in departments related to sabo and flood control in Tribhuvan University

Department (subject)	Civil Engineering	Forestry	Agricultural and Animal Science
Curriculum	• Irrigation and river engineering • Hydrology • Soil mechanics • RCC structure design • Traffic engineering	• Soil conservation and watershed management • Hydrology • Irrigation • Sewerage • Soil productivity • Soil creation • Afforestation • Forest protection, etc.	• Soil productivity • Botanical dietetics • Soil microbiology • Soil and water conservation • Agricultural foundation and planning & design, etc.
No. of graduates per year	25	40	150
Level of degree			

Table 2-1-4 Number of engineers in each related Ministry

Ministry	No. of engineers	Engineers engaging in flood and erosion control related works
Water Resources	1,000	50
Forests & Soil Conservation	400	50 • Civil engineering : 40 • Forestry : 10
Works & Transport	600	NA

According to the above, in the government the number of personnel and allocation of budget for sabo and flood control works are not sufficient to prevent the water induced disaster, and offices which consolidate sabo and flood control works are dispersed in each Ministry. Therefore, there is a strong desire to immediately increase the number of sabo and flood control engineers in order to predict floods and water induced disasters which occur in Nepal on a yearly basis, and conduct training and develop technologies in a wide range of fields such as establishing preventive methods and rehabilitation methods, etc.

2-2 Outline of related national projects

2-2-1 National projects

The Kingdom of Nepal was founded in 1951 with the restoration of Imperial rule. A development system based on the concept of the 5-year project was introduced in 1956 with a policy that placed the construction of a reborn Nepal as the highest priority. At that time, since the social foundation – a precondition of development – was unprepared, focus was put on improvement of the economic foundation, thereby implementing development projects one after another, mainly large scale projects, with cooperation from foreign countries. Unfortunately, in addition to the unfavorable geographical conditions of Nepal (a landlocked country), the country does not have rich underground resources, basically relying on imported raw materials. As a result, the industry does not develop and though the agriculture and forest industries account for 55.9% of GDP (1989), it is mainly volatile, unstable water based agriculture heavily influenced by natural conditions. The birth rate is high at 2.59%/year and 56% of the population live in hilly and mountainous areas. However, those areas have many steep slopes and are thus unable to support the increased population. At least partially because of the unique environmental conditions in Nepal, economic development requires a lot of budget and the effects of investment do not reach the intended goals, thus the country has difficulty in breaking through its current state of low economic growth.

With the above history, in the Fourth Plan (1970 ~ 75) the direction was changed from capital concentration-oriented projects to appropriate scale production-oriented projects. In the Fifth Plan (1975 ~ 80), the focus was on the development of the agricultural sector, economic development areas were designated and an attitude that emphasized an approach of meticulous development was shown to those areas having different phases of development. In the following Sixth Plan (1980 ~ 85), new large scale projects were not adopted since previous development projects had all failed, and instead many small sized projects aimed at the creation of employment opportunities in local areas were implemented.

In the Seventh Plan (1985 ~ 90), the policy of decentralization of power was further embodied and appropriate localized development measures were adopted under the District Development Plan. Special efforts were made to increase the economic efficiency of development by encouraging inhabitants in the target areas to participate in projects but the gap between the plans of the higher-ups in the country and the actual situations in local areas could not be eliminated to a great enough degree. At this point, 70% of national development projects were already relying on foreign aid and, with the limited organization and capabilities of the government, it was not possible to fully

explain the plans to recipients who directly benefit from these sort of development projects, thus the active participation of the beneficiaries could not easily be obtained. As a result, to a large degree development investment has not increased initial production effects, instead worsening the international balance of payments and resulting in an overall increase in debt.

At the end of 1986, His Majesty's Government of Nepal started a structural adjustment plan in response to suggestions from the World Bank and the IMF, intending to reconstruct the economic system of the country and aiming at macroeconomic stabilization. The further deterioration of the economic condition became a trigger of democratization and a provisional cabinet was inaugurated in May 1990. A new constitution was promulgated in November of the same year, then in May 1991 a general election saw Prime Minister Koirala handed the reins of power.

Heavily influenced by the democratization movement, the Eighth Plan (1992-97) was announced two years later, in July 1992. The targets of the Plan are as shown in Table 2-2-1, "Economic Development Plan of Nepal." The targets expressed in the Seventh Plan with respect to "improvement of productivity" were replaced with "continuous economic growth" and "development harmonized with the environment" and are continually being emphasized. The basic theme of the Eighth Plan (1992–1997) explains that without further destroying the biophysical environment of Nepal, which has already reached the saturation point in its ability to support the population, development efforts should be made which are in harmony with the limited amount of natural resources, and efforts should be made to improve the lot of those living below the poverty line, said persons in fact accounting for more than half the country's population. Together with those people, send light to district or villages where none of the benefits of development have been received and make efforts to correct unfairness in areas. These efforts will enable continuous growth.

Table 2-2-1 Economic Development Plan (7 and 8) of Nepal

The Seventh Plan (1985 ~ 1990)	The Eighth Plan (1992 ~ 1997)
Targets 1. Acceleration of expansion of production 2. Increased productive job opportunities 3. Satisfy basic needs of citizens	Targets 1. Sustainable economic growth 2. Alleviation of poverty 3. Reduction of regional imbalances
Development strategies 1) Priority placed on the agricultural sector 2) Conservation of forest resources & soil 3) Reinforcement of water resources development 4) Reinforcement of industrial development. 5) Expansion of exports 6) Development of tourism 7) Suppression of rate of population increase 8) Promotion of integration of national economy 9) Improvement of administrative organization 10) Reinforcement and activation of development administration	Development strategies 1) Agricultural Intensification and diversification 2) Energy development 3) Development of rural infrastructure 4) Employment generation and human resource development 5) Reduction in population growth 6) Industry and tourism development 7) Export promotion and diversification 8) Macro-economic stabilization 9) Administrative reform 10) Reinforcement of monitoring and evaluation

In order to achieve the targets and development strategies outlined in the Eighth Plan, it is essential to develop agriculture, which accounts for employment in 84.9% of the nation's 2,590,000 families and provides employment to 79% of the working population and accounts for about 50% of the Gross Domestic Product (GDP). Unfortunately, agricultural production is greatly influenced by natural conditions (the monsoon). As improvements in sanitation and medicine bring about a falling death rate and corresponding rises in population levels, food shortages will occur if agricultural production is low. Moreover, most agricultural areas have already been cultivated, but with the increases in population levels, even land not suitable for farming is being cultivated and farmed. When the procurement of feed for livestock and cutting down of trees for fuel is factored in, such kind of land use eventually leads to the destruction of the production environment, eroding the existing agricultural foundation and weakening the ability of the land to produce harvests. Under such conditions, sabo and flood control technologies are expected to provide the following effects in the agricultural field.

1) Prevention of loss of farming areas due to slope failures
2) Prevention of farming area outflow due to flooding
3) Prevention of inflow of soil into irrigation facilities
4) Prevention of river erosion

Those technologies will be felt not only in the agricultural sector but also in the road maintenance technologies required for transportation of goods and tourism, thus the DPTC is heavily relied on.

Of the development strategies in the Eighth Plan, the four items listed below are closely related to the activities to be undertaken by the DPTC – their positioning in the five-year plan attesting to the fact that their importance is recognized.

- Strengthening and diversifying agriculture
- Developing local social infrastructures
- Developing industry and tourism
- Strengthening the domestic economic base

Table 2-2-2 1990 economic and social indices of major developing countries and Japan

Item (year, unit)	Country			
	Nepal	Bangladesh	India	Japan
1. Area, population				
• Area (1,000 km²)	141.0	144.0	3,288.0	378.0
• Estimated population (10 mill.)	1.9	16.5	84.4	12.4
• Population increase rate (%/yr)	2.6	2.6	2.2	0.7
• Average longevity				
– Men	48.0	51.0	57.0	75.0
– Women	47.0	50.0	56.0	81.0
• Ratio of population engaging in economic activities (15 yrs old or older / total population (%))	39.1	27.0	34.7	49.8
2. National income / prices				
• GDP (US$100 million)	30.0	204.0	2,729.0	33,630.0
• GDP actual growth rate (%)	2.3	2.4	12.1	5.2
• GNP / person (US$)	160.0	180.0	336.0	27,093.0
• Consumer price rise rate (%)	20.9	8.1	8.9	3.3
3. Energy/food supply and demand				
• Per capita commercial energy consumption	19.0	43.0	190.0	2,538.0
• Power generation amount (1 million kwh)	427.0	5,125.0	202,574.0	671,770.0
4. Education / urbanization / preservation of health				
• Literacy rate (older than 14 years old) (%)	20.6	29.2	40.8	99.7
• Urban population ratio (%)	7.0	18.0	25.0	76.0
• Number of doctors per 10,000 people	0.3	1.0	2.7	13.5

Source : JETRO

2-2-2 Project with respect to the concerned sector

In addition to naturally occurring water induced disasters, as national development proceeds, human induced disasters have become a frequent occurrence due to deforestation or road construction. These human induced disasters emerged as problems around the time of the Fourth Plan (1970–75), thus His Majesty's Government of Nepal began to take measures.

In 1974, the Department of Soil and Water Conservation was established in the Ministry of Forests to tackle erosion control and comprehensive watershed management. Its activities focused on the education of local people concerning improvement of farming areas and effective land use. From the viewpoint of the protection of the people's lives, planting and small scale collapse preventive measures were implemented with the participation of local residents. Because of Nepal's weakness technologically, the establishment of a Research Centre for Soil and Water Conservation was proposed but it did not materialize. In 1980 the name of the Department was changed to the Department of Soil Conservation and Water Management, the Ministry of Forests became the Ministry of Forests and the Environment, and a Water Conservation Law was established in 1982. A small-scale water groyne construction using gabion works was implemented as a flood control measure and this was transferred to the Ministry of Water Resources around 1980.

The Ministry of Water Resources established the Water and Energy Commission Secretariat in 1976 to study the issues and make suggestions concerning comprehensive water resources development planning and energy policy. The Department of Irrigation planned a Riverbank Protection Project and has implemented bank protection/water control construction using gabions, with the government supplying equipment to the locals so they can do small scale constructions on their own. The Government of Japan provided Grant Aid for equipment and materials for this project. In the 5 terms from 1987 to 1991, a total of ¥3,374 million was provided, enough for 20,000 tons of steel wire and five machines for manufacturing gabions, 5 trucks for hauling gabions, 5 dump trucks for hauling stone, and 5 vehicles for supervising the work, and this aid was used effectively. In the current situation, however, measures are intended for limited protection and should not be mistaken for comprehensive sabo and flood control project which take the entire water control system into consideration.

The Department of Roads of the Ministry of Works and Transportation is taking measures to prevent the slope failure along the roads and the loss of bridges due to mountain streams. The establishment of Land Slide Prevention Technical Centre was requested to develop and expand technologies in this field but it was not realized.

The contents of the related projects in each Ministry are as shown in Table 2-1-2, "Administrative classification of sabo and flood control works in Nepal."

Supporting organizations in foreign countries are proceeding with investigation and research with respect to a comprehensive area development project, farming village development, afforestation and environmental conservation, and projects are being implemented in related fields including the construction of roads, irrigation facilities, power stations. Proceeding with this kind of diversified approach produces only fragmentary results.

As explained above, activities related to environment conservation in Nepal and the prevention of water induced disasters are assisted in various ways by international organizations and supporting organizations from foreign countries as well as through the government's own efforts. In order to implement the economic development of Nepal, environmental conservation and disaster prevention measures have been determined to be critical to Nepalese efforts at continuous development. Nepal must face these issues now, and must urgently seek out improvements and introduce specific methodology. It is also necessary to immediately adjust the fragmentation resulting from the uncoordinated efforts of the various organizations operating in Nepal. The focus must be on implementing comprehensive environmental conservation and disaster preventive planning. Nepal especially lags behind in technological approaches to this field; therefore, it is vital that specific planning be undertaken.

2-2-3 Aid from international organizations

(1) International organizations providing aid for sabo and flood control

Listed below are the international organizations that are providing assistance for sabo and flood control in His Majesty's Government of Nepal.

- ICIMOD (International Centre for Integrated Mountain Development)
- FAO
- World Bank
- ADB
- UNDP
- ILO

(2) Outline of selected aid organizations

- ICIMOD

History

Founded in Kathmandu in December 1983 with the participation of representatives including the Prime Minister of Nepal, UNESCO, Germany, Switzerland and subject countries. Actual activities started in September 1984.

