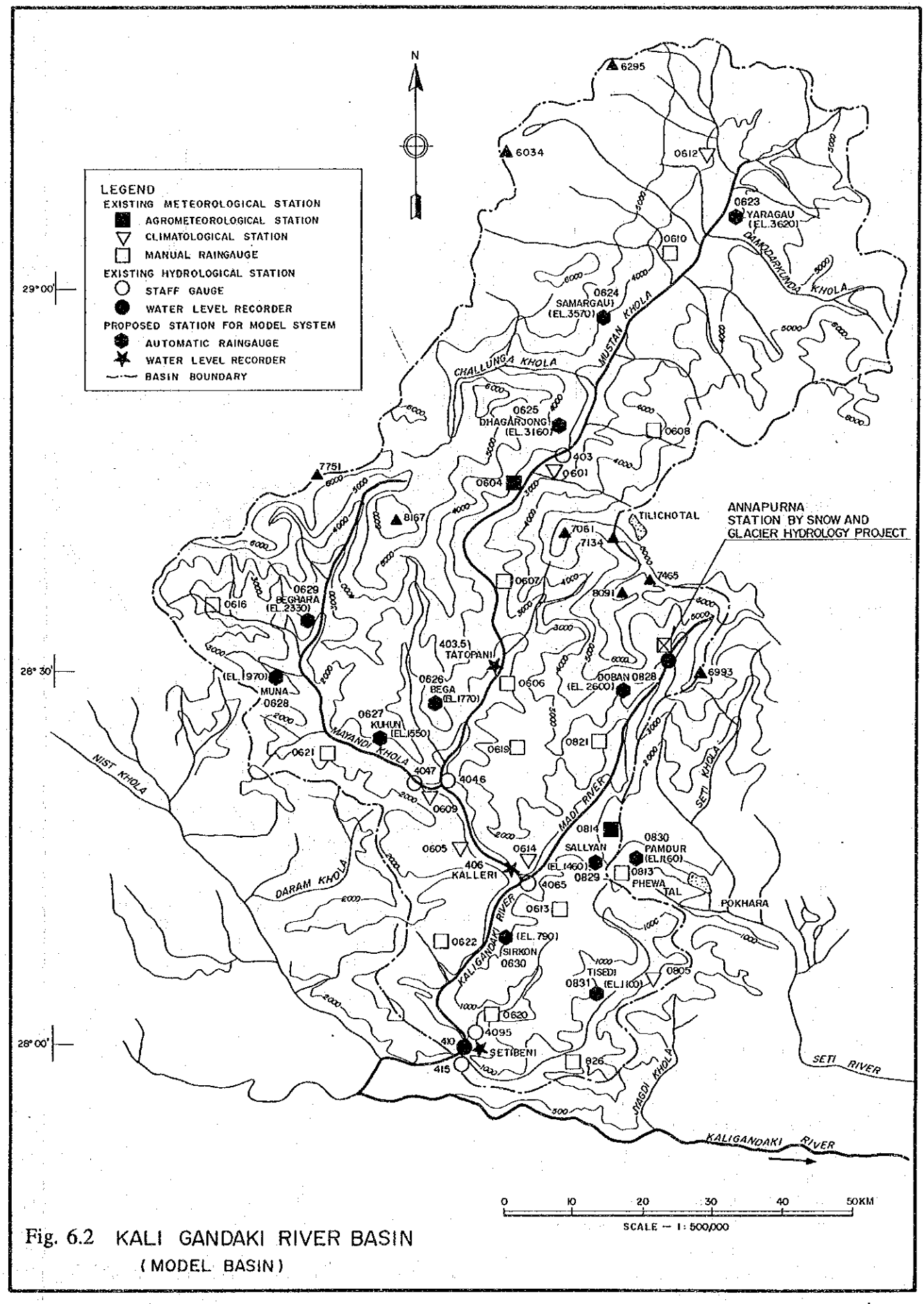


Fig. 6.2 KALI GANDAKI RIVER BASIN
(MODEL BASIN)

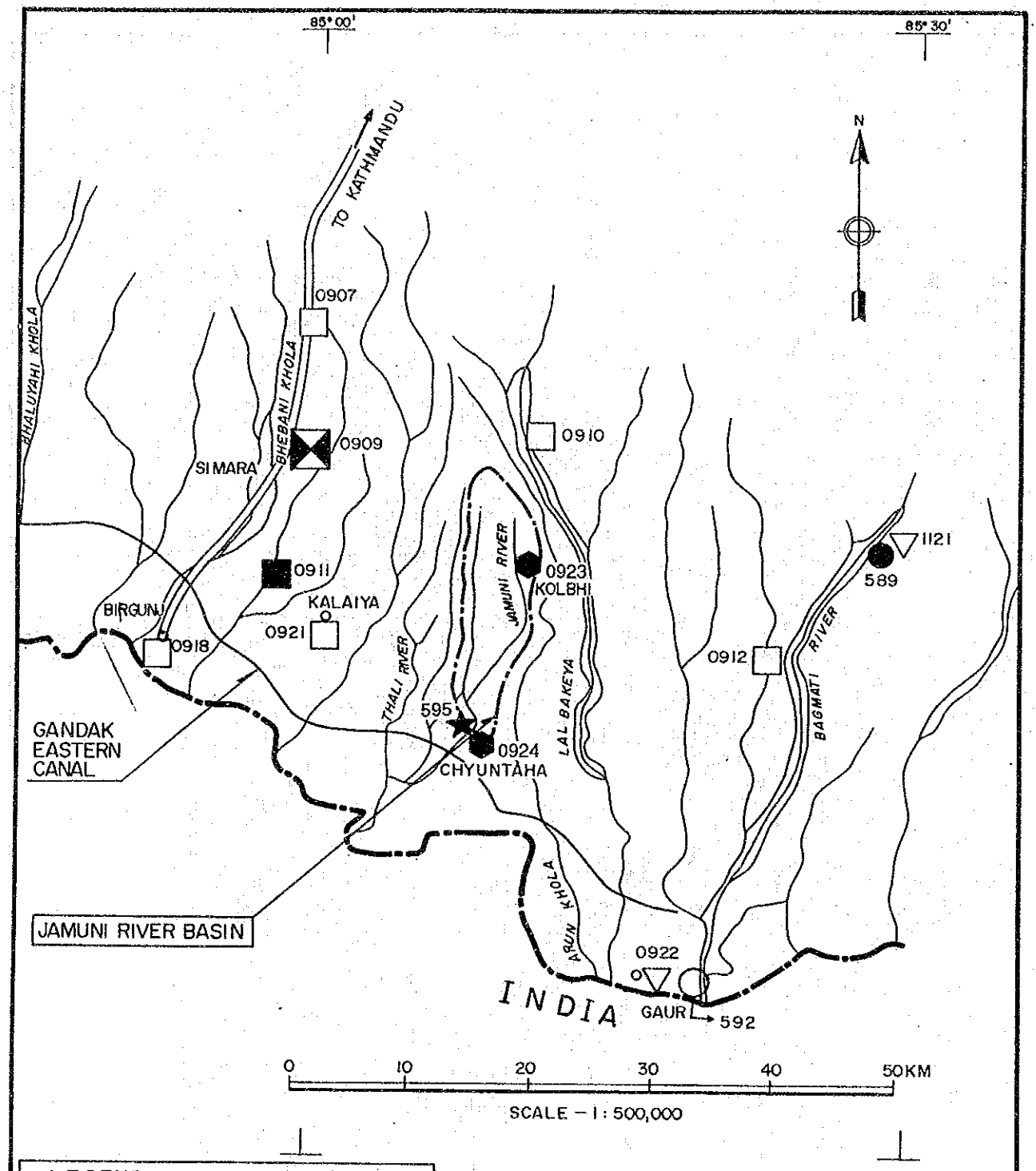


Fig. 6.3 JAMUNI RIVER BASIN (MODEL BASIN)