Subject countries

Nepal, India, China, Pakistan, Bhutan, Bangladesh, Afghanistan, Myanmar, totaling 8 countries : Hindu Kush Himalana area (3,500 km from east to west)

Purpose of activities

An international organization which investigates and researches the comprehensive development of mountainous areas in which the ecological system and environment are taken into consideration. The main activities focus on the following:

1) Exchanging knowledge about policies, planning and projects with respect to the comprehensive development of mountainous areas in each country.
2) Conducting practical training and seminars.
3) Conducting application research on specific problems relating to the cooperative development of mountainous areas and ecological systems.
4) Providing consultation services with respect to the development of mountain areas and environmental conservation.

Budget

Total expenditures in 1990 worked out to about $1.3 million. Funds are granted from subject countries (except Myanmar and Afghanistan) or organizations including Germany, Switzerland and UNESCO. Financial support is obtained from international organizations and other countries on a project basis.

Organization

32 full time (professional) staff members including clerks and researchers are employed for each project on short term contracts.

Activities

Currently, the following eight programs (divisions) are ongoing.

1) Mountain agriculture system
2) Population and employment issues
3) Infrastructure and technology
4) Environmental management plan

5) Document and information exchange
6) Evaluation and monitoring of natural resources
7) Planning and implementation of local development
8) Training programs

- FAO

(Regional Watershed Programme, Support to Watershed Management in Asia)

Purpose

Established as a local watershed program to support watershed management in Asia.

Subject countries

Afghanistan, Bangladesh, Bhutan, China, India, Mynamar, Nepal, Pakistan, Sri Lanka and Thailand (the office is in Nepal)

Funding countries / organizations

UNDP and Holland

Implementation period

1989 ~ 1992

Objectives

Long term objectives

Aims at the stable use of forest, soil and water resources by increasing the planning, implementation and evaluation abilities of watershed management programs in the target countries, recognizing the devastation in drainage areas and increasing the ability to cope with it. Improves the basic life of the people in highland areas and protects villages and infrastructure near the lower reaches of rivers by easing floods, drought, sedimentation and unstable river routes.

Short term objectives

① Develop human resources to engage in watershed management works.
② Exchange technical information on watershed management works in the subject countries for the purpose of mutual cooperation.
③ Improve ability to plan, implement and monitor ongoing projects, and promote watershed management works.
④ Encourage the participation of area inhabitants in order to ensure stable development of the environment, economy and society through watershed management to improve watershed management works.

Description of implementation

① Conduct training/seminars and create manuals in order to develop human resources engaged in watershed management work.

② Create guidelines for project evaluation and monitoring and issue newsletters to facilitate watershed management technology and information exchanges.

③ Make arrangements with funding countries to promote watershed management projects.

④ Issue and distribute books, catalogues and guidelines, introduce activities of NGOs and conduct seminars for NGOs in order to promote watershed management work with the involvement of the local population in affected areas. Also, create guidelines and issue newsletters.

• World Bank

① As a three-year program beginning in 1989, co-administered with the ADB a loan totaling $53 million to a support project for the Ministry of Water Resources, Department of Irrigation (ISSP).

② Co-administered with the UNDP for two years beginning in 1988 the irrigation planning and designing reinforcement project (PPSP) of the Ministry of Water Resources, Department of Irrigation, whereby an irrigation development master plan (four volumes) and an irrigation project design manual (21 volumes) were compiled.

③ Furnished a World Bank loan for riparian works (riverbank protection and groyne works) on the Bagmati River (from the East-West Highway to about 55 km from the Indian border) located on the Terai Plain, which was carried out under the auspices of the Narayani Prefecture Irrigation Project and the Manusumara Irrigation Sub-Project as a part of the Irrigation Development Project.

④ Furnished a World Bank loan and UNDP technical assistance from 1988 to 1991 in the sabo and flood control field of the Department of Roads, Ministry of Public Works for the Highway Flood Restoration Project that was employed for a restoration project for the 1987 floods.

The main projects undertaken were as follows:

- Restoration of Arniko Highway
- Rebuilding of bridges at four locations in the Kathmandu Basin
- Restoration work between Kathmandu and Noubise

• ADB

① As a three-year program beginning in 1989, co-administered with the World Bank a loan totaling $53 million to a support project for the Ministry of Water Resources, Department of Irrigation (ISSP).

② From 1983 to 1988 an ADB loan of $20 million and ILO technical assistance were provided for the Second Mountainous Area Irrigation Project of the Ministry of Water Resources, Department of Irrigation. With the participation of the farming population, this project included riverbank protection works aimed at preventing the washing away of farmland due to such causes as river-induced erosion.

• UNDP

① Administered with the World Bank for two years beginning in 1988 the irrigation planning and designing reinforcement project (PPSP) of the Ministry of Water Resources, Department of Irrigation, whereby an irrigation development master plan (four volumes) and an irrigation project design manual (21 volumes) were compiled.

② From 1982 to 1987 furnished personal computers for hydrological data resource management to the Ministry of Water Resources, Department of Hydrology and Meteorology.

③ Furnished a World Bank loan and UNDP technical assistance from 1988 to 1991 in the sabo and flood control field of the Department of Roads, Ministry of Public Works for the Highway Flood Restoration Project that was employed for a restoration project for the 1987 floods.

- Restoration of Arniko Highway
- Rebuilding of bridges at four locations in the Kathmandu Basin
- Restoration work between Kathmandu and Noubise

• ILO

① Co-administered from 1983 to 1988 an ADB loan of $20 million and World Bank technical assistance for the Second Mountainous Area Irrigation Project of the Ministry of Water Resources, Department of Irrigation. With the participation of the farming population, this project included riverbank protection works aimed at preventing the washing away of farmland due to such causes as river-induced erosion.

2-2-4 Bilateral cooperation

(1) Countries providing assistance to Nepal in fields related to sabo and flood control

The major countries currently providing assistance to Nepal in fields related to sabo and flood control are as follows:

Japan, Switzerland, England, Finland, Denmark, Norway, Holland, Australia, USA

(2) Outline of assistance in fields related to sabo and flood control by each country

1) Japan

Grant-Aid supported Kingdom of Nepal Riverbank Protection Project extending in 5 phases (total amount ¥3,374 million) from fiscal 1987 ~ 1991 Based on the recommendations specified in a pre-project study conducted in November 1987, 20,000 tons of steel wire and five machines for manufacturing gabions, 5 trucks for hauling gabions, 5 dump trucks for hauling stone, and 5 vehicles for supervising the work have been provided. Nepal has 15 years of experience with gabion-type riverbank protection, and has disposed of all technical problems. With the enthusiastic participation of residents, the gabions are set in place under the direction and cooperation of Nepalese engineers. An additional 6th phase is planned to be implemented this year.

2) Switzerland

① Construction of Lamosangu ~ Jili Road and implementation of protection measures on the side-face of the road.

② Comprehensive development work in farming villages in Jili (including the installation and operation of a technical school for the training of civil engineers and agricultural engineers who are high-school graduate level.)

3) England

Construction of the Dharan ~ Dhankuta Road (1978~1982) and implementation of protection measures on the side-slope of the road. (England issued a publication entitled *Vegetation Structures for Stabilizing Highway Slopes* which describes a side-face protection method using planted vegetation).

4) Finland

In 1987, Finland began providing financial aid to the watershed management project at Kulekhani Reservoir and Neuwatalu Lake in place of the FAO. Completion of this phase was planned for 1991 and a total of 98 million rupees was invested (Department of Soil Conservation and Water Management). The

Forest Survey & Statistics Division started a project to create forest condition drawings using satellite pictures and aerial photographs (1990 ~ 1993).

5) Denmark
Water Management Project (Computer-aided flood analysis : planned in the Department of Irrigation)

6) Norway
Implementation of the Shibapuri Watershed Management Project (Department of Soil Conservation and Water Management). This Project was first started by His Majesty's Government of Nepal itself (1975 ~) but Norway began to provide financial assistance in 1985. Phase I was completed in 1990 and Phase II is currently ongoing (1991 ~).

7) Holland
Implementation of the Riverbank Protection & Irrigation Rehabilitation Project (Department of Irrigation) is planned through the technical cooperation of ILO.

8) Australia
Australia has engaged in an afforestation project since 1962 (Ministry of Forest, Department of Forest) and possesses expertise in the study of choosing the optimum type of tree for a particular habitat. It issued an illustrated book about the major trees of Nepal (*Plant Propagation for Reforestation in Nepal*).

9) U.S.A.
Implementation of a watershed management project (fund conservation use project) in the Dhaulagiri / Myagudi / Mustan districts (from 1980 to 1985). This project has been taken over by the Department of Soil Conservation.

2-3 Description of request and its progress

2-3-1 Progress of request

Nepal is an exceptional country due to its steep geographical characteristics and weak nature of the soil and as a result is constantly threatened with water induced disasters. Explosive increases in population and road construction destroy the environment, further aggravating such disasters, resulting in extensive loss of life and greatly damaging fundamental facilities such as trunk roads, power generation dams and irrigation facilities, as well as severely affecting the base of people's lives through the destruction or damaging of farming areas and forests.

Japan first participated in this field back in 1963 and at that time, the Government of Japan and His Majesty's Government of Nepal had not established diplomatic relations. Shortly after the founding of the country, His Majesty's Government of Nepal determined that to make inroads in national development it would be necessary

to introduce disaster prevention technologies in this field and, because Japan and Nepal have similar geographical features, subsequently made a request to the Government of Japan to investigate the situation. In response to this request, the Ministry of Construction dispatched sabo engineers to Nepal and destructive condition of mountain areas and a countermeasure proposal was drafted.

His Majesty's Government of Nepal began in 1970 to implement countermeasures with clear recognition of the necessity for conservation of soil and water resources and disaster prevention plans. However, Nepal's technology was inadequate for the task at hand, and His Majesty's Government of Nepal requested that the Government of Japan provide for a long-term dispatch of a team of experts for the prevention of natural disasters. In 1977, the Government of Japan thereby dispatched for two years a study team comprising personnel expert in the field of sabo and flood control who submitted a report explaining the necessity from the viewpoint of environmental conservation of establishing a Soil Water Conservation Research Centre under the Ministry of Forests. This plan did not materialize and 10 years passed. During this time, survey groups related to irrigation facility or road construction projects have conducted surveys of water systems and occasionally reported the danger of the occurrence of water induced disasters and the necessity to take preventive measures.

To deal with natural disasters, whose numbers were generally increasing, His Majesty's Government of Nepal promoted sabo and flood control work as a major policy in the Seventh Five-Year Plan. However, because this area suffers technically in terms of both quality and quantity, actual implementation proved problematic. For this reason, in February 1990 His Majesty's Government of Nepal submitted a request to the Government of Japan for Project Type Technical Cooperation with respect to the Water Induced Disaster Prevention Technical Centre, with the goal being to train engineers, develop appropriate sabo and flood control technologies, and collect and analyze information. Upon receiving the request, the Government of Japan in the one-year period from September 1990 to August 1991 once dispatched a pre-survey team and thrice a long-term survey team, the members of which conducted a detailed survey calling for the establishment of the DPTC.

In the beginning, His Majesty's Government of Nepal planned to establish a Slope Failure Preventive Technology Centre under the Department of Roads of the Ministry of Work and Transport, placing importance on preventing road construction-related slope failures. However, the survey team concluded that such local countermeasures as road conservation cannot solve the fundamental problems, and the impetus was changed to the establishment of the Water Induced Disaster Prevention Technical

Centre aimed at the design of preventive measures concerned with conservation of the entire water system.

In such a fashion, the request began its life in the Ministry of Forests as an erosion control measure designed to conserve the environment, from where it was transferred eventually to the Department of Roads of the Ministry of Works and Transportation as a road conservation measure designed to prevent slope failure, and finally to the Ministry of Water Resources as a sabo and flood control project designed mainly to conserve water.

In response to the pre-project survey and the survey conducted by the long-term survey team, Japan dispatched a full-scale survey team in September 1991, signing the R/D on October 7, 1991. A long-term expert team (5 personnel) was then sent to Nepal, equipment was provided for hydraulic model experimentation, a hydraulic building was constructed using the local expenditures necessary for establishing the physical infrastructure of the Project, and a training course was opened with the expressed goal of educating sabo and flood control related engineers on technologies appropriate for the Master Plan for Project Type Technical Cooperation. (See Appendix 7, "Master Plan for Project Type Technical Cooperation" for details.)

However, the buildings currently being used as offices and lecture room is residential building that is being rented. This results in the size of the rooms being inadequate for the number of trainees and leaves no overnight accommodations within which the trainees can live. Hence it was worried that such a situation would impede the smooth operation of the DPTC and the performance of related activities.

Although these facilities were to be prepared by the Ministry of Water Resources, Ministry budget constraints resulted in Project Type Technical Cooperation paying the leasing fees. Furthermore, machinery and materials donated by Project Type Technical Cooperation are stored in a storehouse, which uses the packaging material for the machinery and material, constructed in the Godawari district on a portion of the site upon which the hydraulics laboratory is constructed, and is not in a condition to be readily used. To improve this situation and ensure the smooth operation of the DPTC, His Majesty's Government of Nepal requested that the Grant Aid program construct a main building, a technology development building, a trainees' dormitory, and a garage for heavy equipment as described in Section 2-3-3, "Description of the request."

2-3-2 Purpose of establishment and description of activities

The purpose of the establishment of the DPTC and the activity contents are as follows. See Appendix 7, "Technical Cooperation Master Plan", for scheduling details.

(1) Purpose of the DPTC

- Use training to improve the techniques used by engineers engaged in sabo and flood control field.
- Prevent and reduce water induced disasters by developing sabo and flood control technologies and methods appropriate to Nepal.
- Prepare to create a sabo and flood control technology standard (establishment of a database)
- Promote the application and use of developed technologies and methods.

(2) Activity contents of the DPTC

- Training activities (initial plan)

  Lectures, exercises and OJT will be conducted in order to improve knowledge and techniques of Nepalese engineers necessary for survey, planning and designing of the sabo and flood control field.

  ① *General course : 2 weeks (5 ~ 10 trainees), twice a year*

  The purposes and effect of the study of general sabo and flood control is explained to civil engineers or private engineers.

  ② *Advanced course : 3 months (5 trainees), once a year*

  This course is intended for upper class officials who will lead the sabo and flood control effort in future. (See Section 3-3-2 (6), "Curriculum.")

  ③ *Intensive course : 12 months (5 trainees), once a year*

  This course uses OJT to train kernel engineers, placing importance on F/S of sabo and flood control works and creation of D/D of facilities. (See Section 3-3-2 (6), "Curriculum.")

- Technology development activities

  Combining traditional techniques unique to local areas and contemporary technologies, methods are developed that are suitable for the Nepalese situation. A technical standard will be created and technical advice will be provided for on-going projects in each area.

- Contents of technology development

  ① By implementing a pilot project, appropriate sabo and flood control methods will be developed in various technical disciplines such as public structures, planting and land use.

  ② Technical advice will be offered to on-going projects in each area.

  ③ Surveys, tests and studies necessary to prepare the sabo and flood technology standard.

- Building of a database

  Technical data on the occurrence of water induced disasters and experimental exercise data obtained through DPTC activities will be compiled in a database to create fundamental data that can be analyzed to help prevent or ease the effects of floods and water induced disasters.

2-3-3 Description of the request

The facilities requested by DPTC are as follows:

Table 2-3-1 Scale of requested facility

Building name (site)	Facilities	Total floor area
Main Building (Lalitpur)	Lecture room, meeting room, designing & drawing room, library, expert's room, staff room, lounge, guard room, others	1,950 m^2 (3-story)
Technology Development Building (Godawari)	Material storage, equipment storage, AV room, data processing room, maintenance workshop, soil testing room	900 m^2 (3-story)
Trainees' dormitory (Lalitpur)	30 rooms	1,200 m^2 (3-story)
Total		4,050 m^2

Although, initially, it was planned to build a maintenance workshop for heavy equipment and machinery/material in the Technology Development Building, a survey conducted during the Basic Design stage revealed that the following items:

1) Transporting the heavy equipment to Godawari was problematic.
2) There was insufficient space to store all the heavy equipment.
3) Increased facility operating expenses would be required to cover the increases in maintenance personnel.

To solve these problems, the Ministry of Water Resources presented an alternate plan to the Basic Design Survey Team in which the Department of Roads, Ministry of Works and Transportation is requested to build, in their maintenance yard, a garage to house the DPTC's heavy equipment, as well as to be responsible for maintaining the heavy equipment, and commenced negotiations with the said department. Table 2-3-2 shows the scale of the garage for heavy equipment presented in the alternate plan.

Table 2-3-2 Scale of heavy equipment garage

Building name (site)	Equipment description	Total floor area
Garage (in the maintenance yard, Department of Roads of the Ministry of Works and Transport)	Bulldozer : 2 Dump truck : 2 Back hoe : 2 Loader : 1 Concrete mixer : 1 Truck : 1 Truck with crane : 1	195 m^2

CHAPTER 3 DESCRIPTION OF PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3-1 Objective

The DPTC currently leases residential-use buildings for use as office and training rooms. However, it was worried that such a situation would impede the smooth operations and activities of the DPTC, as the rooms were too small for the number of trainees and lacked facilities needed for training, such as a library, seminar hall, conference room, overnight accommodations, and so on.

Although the Ministry of Water Resources was originally charged with providing these facilities, budget constraints resulted in Project Type Technical Cooperation paying the leasing fees for the residential-use buildings. Moreover, most machinery and materials granted by Project Type Technical Cooperation are stored in a storehouse, which uses the packaging material for the machinery and material, erected in the Godawari district on a portion of the site upon which the hydraulic laboratory is constructed, and is not in a condition to be readily used.

In order to improve such conditions, the Project is to construct a DPTC main building, trainee's dormitory, technology development building and a heavy equipment garage, further educate Nepalese sabo and flood control engineers, increase technical know-how, develop new technologies, and construct a database so that Project Type Technical Cooperation is able to function smoothly.

3-2 Study and examination of the request

3-2-1 Suitability and necessity of the Project

As explained in Section 2-1-1, due to a shortage of both financial and human resources in Nepal, prediction, prevention and countermeasures are not adequate to respond to water induced disasters, and this situation is believed to be one of the factors hindering the social and economic development of Nepal. In addition, water induced disasters in Nepal are thought to raise riverbeds in India and Bangladesh, eventually causing floods in those countries.

With this in mind, as explained in Section 2-1-1 each Ministry is individually developing activities with respect to sabo and flood control in Nepal, and there is as

yet no laboratory or training centre which unifies sabo and flood control technologies in Nepal. The activities of each Ministry are focused mainly on relief work in areas stricken by disaster, natural or otherwise, and a system has not yet been implemented through which comprehensive measures can be instituted which cover all watershed areas.

With respect to university education, the Departments of Civil Engineering, Forestry and Agriculture provide a only small number of lectures relating to sabo and flood control—there is no independent curriculum for erosion control engineering. The Department of Engineering, Tribhuvan University, has the only research models for the study of sabo and flood control, a 3 dimensional model and an extraction model of a water intake canal of a flow-in type hydroelectric power plant constructed with the support of Trondheim University in Norway. However, these models have remained virtually unused since they were used for hydraulic experiments on the Jimuraku River.

In view of this situation, the following activities aimed at engineers in the sabo and flood control field in each Ministry were commenced with the assistance of Project Type Technical Cooperation.

(1) Training of engineers in the sabo and flood control field
(2) Development of sabo and flood control technologies and construction methods appropriate to Nepal
(3) Preparation for drafting sabo and flood control technology standards
(4) Promotion of application and use of developed technologies and methods

However, in the second year after Project Type Technical Cooperation had begun, which was during the time activities were planned to be pursued at an even higher pitch, a situation arose in which it become impossible to provide such rooms indispensable for research as a seminar hall, conference rooms and a library (data resource room) within the residential building rental space being used at that time, hampering the activities of Project Type Technical Cooperation. Although these facilities were to be prepared by the Ministry of Water Resources, due to inadequate operating budgets, Project Type Technical Cooperation is paying the leasing fees and other expenses for the residential buildings. Although, as shown in Table 3-2-2 "Operating Budget of DPTC," the operating funds disbursed to the DPTC from the Ministry of Water Resources have grown by roughly 40% over the initial budget, due to increase in staff and full-scale implementation of activity plans, the operating expenses have tended to increase each year, leading to chronic budget shortfalls.

In view of this situation, the use of Grant Aid from the Japanese Government to construct the DPTC – by which the Project Type Technical Cooperation activity

schedule could be carried out within the limited time period allotted it thus enabling the technology to be transferred as initially planned – is deemed to be extremely important in light of the water induced disaster damage that is occurring in Nepal.

It is also thought important to direct consideration to a facility plan that minimizes to the extent possible facility operating and maintenance expenses so that, after Project Type Technical Cooperation is completed, the facilities can be operated solely by the Nepal side.

In due consideration of the above, construction of the DPTC has been deemed to be reasonable.

3-2-2 Study of implementation and operation plans

(1) Personnel arrangement

The DPTC has already started its activities with five experts dispatched on a long term basis under the auspices of Project Type Technical Cooperation. The placement of DPTC personnel is as shown in Fig. 3-3-2, DPTC Joint Committee and personnel management." The DPTC is structured in such a way that there are four Divisions under the Director: the Administration Division, Training Divisions (planning, training, evaluation and training equipment), Technology Development Division (testing, technical development, equipment) and Information Division (library, database, public relations). The DPTC is operated by each division head and 15 staff members allocated from MOWR, DOSC and DOR, a total of 20 persons. The initial plan called for there to be a total of 22 staff members but the current rented office has no room for additional staff; therefore, the DPTC will operate at current staff levels until the new facility is completed.

With respect to personnel placement upon completion of construction, based on confirmation of facility content and the number of operating staff, it has been decided to add a librarian and a secretary so that the facility will ultimately be operated with 24 personnel. The staff of each division will operate the office and also act as counterparts to long term experts, thus there will be a stable supply of lecturers for training courses.

(2) Project budget

1) Budget of the Ministry of Water Resources

The budget of the Government of Nepal in 1992/93 is an appropriated total of Rs33,595,224,000. Of this, 14.3%, i.e. Rs4,821,833,000, is appropriated for the budget of the Ministry of Water Resources.

The operating costs shown in Table 3-2-1, "Budget of the Ministry of Water Resources (1990/91 ~ 1993/4)," consists of the salaries of the staff working

for the Ministry, and each Authority and Division, and the costs of operating the offices. The development cost is covered by the project development budget which comes under the budget for large-scale projects of each Division, Authority and committee, such as dam construction, irrigation works, and so forth. The DPTC does not have a large-scale development project so far, thus only the operating cost has been allocated.

However, in the future, in order to independently do development work, a major activity of DPTC, it is necessary to obtain the development budget distributed from the Ministry of Water Resources. To do this, it was suggested that DPTC must strongly appeal to the Ministry of Water Resources by estimating the budget based on the training schedule.

2) Operation budget of DPTC (budget distribution by the Ministry of Water Resources)

As shown in Table 3-2-2, "Operating budget of DPTC," according to the budget allocation of the Ministry of Water Resources, DPTC's budget in 1992/93 was Rs1,713,000.– and 1% of the commodity tax has been added as of August 1992, thus the budget has become Rs1,829,765.59.

Since the budget calculated in Section 3-3-5, Maintenance and Control, is necessary after the completion of the Project which is scheduled for March 1995, it was suggested that DPTC needs to include it in the budget in 1994/95.

Table 3-2-1 Budget of the Ministry of Water Resources (1990/91 ~ 1993/94)

Unit : Rs

	1990/91	1991/92	1992/93	1993/94
Ministry of Water Resources				
Operating cost	1,773,000	2,377,000	5,263,000	3,296,000
Department of Irrigation				
Operating cost	4,586,000	9,145,000	12,032,000	10,282,000
Development cost	1,111,294,000	1,561,622,000	2,054,320,000	2,402,496,000
Department of Hydrology and Meteorology				
Operating cost	1,964,000	3,794,000	6,304,000	5,843,000
Development cost	17,458,000	18,023,000	20,680,000	20,505,000
Nepal Electrical Authority				
Operating cost	–	–	–	–
Development cost	1,316,537,000	1,915,166,000	2,715,821,000	2,935,063,000
Water and Energy Commission Secretary				
Operating cost	–	–	–	–
*1 Development cost	2,834,000	3,650,000	5,700,000	5,700,000
DPTC				
Operating cost	–	1,500,000	1,713,000	*2 3,448,000
Electricity Development Centre				
Development cost	–	–	–	14,930,000
Total	2,456,446,000	3,515,277,000	4,821,833,000	5,401,563,000

*1 Included in the budget of Nepal Electrical Authority.
*2 KRII budget included.