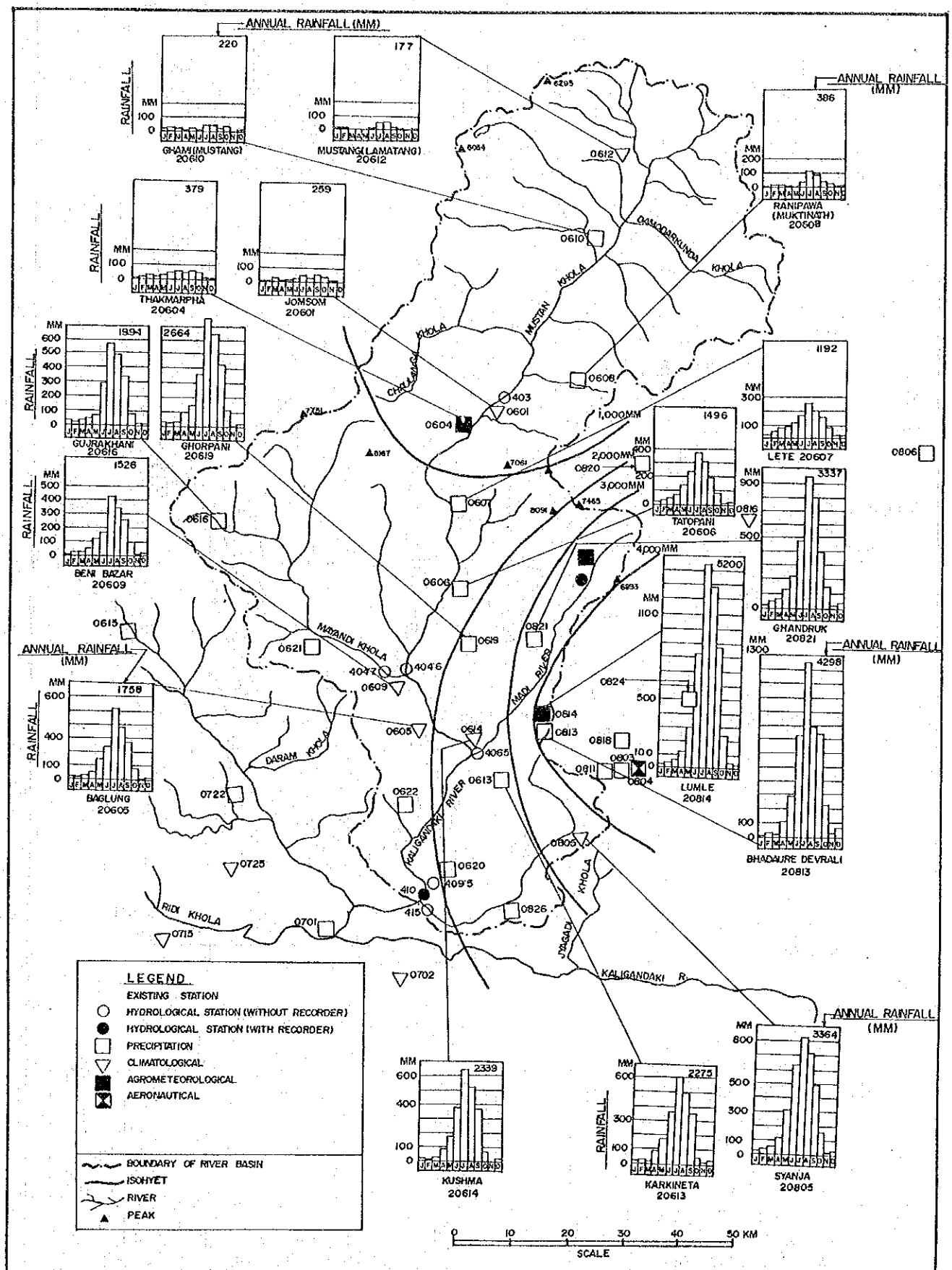


Fig. 6.4 RAINFALL