Source: Red Book Ministry of Finance

Table 3-2-2 Operating budget of DPTC (Budget distribution of the Ministry of Water Resources)

Unit : Rs

No.	Item	July 1991 to July 1992		July 16, 1992 to June 15, 1993		July 16, 1993 to July 15, 1994	
		Approved budget (Rs.)	Consumption (Rs.)	Approved budget (Rs.)	Consumption (Rs.)	Approved budget (Rs.)	Consumption (Rs.)
1	Salaries	251,000.00	76,458.52	710,000.00	720,666.15	1,050,000	
2	Allowances	10,000.00	1,182.20	10,000.00	15,017.55	25,000	
3	T.& D. allowances	10,000.00	1,786.00	30,000.00	32,695.95	30,000	
4-1	Services tax	34,000.00	13,285.59	40,000.00	37,108.48	70,000	
4-2	Services other	10,000.00	8,425.00	18,000.00	26,083.15	24,000	
4-3	Over service	—	—	10,000.00	6,174.00	11,000	
5	Hire charge / rent	20,000.00	1,400.00	20,000.00	—	288,000	
6	Repair & maintenance	60,000.00	3,837.00	40,000.00	7,385.00	40,000	
7-1	Office materials	20,000.00	9,908.00	30,000.00	16,847.50	30,000	
7-1-2	Printing	—	—	20,000.00	10,600.00	20,000	
7-2	Magazines	5,000.00	1,463.00	5,000.00	3,883.00	5,000	
7-3-1	Fuel for vehicles	70,000.00	19,607.00	50,000.00	89,935.22	50,000	
7-3-2	Fuel for other purposes	4,000.00	50.00	5,000.00	2,950.00	5,000	
7-4-1	Clothing & shoes						
7-5	Other office materials					15,000	
8-3	Medicine	10,000.00	—	15,000.00	8,233.00		
9-1	Contingencies	10,000.00	4,790.90	10,000.00	53,321.72		
9-2	Land purchase	—	—	200,000.00	—		
10-1	Furniture	20,000.00	19,945.00	—	—		
10-2	Vehicles	10,000.00	4,975.00	—	—		
10-3	Machine tools	50,000.00	49,785.00	—	—		
12-1	House purchase & construction						
12-2	Other construction	906,000.00	905,686.54	500,000.00	218,956.10	200,000	
13	Customs & duty	—	—	116,765.59	420,968.70		
Total		1,500,000.00	1,122,584.75	1,829,765.59	1,670,825.52	3,448,000	

Source : DPTC

3-2-3 Relation to and duplication among similar projects

The main activities of the DPTC include enhancement of the technical level of engineers in the sabo and flood control fields, development of sabo and flood control technologies and construction methods, preparation of sabo and flood control technical standards, construction of databases, and dissemination activities.

Sabo and flood related assistance extended by international organizations and through bilateral cooperation are mainly characterized by project base construction, such as road, dam and irrigation construction, thus, there is little assistance provided that overlaps the activities of the DPTC. The only cooperative assistance that is even similar is aid extended through ICIMOD (International Centre for Integrated Mountain Development) established by 8 countries : Nepal, India, China, Pakistan, Bhutan, Bangladesh, Afghanistan and Mynamar. Their particular charter is essentially to survey and study the comprehensive development of mountainous areas, and some of the sabo/flood control-related training exercises and seminars held by ICIMOD are similar to DPTC's activities. However, the participants of these training exercises and seminars are researchers from the countries associated with ICIMOD's establishment, which differ from the trainees targeted by the DPTC activities.

The Department of Roads, Ministry of Public Works and Transportation has a soil testing laboratory, a soil analysis laboratory, a concrete testing laboratory and a steel reinforcement bar tension testing laboratory constructed in 1987 through assistance provided by Britain and furnished with Italian-made testing materials and equipment. Because experiments in these laboratories are conducted mainly under the auspices of the Department of Roads, their use configuration differs from those of the DPTC laboratories, which are to be used mainly for research and training. Their operating system differs as well in that the laboratories of the Department of Roads include only the experiment administrator. In addition to the testing equipment and materials owned by the Department of Roads, only those machinery and materials required for work, such as soil testing equipment, that are partially owned by private companies exist in Nepal. Because of this, it is thought that one of the reasons for the slowness in re-establishing the technical fields that utilize the machinery and materials is the slowness in which they are being upgraded.

3-2-4 Study of project components

This project is to through Project Type Technical Cooperation construct a facility to facilitate and smooth the activities which are currently operating out of rental offices. It is necessary to make a facility plan by taking into consideration future plans such as

the number of facility operating staff, number of trainees, training schedule and training contents, etc.

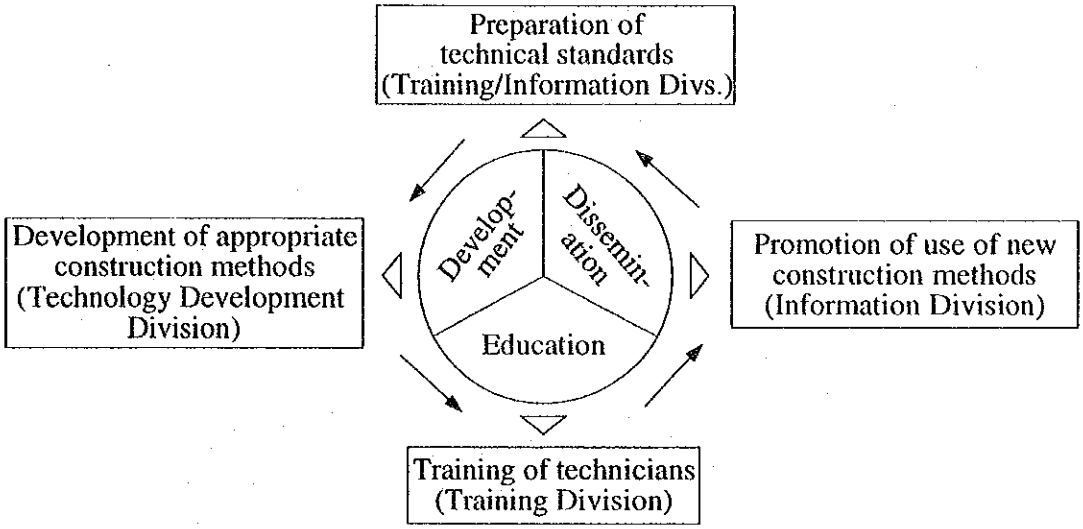
The major facilities are as follows:

Main building	
• General affairs section	Director's room, secretary's room, meeting room, office, other
• Training section	Office, lecture room, seminar room. seminar hall, other
• Technology development section	Researchers' room, design & drawing room, other
• Data processing section	Library, data processing room, office, other
Trainees' dormitory	10 rooms, lounge, office, other
Technology development building	Soil testing room, concrete testing room, workshop, materials storeroom, other
Heavy machine garage	Bulldozer, dump truck, backhoe, loader, truck, a total of 10 heavy machines

The DPTC is founded upon 3 pillars: education, development and dissemination. Education is centered upon the DPTC Training Division, and its goal is to train as many personnel as possible in the fields of sabo and flood control through general, advanced and intensive courses. Development is centered in the Technology Development Division, and its goal is, through practical exercises and research using pilot project studies and laboratories, to develop new construction methods and to improve them further to practical methods through feedback on their feasibility. Dissemination is designed not only to disseminate the newly-developed construction methods through training, but is to take the first step of delving into the question of what sabo and flood control policies should be, and eventually witness the spread of sabo and flood control technologies throughout Nepal.

In order to skillfully mesh the cycles of these 3 pillars together, matching the facilities to be constructed, or the hardware aspects, to the requirements of the software aspects that are being handled by Project Type Technical Cooperation is of the utmost importance. To do this, the Project Type Technical Cooperation team must fully consider the technical cooperation master plan with respect to the details of requests from the Ministry of Water Resources in order to decide the functions and sizes of the required facilities.

Professional technical cooperation activities - Project cycle



3-2-5 Study of requested facilities

(1) Study of the scale of facilities

Although the details of the facilities requested for the DPTC are shown in Table 2-3-1, "Scale of requested facility," because the usage and basis for the calculations of the area of these rooms cannot be understood from the contents of the Request alone, these points must be ascertained by survey to build facilities that take into account future plans.

As shown in Fig. 3-3-2, "DPTC Joint Committee and personnel arrangement," after Project completion the plan calls for the facilities to be operated by 24 staff members, including the Director. There is currently no plan to change this number because of the small number of engineers who are engaged in activities related to sabo and flood control in Nepal.

During the basic design study phase, Nepal's request was evaluated and studied by calculating the scale of the facilities based on the personnel arrangement plan. As a result, the following items in the request have been changed.

1) Training Division – The capacity of the seminar hall has been changed from 100 people to 60 people

Concerning the capacity of the lecture hall, a study was made of the number of participants in opening/closing ceremonies and lectures held in the other rented facility it was found that there were about 60 participants. Therefore, it has been decided that the capacity of the seminar hall will be 60 people. Since such events are held 4~5 times a year, it is planned that the hall can be used as training rooms by dividing the available space in half using movable partitions.

Since the training period for each course overlaps, it was determined that providing these 2 training rooms is effective.

2) Trainees' dormitory – The number of rooms in the trainee's dormitory has been changed from 30 to 10

Calculating based on the Project Type Technical Cooperation Master Plan formulated by Project Type Technical Cooperation experts, the trainee's dormitory will accommodate a maximum of 15 ~ 20 trainees at any one time, even in the event that two or more programs are scheduled to run simultaneously. Furthermore, not all of the trainees come from local areas, and it is possible that some of these people will not need to stay at the dormitory. Therefore, there shall be 10 rooms. Of these, two rooms designated as being for lecturers shall have a shower and toilet. The other eight rooms shall co-use showers and toilets located on each floor.

3) The Data Processing Room and Audiovisual Room planned for the Technology Development Building (Godawari) shall be consolidated in the main building, with the intent being to reduce the amount of travel time for trainees and staff members.

4) Kitchen and dining room in the Trainees' dormitory

Since the Trainees' Dormitory is small scale and there are relatively few staff (24 persons), it is doubtful whether full scale kitchen facilities and dining areas would be all that useful. However, the people have a custom of taking tea often, therefore, a canteen where tea and light meals can be served shall be installed and the kitchen shall be a pantry equipped with cooking utensils designed for this purpose. The fact that the canteen will be used as a meeting space for staff and trainees will be taken into consideration when deciding the size of the facility.

5) Concerning the garage for heavy equipment

The initial plan for the heavy equipment garage called for it to be constructed at the Godawari site, but, because maintenance could not be performed at the DPTC nor could heavy machinery be transported thereto, a substitute plan was studied relating to the possibility of constructing the garage at the site of the Heavy Machine Section of the DOR. A land-use agreement for the construction of the garage was subsequently reached between the DPTC and the DOR and, through preparation of other required documents, it was decided to construct the garage for heavy equipment in the Baneswar district. A total of 10 units including bulldozers, dump trucks, backhoes, loaders, etc. will be housed in this garage and maintenance will be carried out by the Department of Roads. (See Table 2-3-2, "Scale of heavy equipment garage" for details.)

Including the above, the requested facilities and contents were discussed with the Nepal side. As a result, it was determined that the appropriate amount of total floor area will about 3,450 m^2 against the requested total floor area of 4,050 m^2.

(2) Concerning the facility plan

Even an initial capital outlay is required, the following items were investigated in order to reduce the operation and maintenance costs and facilitate operation of the facility after termination of Project Type Technical Cooperation.

1) Water supply facilities

There are currently 50 mm and 80 mm water pipes along Pulchouk road at the DPTC's main building site and a 400 mm water main pipe was laid at the other side of Narayani Hotel. It would be possible to run a water pipe from one of these pipes. However, in such a case, only half inch size pipe would be permitted for general buildings and even for buildings which consume large amounts of water, the maximum allowable diameter would be only up to 1 inch pipe. Moreover, the Lalitpur area in Kathmandu has a water supply regulation restricting water supply to between 4:00 am and 6:30 am, and in fact that system cannot really be counted on either, as some places are supplied water and some places are not. A bus maintenance yard belonging to Sajha Yatayat, a Grant Aid facility adjacent to the site, has 2 water pipes but water is not supplied from one. Also, during the dry season, it becomes considerably more difficult to gain access to a supply of water and it has been deemed impossible to cover the demand with city water. Thus, it was decided to co-use the deep well.

2) Sewage treatment

According to the Sewage Division of the Water Supply & Sewage Corporation, a 450 mm drain pipe has been laid along Pulchouk Road, but it was stated that it is possible to connect to this line. However, it is necessary to investigate whether or not the drain pipe can be used. In Lalitpur City, sewage can be connected to a drain pipe without treatment but the public sewage treatment facility, built in 1975, is absolutely inadequate in terms of treatment capacity and raw sewage flows into Bagmati River. Furthermore, generally speaking, each facility has installed its own sewage treatment tank, allowing the water to seep into the soil naturally after treatment. With the Project, since the height of the site is lower than the drain pipe, a dedicated sewage treatment tank will be installed as at other facilities and water will be handled with natural infiltration.

3) Emergency power supply system

According to the Nepal Electrical Authority, there is an 11,000V high voltage trunk line along Pulchouk Road and it is possible to take power from this line. However, scheduled power outages are carried out at the following times during the rainy and dry seasons.