CHARACTER IN KALI GANDAKI BASIN

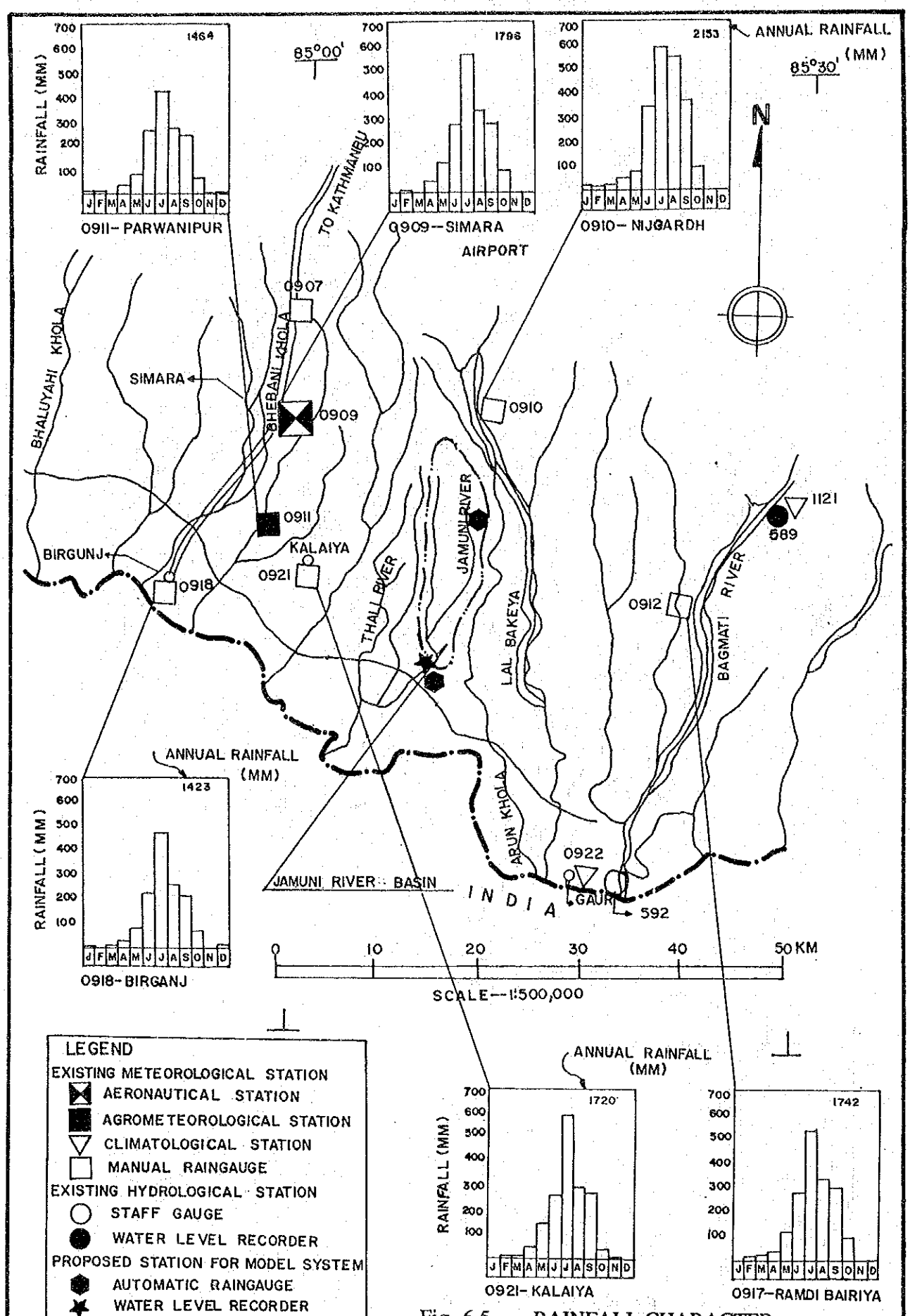
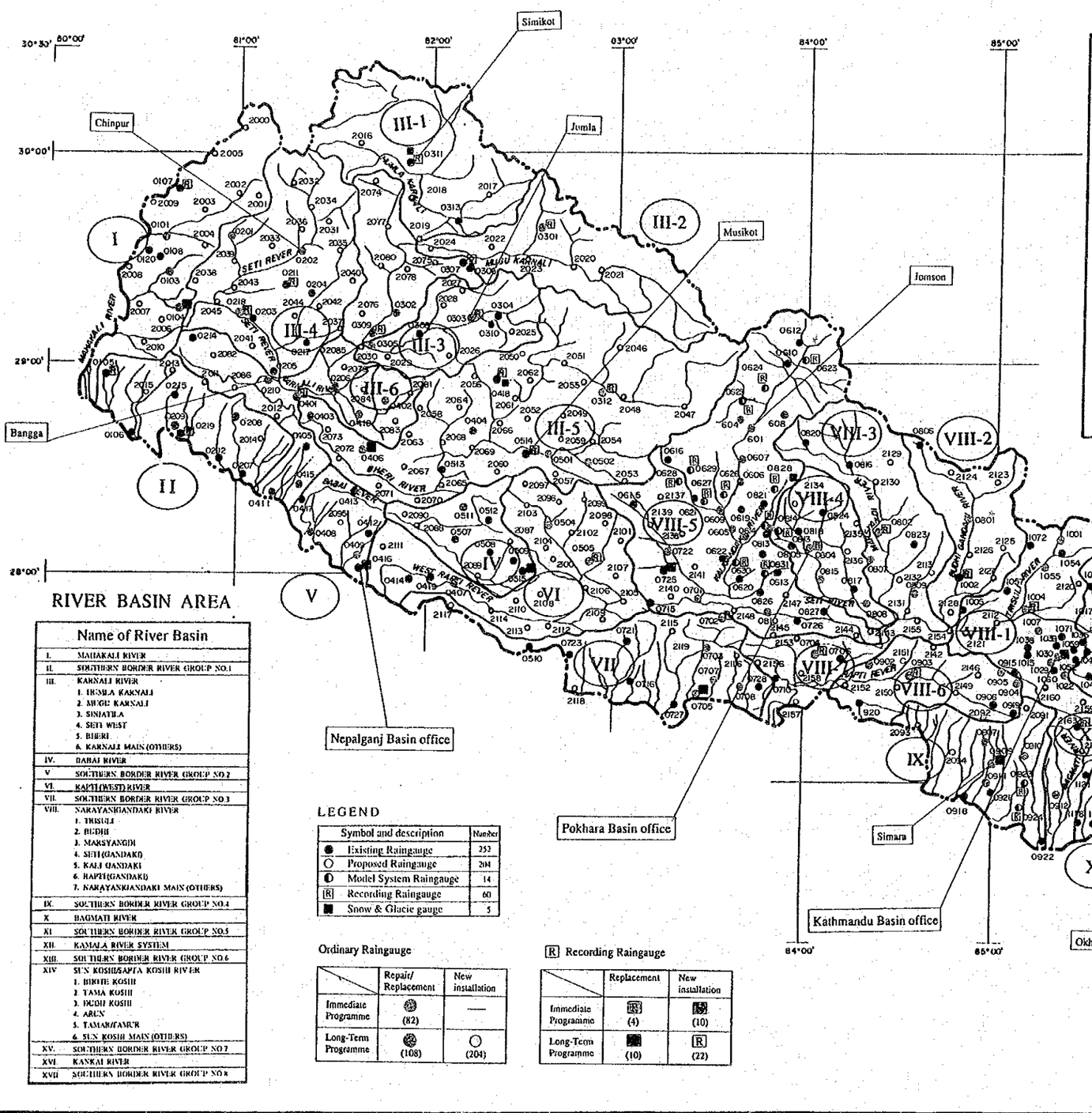