Rainy season	*6:30 pm ~ 8:00 pm	Scheduled power outages
Dry season	*11:30 pm ~ 9:00 pm	October, November & December

* as of June 1993

While the study team was staying in Kathmandu, they actually experienced brownouts each day between 6:30 pm to 8:00 pm. Moreover, in addition to scheduled power outages, accidental power failures due to such causes as electrical generating plant or transformer failures and severance of electrical power lines occur frequently, and it is forecast that these outages will affect the usage of personal computers and optical instruments.

Even with the construction of hydroelectric plants, the electrical power capacity originally planned cannot be ensured due to sedimentation upstream of the dam, and there is little likelihood that this chronic electrical power shortage will be resolved in the foreseeable future.

Therefore, it is planned to install an emergency-use power generator with a capacity of 30 KVA to supply back-up power, but only to those sections of the facility where power is absolutely required.

4) Calorifier

Nepal's climate is clearly divided into a rainy season and a dry season. Unlike Japan's rainy season, in Nepal sunlight can to a certain extent be obtained during the rainy season as well as during the dry season. For this reason, a solar panel calorifier shall be installed which does not require fuel. This type of calorifier is widely used in Kathmandu and is often found on the roofs of private houses and hotels. There seems to no problem in terms of maintenance. The circulation of hot water shall be natural circulation depending on temperature differences and water shall be supplied to the solar panel from an elevated water tank. The solar panel calorifier shall be designed in such a way that neither the pump nor maintenance will require a supply of power.

(3) Equipment construction

Equipment used by DPTC is provided under Project Type Technical Cooperation, thus a decision was made to exclude such goods from the range of Grant Aid cooperation. Since through Project Type Technical Cooperation the Government

of Japan has approved the provision of equipment through 1993, locations schedule to receive such equipment were carefully confirmed.
(See Appendix 7 for a list of equipment supplied through Project Type Technical Cooperation.)

3-2-6 Necessity for technical cooperation

Project Type Technical Cooperation for the Project was begun in October 1991 as a five-year plan and five long term experts are currently working in DPTC. Accordingly, the necessity of C/P Training in Japan and dispatch of additional experts through Grant Aid was not recognized. Refer to Section 3-3-2 for details.

3-2-7 Basic policy of cooperation implementation

Based on the above studies, it was determined that implementation of the Project with Japan's Grant Aid is appropriate because its effects, feasibility and the implementation ability of Nepal have been confirmed and the effects of the Project conform to Japan's Grant Aid Program system. Therefore, an outline of the Project will be studied on the following pages to implement the basic design on condition that Japan's Grant Aid is used. However, as explained in "Project components" and "Contents of requested facilities and equipment" sections, it is appropriate to change part of the request.

3-3 Project Description

3-3-1 Executing agency and operation system

The Ministry of Water Resources (MOWR) is responsible for the execution of the Project and the DPTC is under the control of the secretary of MOWR. (See Fig. 3-3-1 , "System of Ministry of Water Resources.")

Following the initiation of Project Type Technical Cooperation, the Joint Committee was established to ensure that the activities of the DPTC proceed smoothly and effectively. Refer to Fig. 3-3-2 for more information on this.

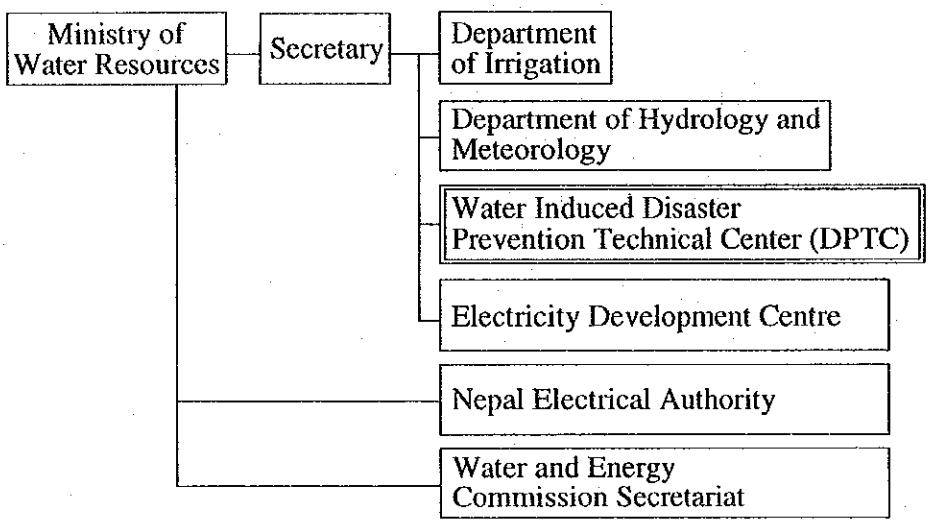


Fig. 3-3-1 System of the Ministry of Water Resources

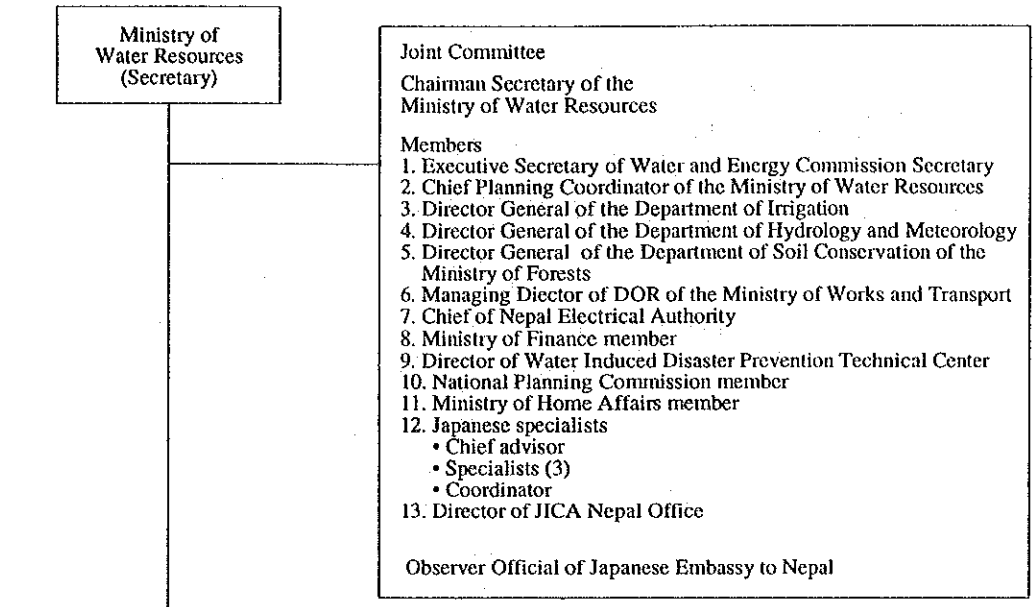
(1) Joint Committee

The major roles of the Joint Committee are as follows.

1. Evaluate the content of the annual activity report submitted by the Director of DPTC.
2. Establish the annual activity policies.
3. Provide advice for DPTC operation in terms of management and technical aspects.
4. Exchange opinions about the Project with the concerned Ministries.

The following two members were not included in the Joint Committee when it was established, but are included here to ensure smooth operation of the DPTC.

- National Planning Commission .....Member
- Ministry of Home Affairs .....Member



* Vacancy

Division / Where to belong	Administration Division	Training Division	Technology Development Division	Information Division	Total	Current state
Chief	1	1	1	1	4	4
Ministry of Water Resources	1 (4)	1 (1)	1* (1)	1 (1)	4 (7)	4 (5)
Department of Soil Conservation of the Ministry of Forests	– –	1* <	1 (1)	1 –	3 (1)	1 (1)
Dep. of Road of Ministry of Works and Transport	– –	– (1)	1 (1)	– (1)*	1 (3)	1 (3)
Itemized Totals	2 (4)	3 (2)	4 (3)	3 (2)	12 (11)	10 (9)
Grand Totals	6	5	7	5	23	19

( ) : Non Gazetted Level

Source : DPTC

Fig. 3-3-2 DPTC Joint Committee and personnel arrangement

(2) Personnel plan

Under the Director, DPTC is operated by the chief of each division – Administration, Training, Technology Development and Information, and 15 staff members allocated from the MOWR, DOSC and DOR, for a total of 20 persons (including Director). (Refer to Fig. 3-3-2, "DPTC Joint Committee and personnel arrangement" and Table 3-3-1, "DPTC staff list.")

In addition to these 20 staff members, the 5 experts comprising the Project Type Technical Cooperation team are beginning their activities. However, since the office space currently used is cramped, operations will continue under the same system until completion of the Project facilities. as shown in Fig.3-3-2, "DPTC Joint Committee and personnel arrangement," it is planned that the staff will be increased to 24 (including the Director) when the Project is completed.

With respect to the future plan, the DPTC explained that the number of operation staff and trainees will not be changed in the future, in consideration of the number of university graduates in Nepal and the staff in charge of the sabo and flood control field in each Ministry. The staff will also operate as counterparts to the Japanese experts, to teach them technologies and to lecture in the training courses.

Table 3-3-1 DPTC staff list

As of October 1993

	Name	Final education		
1.	S.P. Rimal	M.S.	[Engineering]	Director
2.	N.P. Bhattarai	M.S.	[Engineering]	Training Division Chief
3.	G.R. Joshi	M.S.	[Engineering]	Technology Development Chief
4.	B.G. Rajkarniker	M.S.	[Engineering]	Information Division Chief
5.	A.K. Pradhan	M.A		Administration Division Chief
6.	A.S. Dhakal	B.E.	[Engineering]	Assistant Engineer
7.	J.K. Bhusal	M.S.	[Engineering]	Hydrologist
8.	D.P. Acharya	M.S.	[Engineering]	Assistant Engineer
9.	B.P. Gyawali	B.E.	[Engineering]	Soil Conservation Technology Ass't
10.	L. Sunuwar	B.E.	[Engineering]	Assistant Engineer
11.	S.L. Bataju	B.E.	[Forestry]	Research Assistant
12.	B.P. Timilsena	B.S.	[B. Com]	Accountant
13.	Bimala Dhungana	I.A.		Secretary
14.	K.B. Shrestha	P.C.C.E.	[Intermediate]	Overseer
15.	B.B.K.C.	P.C.C.E.	[Intermediate]	Overseer
16.	A.M. Rimal	P.C.C.E.	[Intermediate]	Overseer
17.	K.B. Pandey	B.A.		Assistant Hydrologist
18.	C.L. Nakarmi	Engineering	[Intermediate]	Overseer
19.	C.S. Gautam	P.C.C.E.	[Intermediate]	Overseer
20.	R. H. Paneru	I.A.		Store Keeper
				Driver 4 persons
				Peon 2 persons
				Guard 3 persons
				Sweeper 1 person

Source : DPTC

3-3-2 Plan of Activities

The work plan for Project Type Technical Cooperation covers the dispatch of long and short term experts, supply of equipment, training of C/P in Japan and technology development, etc. The details are as follows.

(1) Dispatch of long term base specialists

Since Project Type Technical Cooperation started on October 7, 1991 with a 5-year plan, long term experts have been dispatched one after another based on the R/D agreement. There are currently 5 experts on duty.

- Chief advisor
- Coordinator
- Sabo : Responsible for soil conservation and watershed management

- Landslide : Responsible for protection of infrastructure from land slides and slope failure
- River engineering : Responsible for river engineering work

The major activities of those experts are as follows.

1) Technology development

Unify the domestic technologies of Nepal and contemporary technologies and develop technologies appropriate to the regional conditions of Nepal. As a part of technology development, study technical guides and also offer advice to ongoing projects in each area. Also, as a part of technology development, execute disaster prevention construction and rehabilitation measures and use this activity as a demonstration so that people become more aware of the importance of this type of construction.

2) Training

Conduct training by means of lectures, experiments and exercises to foster the emergence of Nepalese engineers who have knowledge and technique about water induced disasters.

The following training courses will be established.

① General course (aimed at engineers related to sabo and flood control of concerned Ministries)

② Advanced course (aimed at Gazzetted Class II & III middle class engineers of concerned Ministries)

③ Intensive course (aimed at university graduate level middle class engineers of concerned Ministries)

In the future, the participants in the intensive course will be DPTC staff or key individuals from within His Majesty's Government of Nepal. Participants in the advanced and intensive courses observe the construction work mentioned above or participate in the work as a part of their exercises.

3) Database

Build a database for prevention of water induced disasters and rehabilitation.

(2) Dispatch of short term experts (1992 /93)

It is planned to dispatch short term experts to cover fields which cannot be covered by long term experts. The 1992/93 dispatch plan and record of short term experts is shown in the following table.