Fig. 6.5 RAINFALL CHARACTER IN JAMUNI RIVER

Fig. 7.1 PRECIPITATION NETWORK IN THE LONG TERM PROGRAMME



RIVER BASIN AREA

Name of River Basin	
I.	MAHAKALI RIVER
II.	SOUTHERN BORDER RIVER GROUP NO.1
III.	KARNALI RIVER 1. HUMLA KARNALI 2. MUGU KARNALI 3. SINIATILA 4. SETI WEST 5. BHERI 6. KARNALI MAIN (OTHERS)
IV.	BABAI RIVER
V	SOUTHERN BORDER RIVER GROUP NO.2
VI.	KAPTI (WEST) RIVER
VII.	SOUTHERN BORDER RIVER GROUP NO.3
VIII.	NARAYANKHANDAKI RIVER 1. TRISULI 2. BUDHI 3. MARSYANGDI 4. SETI (GANDAKI) 5. KALI GANDAKI 6. KAPTI (GANDAKI) 7. NARAYANKHANDAKI MAIN (OTHERS)
IX.	SOUTHERN BORDER RIVER GROUP NO.4
X	BAGMATI RIVER
XI	SOUTHERN BORDER RIVER GROUP NO.5
XII.	KAMALA RIVER SYSTEM
XIII.	SOUTHERN BORDER RIVER GROUP NO.6
XIV	SUN KOSHI&SAPTA KOSHI RIVER 1. BHOTE KOSHI 2. TAMA KOSHI 3. DUDH KOSHI 4. ARUN 5. TAMAR/TAMUR 6. SUN KOSHI MAIN (OTHERS)
XV.	SOUTHERN BORDER RIVER GROUP NO.7
XVI.	KANKAI RIVER
XVII	SOUTHERN BORDER RIVER GROUP NO.8

LEGEND

Symbol and description	Number
● Existing Raingauge	252
○ Proposed Raingauge	204
◐ Model System Raingauge	14
[R] Recording Raingauge	60
■ Snow & Glacie gauge	5

Ordinary Raingauge

	Repair/ Replacement	New installation
Immediate Programme	(82)	—
Long-Term Programme	(108)	(204)

[R] Recording Raingauge

	Replacement	New installation
Immediate Programme	[R] (4)	[R] (10)
Long-Term Programme	■ (10)	[R] (22)