Table 3-3-2 1992/93 short term experts dispatch schedule

No.	Field	Record
1.	Sabo Planning (1)	September 17 – 29, 1992
2.	Sabo Planning (2)	March 6 – 13, 1993
3.	Watershed Management	March 6 – 13, 1993
4.	Landslide and Slope Failure	March 16 – 28, 1993
5.	Hydraulic experiment	December 20, 1992 – January 10, 1993
6.	Landslide experiment	March 6 – 13, 1993
7.	Computer database (1)	March 6 – 19, 1993
8.	Hydraulic experiment	January 5 – 31, 1993
9.	Hydrological equipment	March 16 – 28, 1993

(3) Supply of equipment

Equipment supplied began in October 1991 with the beginning of Project Type Technical Cooperation and the following major equipment has already been supplied. The equipment earmarked for 1992 was delivered to JICA in July 1993, and the equipment for 1993 has not been supplied yet because it was just approved by the Government of Japan and the appropriate procurement procedures have to be followed. Since Project Type Technical Cooperation is proceeding in a small rental office and there is not enough space for the supplied equipment, a small house has been built using equipment packing materials and part of the hydraulic experiment equipment is stored in this house. More equipment will be supplied in the future and safe storage must be found for that equipment, the early completion of the Project is desired.

The following major equipment has been supplied thus far:

① Equipment for hydraulic model test
② Equipment for field survey
③ Equipment for exercises
④ Equipment for creating a database
⑤ Equipment for soil testing
⑥ Equipment for concrete testing
⑦ Equipment for rock testing
⑧ Audio visual equipment
⑨ Vehicles
⑩ Other

Refer to Appendix 6, "List of furnished equipment" for more details.

(4) Training of C/P in Japan

Counterpart training was conducted in Japan in 1991/92 and more such training is planned in the future. The two tables below explain this already conducted training in more detail.

Table 3-3-3 1991/92 counterpart training

* As of June 1993

F.Y.	Name	Position	Duration	Training subjects
1991/92	Mr. H.M. Shrestha	Chief Planning Coordinator, Ministry of Water Resources	15 Feb. to 28 Feb. 1992	Project Management, Sabo Planning, River Engineering, Road Maintenance
	Mr. R.K. Mahato	Superintendent Engineer, Department of Irrigation, Ministry of Water Resources	Same as above	Same as above
	Mr. K.B. Malla	Director General, Department of Soil Conservation and Watershed Management, Ministry of Forest and Environment	Same as above	Same as above
	Mr. V.P. Shrestha	Deputy Director General, Department of Roads, Ministry of Works and Transport	Same as above	Same as above

Table 3-3-4 1992/93 river and dam technology group training course

* As of June 1993

F.Y.	Name	Position	Duration	Training subjects
1992/93	Mr. J.K. Bhushal	Hydrologist DPTC	01 Sep. 1992 to 30 Nov. 1992	Sabo Planning, River & Landslide Engineering

(5) Master Plan for Project Type Technical Cooperation

Project Type Technical Cooperation that began October 1991 was planned by the long term experts currently stationed in Nepal and the training and exercises were conducted during the basic design study based on the Master Plan. (See Appendix 7 for the Technical Cooperation Master Plan.)

(6) Curriculum of the training course

① Curriculum of general course (training contents implemented are explained)

Initially, a 2-week training period was planned but the Standard course training conducted in 1992 lasted 19 days and a 3-week training period is planned to begin in 1993.

Purpose : Trainees master basic technologies for handling water induced disasters

Subjects : Engineers related to sabo and flood control works of each Ministry

Period : 1–2 times/yr for 3 weeks (once). Implemented from Sept. 6–24, 1992.

Capacity : 5–10 trainees Number of participants : 12

Table 3-3-5 Curriculum of standard course

	Date	Location	Description
1 2 3	Sept. 6 Sun 7 Mon 8 Tue	Lecture room	Orientation, opening ceremony, special lecture Types & causes of water induced disasters, special lecture Policies & activities of HMG/N for disaster prevention/ preparedness
4	9 Wed	Disaster area	Field trip to areas recently struck by disasters
5	10 Thu	Day off	
6	11 Fri	Lecture room	Water level gauge, rain gauge and extensometer installation method and data organization and analysis. Investigation of landslide and collapsed area. Actual river condition investi-gation and data organization and analytic hydrology study.
7	12 Sat	Day off	
8	13 Sun	Lecture room	Same as above.
9	14 Mon	Lecture room	Sabo engineering
10	15 Tue	Lecture room	Same as above.
11	16 Wed	Lecture room	Landslide engineering
12	17 Thu	Lecture room	Same as above.
13	18 Fri	Lecture room	River engineering
14	19 Sat	Day off	
15	20 Sun	Lecture room	River engineering
16	21 Mon	Disaster area	Field trip to areas recently struck by disasters
17	22 Tue	Lecture room	Construction materials (for flood & sabo control)
18	23 Wed	Lecture room	Discussion of each subject, questionnaire
19	24 Thu	Lecture room	Examination, course evaluation, closing ceremony

[Lecturers]

Employer	No. of lecturers	Classes
DPTC Nepalese staff DPTC Japanese Experts	7 4	20 21
Outside lecturers Japanese short-term experts Other supporting organization Related Ministry staffs	12	13

② Advanced course curriculum (training contents already implemented are explained)

Purpose : Trainees master the application technologies to promote works to handle water induced disasters.

Subjects : Middle class engineers with Gazetted Class II and III level of each Ministry (local organizations are included).

Period : Once a year for 3 months (one time). Implemented from April 5 to June 10, 1993. (The implemented curriculum is shown below.)

Capacity : 5 trainees Number of participants : 7

Table 3-3-6 Curriculum of advanced course

Week	Place	Description
1	Lecture room	Opening ceremony/lecture (type and cause of disasters, preventive measures, survey, project, DPTC activities, concept of disaster management Activities of related Ministries
2	Lecture room	Condition of landslide and its preventive measures/ landslide measurement method, background and concept of sabo control technology. Basic concept of soil conservation. Occurrence and cause of deposit and its measurement method.
3	Lecture room	Lecture about hydrometeorology
4	Disaster area	Observation trip to Kurekani River disaster area
5	Lecture room	Lecture about river engineering technology
6	Lecture room	Lecture about landslide prevention Landslide prevention plan exercise Hydraulic experiment
7	Disaster area	Observation trip to Barganj and Pokhara disaster areas
8	Lecture room	Construction equipment material test exercise Exercise for each field Preparation of training report
9	Lecture room	Preparation of training report Announcement of training report Test Closing ceremonies

③ Intensive course curriculum (ongoing)

The initial plan called for a 12-month training period but this was shortened to 9 months.

Purpose : Education of technical staff of the DPTC and engineers who engage in related work in the main Ministry.

Subjects : Middle class engineers (university graduate level) from related Ministries

Period : 9 months. Implemented Jan. 3 to Sept. 30, 1993. (Ongoing.)

Capacity : 5 trainees Number of participants : 3

Table 3-3-7 Curriculum of intensive course

Duration	Location	Description
3 months	DPTC	The participants engage in daily OJT, performing the same work as DPTC staff, and prepare training plans, technology development, and information correction.
3 months	DPTC	The participants join the advanced course.
3 months	DPTC	Detailed design of project by subject

(7) Activities conducted by the DPTC

1) Development of sabo and flood control technology and construction methods suitable for Nepal

The purpose of this activity is to develop technical methods appropriate for the current conditions in regional areas by combining modern sabo and flood control technology with local domestic technology, and its objectives can be achieved through such activities as research on indigenous technologies, sedimentation/flooding damage studies, and design of drainage basin conduits, dams and irrigation systems. To conduct these activities in a comprehensive manner, a pilot project will be selected, and the undertaking of a series of activities will enable the transfer of technology to the Nepalese staff and trainees and, at the same time, benefit the development of sabo and flood control technology and construction methods.

The candidate sites that have been selected followed by the reasons therefor are listed and explained below.

① Sites designated for sabo engineering

a. Nakhu Khola site

This river that flows past this site is a tributary of the Bagmati River, and it further branches into the Lele Khola and Nallu Khola rivers in the Lalitpur district and the upper reaches of Tikabhairav. This watershed is

also included as part of the area under the Bagmati Watershed Management Project of the Department of Soil Conservation and Water Management by means of assistance from the EEC. In September 1981, this river was the scene of a tremendous disaster due to floating debris carried by the flooding of the Nallukhola and Lelekhola rivers. The DPTC is considering whether this river can be a water supply source to Lalitpur and Kathmandu.

b. Trisuli site

This area has been designated as a sabo technology demonstration site of the Department by the Department of Soil Conservation and Watershed Management in 1989. Cutting down of trees in this area had proceeded and the area was devastated. However, the Department implemented afforestation and constructed a barrage. The Technology Development Division and Public Relations Division of the department made a request to DPTC that they want to use Japan's "PNC block method" for wall protection as the barrage.

c. Shiwarlik site

The soil of the Shiwarlik site is weak, causing substantial deposits in the river which becomes a factor in floods across a wide swath of land to the Terai Plain and India. Despite this fact, this situation has been studied very little.

② Sites of landslide technology activities

The following areas were selected for landslide technology studies:

Trisuli Road, Prisby Highway, Alnico Highway and Rupandihi district in the west state

a. Location at 48 km along the Trisuli Road from Kathmandu

Even compared with similar areas, the occurrence of landslides is particularly frequent in the area surrounding this location. The scale of such landslides is often large, and it feels as if the entire hill is moving. Landslides occur anywhere on the road, changing the position of the breast wall; trees are twisted due to the landslides and many cracks have appeared in the road. Irrespective of this dangerous situation, no countermeasures have ever been implemented.

b. Location at 19 km along Trisuli road from Kathmandu

The volume of traffic on the Kathmandu–Trisuli road has increased in recent years due to increases in travelers going to Cacan. However, frequent landslides occurring in the middle of this site block the road, a

situation that worsens in the monsoon season. Irrespective of this, nothing has been done to deal with the situation at this location.

c. The upper reaches of Butwal along the Tinau River
Many landslides occur along the road fronting the Tinau River. In particular, a large-scale landslide that occurred on Sept. 10, 1978 at the upper reaches of Butwal washed away bridges and plugged the Tinau River with sedimentation. Irrespective of this, nothing has been done to deal with the situation at this location.

③ Sites of river technology activities

The following areas were selected for river technology studies.

a. Bagmati River

Location : Bishnumati, 5 km upstream from Ring Road and Manohara Bridge.

Reasons for selection

- Decreases in the riverbed may destroy the pier, and groundsills of gabions have been installed on the foundation as a temporary measure. Riparian works are urgently needed to keep the flow of the river at a constant position.
- The existing embankment and bank are unstable because of decreases in the riverbed. Great damage can be expected in the event of a large-scale flood.
- Construction of new housing on the riverbank and water supply reservoir has been accelerated. It is therefore necessary to create a flood prevention plan which covers government sites and private lands in order to prevent erosion of the housing area near the riverbank.
- Parking lot sites in the urban area are insufficient, and it is planned to use the riverbank as parking space, creating the need to examine the area.
- This location is close to DPTC, thus is convenient for OJT and technology development activities.

2) Advice on ongoing projects

DPTC made a proposal to the Department of Roads concerning the protection of the foundation of 7 bridges in Kathmandu Valley. This proposal was summarized in the *Proposal and Inspection Report for Seven Bridges in Kathmandu Valley.*

3) Preparation to draft technical standards

Technical materials in Nepal on sabo and flood technology were collected as the first step in drafting technical standards. The collected data is as follows:

① Sabo and Soil Erosion

a. *Notes on Soil Erosion, Basic Structure Specifications and Planting Control Method, Watershed Control & Conservation Education Project*
   - Department of Soil Conservation & Water Management, June 1983.

b. *Field Measurement Method of Erosion and Sedimentation in Nepal*
   - Watershed Management Strong Current Control and Land Use Development Comprehensive Project, Department of Soil Conservation and Water Management, Feb. 1988.

c. *Channel Design in Watershed Control*
   - Written by S. Baidya, Department of Soil Conservation & Water Management, Feb. 1988.

d. *Calculation Manual of Barrage*
   - Written by Vern Handhiller, Department of Soil Conservation and Water Management/technical support from Switzerland, Sept. 1979.

② Landslides

a. *Prevention and Control of Landslides*
   - Watershed Management/Conservation Education Project, Department of Soil Conservation and Water Management, 1985.

b. *Mountain Risk Technical Handbook*
   - Part 1, 2 and guide version , ICIMOD, May 1991.

c. *Planting Structure for Safe Highway Slopes*
   - Department of Roads, March 1991.

③ River technical training and flood restoration measures

a. *Design Manual of River Technology Training in Nepal*
   - Water and Energy Commission Secretary 1988.

b. *Guideline of River Technology Training in Nepal*
   - Department of Roads, Feb. 1990.

c. *Manual of River Technology Training and Deposit*
   - Department of Irrigation, Feb. 1990.

④ Other

a. *Method of Hill Irrigation Project Environmental Protection in Nepal*
   • Department of Irrigation, Irrigation Sector Support Project.

b. *Manual of Survey, Design & Construction for Small Hill Irrigation Systems in Nepal*
   • Hill Agriculture Development Project

   Syncarama Irrigation Program, Department of Irrigation.

4) Conductance of model exercises in the hydraulic experiment building

Using channel of gentle slope, channel of sleep and changeable slope and landslide experimental equipment, exercises were conducted on the mechanisms behind the appearance of floods, avalanches of rocks and earth and slope failures.

5) Information Division Activities

① Preparations for constructing a data base

The following materials have been collected as relevant references and data in preparation for building a database.

a. Reference books, reports, texts, maps (elevation figures, stratum figures, land use figures, etc.) aerial photographs, videotapes, slides, and so forth.

b. Observation reports from stricken areas and the 1992 disaster record

② Public information

A DPTC pamphlet was issued and distributed to government offices concerned with disasters, and to international organizations, NGOS and foreign support organizations.

③ Other

a. Reports were issued for each field survey.

b. Information exchange

   A liaison window was established for information exchange between Nepal and foreign organizations.

The activities outlined above are a description of DPTC's activities thus far and the development of further enlightened activities is planned in the future.

3-3-3 Locations and conditions of Project sites

(1) Locations of Project sites

- Pulchouk site

  The Pulchouk site, upon which the DPTC's main building and trainees' dormitory are to be built, is located in the Pulchouk area in the central area of the Lalitpur municipality in the old capitol district to the south of Kathmandu and on the opposite side of the Bagmati River. On the south side of the Project site lies the five-story Narayani Hotel; on its north side is Sajha Yatayat Bus Maintenance Yard, which was constructed through the Public Transportation Improvement Project, assisted by Grant Aid from Japan. On the west side runs Pulchouk street, a busy, two lane road that serves as a main thoroughfare.

- Godawari site

  The technology development building will be located at the Godawari site, roughly 10 kilometers south (about 20 minutes by car) of the Pulchouk site – the site where the main building will be constructed – on the same tract of land that a laboratory for hydrological studies (hydraulic laboratory) has already been built through Project Type Technical Cooperation.

- Baneswar site

  The industrial garage will be built at a site in Baneswar, where the maintenance building of the Machine Section of the Department of Roads of the Ministry of Works and Transportation has been built at this site. This site is 2 km to the northeast from the Pulchouk site and it takes about 10 minutes to get there from Pulchouk by vehicle.

(2) Conditions at Project sites

- Pulchouk site

  Situated on the same tract of land as the Pulchouk site are two other facilities: the head offices of the Ministry of Local Development and the offices of the Suspension Bridge Division, Department of Roads, Ministry of Works and Transportation. The proposal to the Ministry of Water Resources to allocate approx. 2,860 m^2 for this Project on the western side of this tract was formally approved at the Cabinet Meeting on December 3, 1992. (See Appendix 5, "Notice of Cabinet Decision on Using Proposed Construction Site.")

  The building comprising the five-story Narayani Hotel extends nearly to the tract's southern boundary, and Pulchouk street runs along the west side of the tract. This road is a wide, two lane thoroughfare with heavy traffic. There is an approximately three meter wide strip of trees planted between the tract and Pulchouk street, obstructing one's view from the street of the inside of the

compound. In addition, there is an approximately 3.0 m height difference between this road and the site on the southern side, and a 1.5 m difference on the northern side. (See Appendix 9, "Survey Maps" and Appendix 10, "Project Site Photos.")

There is a plan to establish a new access road, to be co-used by three facilities, the DPTC, the main office of the Ministry of Local Development and the Division of Bridges, Department of Road, Ministry of Works and Transportation. The width established for this access road must be left between the buildings of the DPTC and the Division of Bridges. In view of the fact that the date the access road will be constructed is as yet undetermined, access/usage rights to the existing access road as well as to off-site land for equipment and material storage, a temporary work office and a work shed was confirmed with the Ministry of Local Development.

- Godawari site

  The Godawari tract is owned by the Ministry of Water Resources, and a hydraulic laboratory and a common use building have already been constructed on this tract through JICA project infrastractural upgrading disbursement of Project Type Technical Cooperation.

  The tract is divided down the centre into northern and southern sections. The northern section, which is about 1.5 m lower than the southern section, is dominated by the hydraulic laboratory. The southern section is the site of the common use building and a material storeroom, limiting the area in which it is possible to construct the facilities of the Project to the southwestern portion of the tract. (See Appendix 9, "Survey drawings of the Pulchouk and Godawari Sites" and Appendix 10, "Project Sites Photos.")

- Baneswar site

  This site is owned by the Department of Roads of the Ministry of Works and Transport. Because an approval letter for the construction of the industrial garage of the DPTC was issued to DPTC and decided to construct the garage in this site. Since the maintenance yard of the Department of Roads has been built at this site, the maintenance of the DPTC's heavy machines will be carried out here. There is a vacant lot behind the maintenance building, thus this lot will be borrowed to build the DPTC's industrial garage. (See Appendix 10, "Project Sites Photos.")

(3) Natural conditions of Project area

Both Pulchouk, Baneswar and Godawari, the planned construction sites, are situated in basin areas, and meteorological conditions at the three sites are very

similar. There is little mean monthly temperature variation, with Kathmandu experiencing a mean average low of 10.4°C in January and a mean average high of 24.3°C in August. The mean yearly temperature variation is roughly 14°C. As a reference, in Tokyo the mean average low is 3.2°C in January, the mean average is 26.4°C, and the mean yearly temperature variation is roughly 23°C.

Inspection of precipitation levels depicted in Fig. 3-3-3 reveals that Kathmandu has a mean yearly precipitation of roughly 1,426.1 mm per year, and that a clear delineation exists between the rainy season, which extends from June to the end of September, and the dry season, which runs from October to May, due to the subtropical monsoon weather pattern experienced by the region.

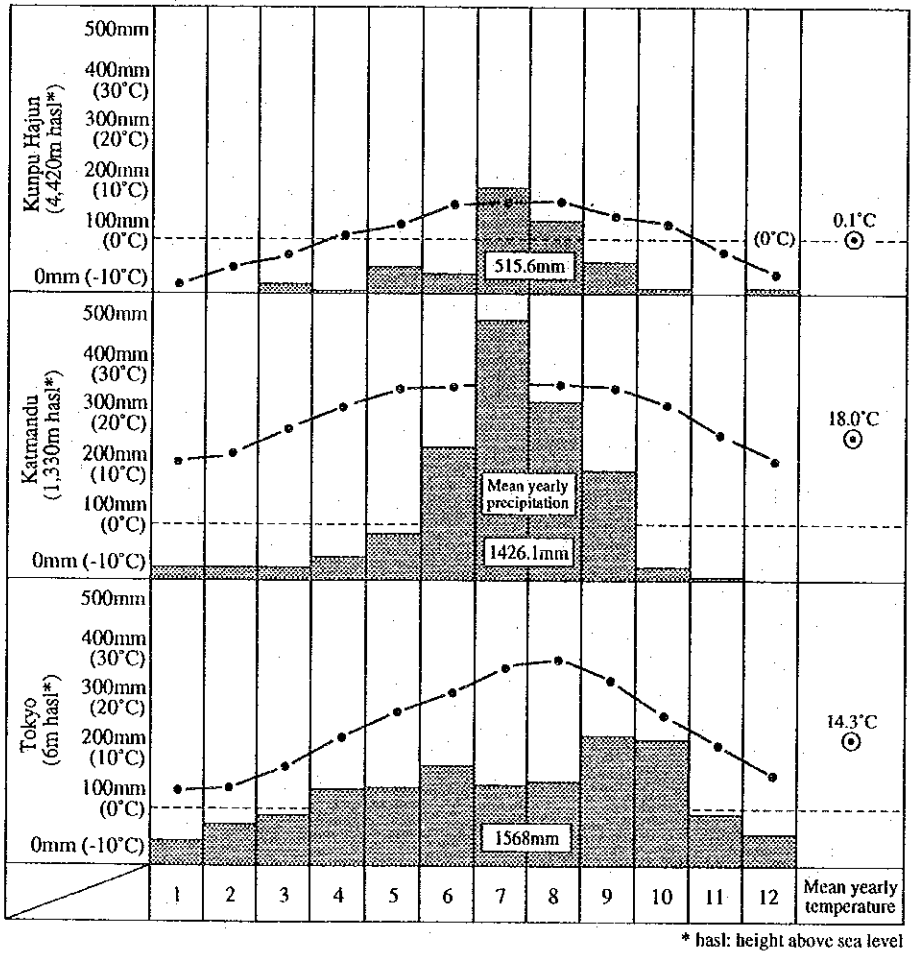


Fig. 3-3-3 Temperature and rainfall variation in the Sagarumata Foothills, Katmandu and Tokyo

As revealed in Fig. 3-3-3, precipitation is concentrated in the rainy season from June to September, and only small quantities of rain fall during the other months. Unlike the rainy season in Japan, rain falls heavily for two to three hours per day, followed by the full glare of the sun. Due to the meteorological conditions cited

above, the building plan must incorporate measures to deal with the heavy rain and strong sunshine.

(4) Condition of infrastructure

1) Water supply

- Pulchouk site

Water pipes of 50 mm and 80 mm have been laid along the Pulchouk road facing the site. Also, the main 400 mm water pipe has been laid along the road on the south side of Narayani Hotel. It is possible to run in a water pipe from any of these existing pipes. However, since the water pipes in Kathmandu and Lalitpur are old and leaky, the situation has become so severe that water is supplied only from 4:00 am to 6:30 am even during the rainy season. Furthermore, water levels in the water source drop during the dry season, thus the water supply is even more restricted. The water source is a reservoir in Pharping 12 km southwest of Lalitpur. According to NWSC, general buildings use half inch pipe and even buildings using a lot of water are only allowed to use up to 1 inch pipe.

Sajha Bus (facilities built with Grant Aid) has two water pipes but one pipe does not supply water. It is in fact in doubt in this Project whether water can be supplied during a limited water supply period.

- Godawari site

Godawari tract receives water from Nodara reservoir with no restrictions in effect, thus it can be thought that city water will cover this aspect of operation.

2) Drainage

- Pulchouk site

A 450 mm sewage drain pipe has been laid at the Pulchouk site. However, since a sewage treatment facility has not been constructed (it has not been determined when construction will commence), untreated sewage is released into Bagmati River. From an environmental contamination point of view, care must be exercised with regard to use of this sewer. A drain has been constructed on one side of the Pulchouk road and it is connected to Bagmati River as well. Regarding drainage of rainwater, a perimeter ditch must be dug around the site and a method must be examined whereby rainwater that exceeds the capacity of this perimeter ditch is discharged to the roadside gutters, such as by pumping the water or some other method.

- Godarawi site

A Hydraulic Laboratory and a common building have already been constructed on this tract and lavatories, shower facilities and a purification tank have been constructed. For this reason, the Project will use the existing shower and lavatories, thus similar facilities will not be installed in the Technology Development Building.

3) Electricity

Operating under the jurisdiction of the Pulchouk branch office of Nepal Electricity Authority, the Lalitpur power station receives 66,000V from Teku service station which is stepped down to 11,000V and distributed to each town. From there, an 11,000 V high voltage line is installed along the Pulchouk road; it is therefore possible to lead in a power line from this trunk line. Though the supplied capacity seems sufficient for Project implementation, it may be necessary to implement countermeasures designed to deal with voltage drops, frequent power outages, and open phase current, etc.

Rainy season	*6:30 pm ~ 8:00 pm
Dry season (Oct, Nov & Dec)	*11:30 pm ~ 9:00 am

* : As of June 1993

4) Telephone

According to the Lalitpur branch office of the Nepal Telecommunications Corporation, a telephone line has been laid along the Pulchouk road and up to 3 lines can be allocated for government-related facilities. A lead in line will be branched from a switch box at the north side of the site.

3-3-4 Outline of facility

(1) Facilities

Regarding the overall scope of the facilities, the number of required rooms and size of each were initially established based on the personnel placement and operation plans, and final figures were formulated in discussions held with officials concerned upon consideration of a study comparing the initially established scope with the facility scope request submitted by His Majesty's government of Nepal. Of a total requested floor area of 4,050 m^2, it was judged feasible for the facilities to comprise an area of roughly 3,446 m^2. The table below presents the required rooms and sizes according to facility division.

Table 3-3-8 Outline of facilities

[Main building]

Room name	Requested by Nepal	Determined by study	Remarks
• Administration Division			
Director room	1 rm x 1 person	1 rm x 1 person	Includes visitor receiving space
Chief adviser room	1 rm x 1 person	1 rm x 1 person	Includes visitor receiving space
Secretarial room	1 rm x 1 person	1 rm x 1 person	Includes visitor waiting area
Meeting room(1)	1 rm	1 rm x 4 persons	Used by Director & Chief Adviser
Meeting room(2)	1 rm	1 rm x 30 persons	
Office (1)	1 rm	1 rm x 4 persons	Office of Administration Division
Office (2)	1 rm	1 rm x 4 persons	For coordinators
• Technology Development Division			
Researchers room	1 rm	1 rm x 8 persons	
Design & drafting room	1 rm	1 rm x 2 persons	
• Training Division			
Office	1 rm x 6 persons	1 rm x 7 persons	
Lecturers room	1 rm	2 rms x 2 persons	
Fieldwise training room	1 rm x 20 persons	3 rms x 7 persons	
Lecture/seminar hall	1 rm x 100 persons	1 rm x 60 persons	Modified to accommodate 60 persons instead of 100. Furnished with movable partitions to divide the room into two research rooms
• Information Division			
Office	1 rm	1 rm x 6 persons	
Data processing room	1 rm	Contains 3 PCs	Moved from Technology Development Building
Library	Reading space for 15 persons + stack space for 10,000 books / periodicals	Reading space for 10 persons + stack space for 10,000 books / periodicals	
Preparation room	(Not requested)	1 rm	
• Miscellaneous			
Machine room		Depends on equipment layout	
Carport		6 cars	
Driver waiting room		1 rm x 6 persons	
Hall	35% of floor area		
Corridor, storage			
Stairwell, storeroom			
Kitchen, porch, etc.			

[Training building]

Room name	Requested by Nepal	Determined by study	Remarks
Bedroom (A-type)	30 rms	8 rms	Common toilets/showers
Bedroom (B-type)		2 rms	With toilet & shower Revised to total 10 rooms
Office	1 rm	1 rm	For reception room
Canteen	Dining area	1 rm x 40 persons	To be used as a gathering space as well
Balcony			
Hall, restrooms			
Stairwell, corridor			
Storage, etc.		35% of floor area	
Laundry room, store-room, etc.			

[Technology development building]

Room name	Requested by Nepal	Determined by study	Remarks
Soil testing laboratory	1 rm	1 rm	
Concrete testing laboratory		1 rm	
Garage Material storage	1 rm	1 rm	To store equipment and materials
Workshop	1 rm	1 rm	To maintain equipment
Garage (heavy equipment)		To be constructed in Machine Section of Dept. of Roads, Ministry of Works & Transport	
Stairwell, hall			
Storeroom, etc.			
AV room	1 rm	Relocate to Training Div. in Main Bldg.	
Lecture room	1 rm		

3-3-5 Operation & maintenance plans

(1) Operation plan

Upon completion of building work and transfer of the DPTC to His Majesty's Government of Nepal, staff and equipment from the current office will be transferred thereto, new personnel added, and facility operation commenced. Although, having already secured the acquisitions and staff required, the Project Type Technical Cooperation Team and employees of the DPTC are currently operating the facilities and performing training activities at the DPTC, in view of the fact that the new centre is larger in scope and that such equipment as electrical

power generators, deep well equipment and solar hot water equipment will be installed, maintenance personnel must be hired prior to completion of construction so that they can be present at equipment installation and to hear explanations of equipment operation at time of facility transfer.

In addition, with respect to the operation budget allocated by the MOWR, it is vital to take budget steps estimating the scope of the facility and its staffing requirements in order to ensure that maintenance and management of the facility are carried out in an efficient and proper manner.

(2) Facility maintenance plan

1) Buildings

There are three main requirements for building maintenance: enforcing regular cleaning practices, reconditioning facilities to prevent wear, breakage and aging, and security and guarding the grounds with the aim of maintaining safety and preventing crime.

The strict enforcement of regular cleaning practices exerts beneficial effects on the behavior of the users and induces respectful treatment of the facilities. Cleaning is also crucial to maintain the degree of cleanliness required in its function as a training facility. In addition, through early detection of breakdowns and faulty operation, repairs can be performed quickly, helping to ensure a longer service life for facility and research equipment.

Reconditioning will mainly be a matter of repairing and upgrading the interior and exterior finishing materials that protect the structural integrity of the buildings. Based on actual historical examples in Japan, the need to recondition and/or refurbish due changes in performed activities and/or staff increases is estimated to occur once every ten years. Although the specifics of periodic inspection and reconditioning to ensure the service life of the buildings will be presented in the form of a maintenance manual at time of facility transfer, a capsulation of periodic inspection items is presented below.

Table 3-3-9 Summary of periodic inspection items

[Exterior]	
• Reconditioning/repainting of exterior finish	Once every 5 years
• Reconditioning/repainting/inspection of shingles	Inspection : Once a year Other : Once every 5 yrs
• Spot reconditioning/inspection of roof waterproofing	Inspection : Once a year Other : As required
• Periodic cleaning of gutters and drains	Once a month
• Inspection/reconditioning of circulation seals for exterior windows and door frames	Once a year
• Repainting of exterior windows and door frames	Once every 5 yrs
• Periodic inspection and cleaning of roadside gutters and manholes	Once a month
• Repainting of outer perimeter fence	Once every 5 yrs
• Periodic supervision of landscaping and planting	As required
[Interior]	
• Interior modifications	As required
• Reconditioning and repainting of interior walls	As required
• Re-affixing of interior ceiling material	As required
• Tightening of household fixtures, replacement of household fittings	Once a year Other : As required

With respect to guarding and securing the grounds, it is crucial that a check be made on users passing to and from the facilities, as well as between divisions of the facilities. Moreover, it is important to establish a security system to prevent the theft of research and training equipment.

2) Architectural facilities

With respect to architectural facilities, in addition to regular operating maintenance and periodic inspections, such maintenance as repair of broken down equipment and replacement of parts is required. Service life of facility equipment does not dependent solely on actual operating time; it can reliably be extended through proper operation and regular inspection, oiling, adjustment, cleaning, and reconditioning. Moreover, effort must be exerted to anticipate and prevent the occurrence of breakdowns and accidents, to preclude adversely affecting the integrity of the building proper, and to maintain facility safety. Regarding periodic inspections, disassembly reconditioning and wear part replacement will be performed in accordance with the maintenance manuals.

Management personnel must be well-versed in the designed components, capabilities and operation of the systems, and must effect a preventative system that anticipates and prevents the occurrence of breakdowns. It is recommended that the engineers employed for the electrical, air conditioning/ventilation, plumbing and special facilities systems be stationed on-site full time as

maintenance staff. Moreover, it is crucial they become thoroughly familiar with the facility systems by receiving on-site training from the equipment installation and adjustment stage to the time of facility transfer. Although operating and management manuals will be supplied at time of facility transfer, the general useful service life of the main equipment is tabulated below.

Table 3-3-10 Useful service life of equipment

[Electrical system]	
• Generator	15 ~ 20 years
• Distribution panel	20 ~ 30 years
• Fluorescent lamp	5,000 ~ 10,000 hours
• Incandescent lamp	1,000 ~ 1,500 hours
• Telephone switchboard	40 years
• Close-circuit broadcast system	10 ~ 20 years
[Plumbing facilities]	
• Pumps, lines, valves	10 ~ 15 years
• Tank	15 ~ 20 years
• Sanitary ware	25 years
• Fire extinguishing apparatus	20 years
• Gas fittings	6 years
• Sewage treatment equipment	7 years
[Air conditioning facilities]	
• Air duct	10 ~ 15 years
• Blower	10 ~ 15 years
• Air conditioning equipment	5 ~ 10 years

(3) Equipment maintenance plan

Although equipment is not being provided through the Project, as a point of principal, it is crucial that sufficient attention be directed to the following items when maintenance is performed.

1) Equipment

There exists equipment with which care must be exercised when installing, such as equipment that is easy to damage, equipment composed of precision parts, or equipment easily affected by vibration, shock, or temperature and humidity.

In view of the above, although assigning DPTC users to carry out general maintenance work on simple machinery should pose no difficulty, the periodic maintenance, inspection and repair of high grade machinery that requires a certain level of technical proficiency must be carried out by specially trained engineers.

For the reader's reference, presented below is an overview of general periodic inspections:

Table 3-3-11 Overview of periodic inspections of various types of equipment

	Performed In DPTC	Outsourced
General laboratory equipment	Clean once a month, inspect 2 times/year	Only when a breakdown occurs
Analysis instruments	Regular cleaning, inspect 4 times/year	1 time/year
Spectrometric instruments	Regular cleaning, inspect 1 time/month	2 times/year
Precision instruments	Regular cleaning, inspect 1 time/month	3 times/year
Audiovisual equipment	Regular cleaning, inspect 1 time/month	2 times/year
Printing equipment	Regular cleaning, inspect 1 time/week	3 times/year

2) Spare parts

Managing personnel shall systematically and consistently stock spare parts required for centre activities and ensure these parts are properly supplied to various sectors.

As it is thought likely that obtaining the spare parts that cannot be procured within Nepal will require much time, purchasing arrangements for such parts must be carried out with ample time to spare.

(4) Provisional calculation of operating and maintenance costs (rough estimate)

After completion and transfer of the DPTC, the operation and maintenance costs required by the Nepal side will be provisionally calculated. Outlays will be categorized into personnel costs, facility operating costs, facility/equipment maintenance costs, wear parts costs, and activity costs.

1) Personnel costs

Below, personnel costs at time of commencement (1995) will be calculated based on the personnel plan submitted by Nepal. Referencing to the data provided by Nepal, the average yearly income was estimated assuming a 10% increase in salaries at the time the facilities are opened.

Project Director	(Gazetted Class-I)	Rs5,500 x 1 x 13 =	71,500
Managerial Personnel	(Gazette Class-II)	Rs4,500 x 4 x 12 =	234,000
Officers	(Gazetted Class-III)	Rs3,500 x 8 x 12 =	364,000
Ordinary	(Non-Gazetted Class-I)	Rs2,500 x 13 x 12 =	422,500
Peon, Guard, etc.		Rs2,500 x 12 x 12 =	234,000
		Total =	Rs1,326,000

2) Facility operating costs

Yearly operating costs were calculated based on estimated usage volumes of electricity, telephone, and water.

① Electricity costs

a. Estimate of maximum electrical power usage

The load capacity of these facilities is estimated to be 175 kVA, and a transformer with an estimated capacity of 200 kVA is planned.

b. Estimate of typical electrical power usage

• Electric light outlets	48kW × 0.7 × 7 hours × 25 days = 5,880 kWh
• Air conditioning/ general power	83kW × 0.6 × 7 hours × 25 days = 8,715 kWh
• Lab/training equipment	21kW × 0.4 × 7 hours × 25 days = 1,470 kWh
	Total = 16,065 kWh

c. Estimated power demand

(Estimated capacity of electrical power) × (Power factor) =

200 kWA × 0.8 = 160kW

d. Estimate of charges

• Demand power charges (monthly)	160kW × 50 Rs/kWh	=	8,000 Rs
• Charges (monthly)	16,065kWh × 3.6 Rs/kWh	=	Rs57,834
• Yearly electrical	(Rs8,000 + Rs57,834) × 12	=	Rs790,008/yr
Sales tax 20%			Rs158,001/yr
charges			948,009
		≈	Rs950,000/yr

② Telephone costs

Local telephone charges are Rs180/month (up to 100 calls); additional calls cost Rs2.0 per call, and it is estimated that the total cost will be Rs750/month per line. DPTC will have three lines, therefore:

(Base charge Rs180 + additional charge Rs820) x 3 lines x 12 months = Rs36,000/yr

③ Water costs

Monthly water	10 m^3/day × 25 days/month = 250 m^3/month
charge	250 m^3/month × Rs8/m^3 × 12 month = Rs24,000/year

The DPTC's water supply is sourced from both city water and well water; however, it is planned to receive city water whenever possible, and reserve well water for supplemental use.

3) Facility / equipment maintenance costs

① Facility maintenance cost

Although building reconditioning costs fluctuate widely from year to year, the yearly reconditioning cost averaged over a 30-year span was provisionally estimated to be Rs50/m^2 for DPTC and Rs30/m^2 for Hydraulic Lab of floor area.

DPTC	Rs50/m^2 · year × 3,251 m^2	=	Rs162,550/year
Hydraulic	Lab. Rs30/m^2 year x 740 m^2	=	Rs22,200/year
	Total		Rs184,750/year
		≈	Rs185,000/year