LEGEND
- INTERNATIONAL BOUNDARY
- WATERSHED BOUNDARY
- RIVER
- LAKE

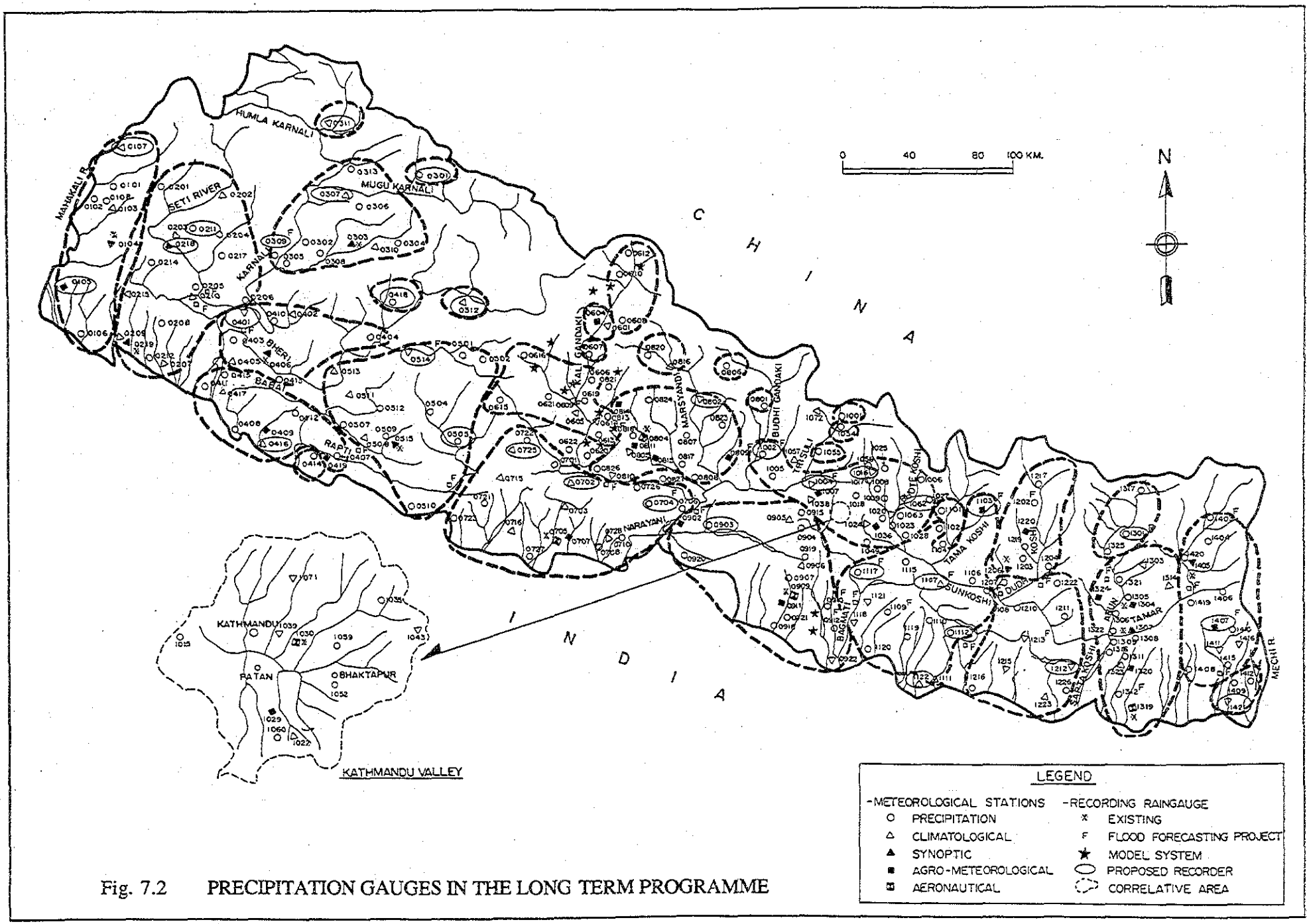
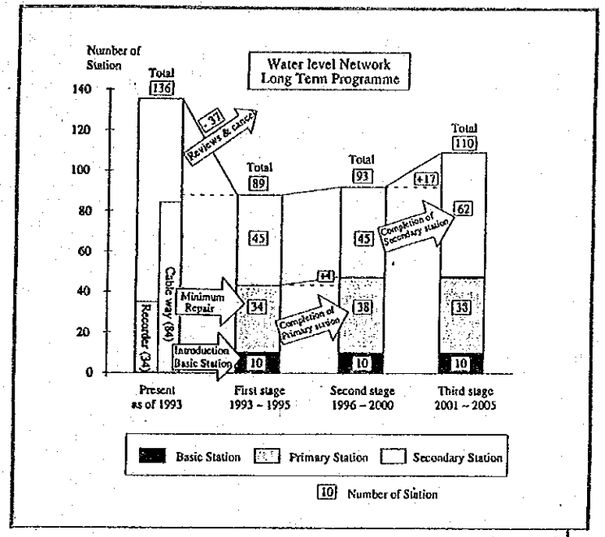


Fig. 7.2 PRECIPITATION GAUGES IN THE LONG TERM PROGRAMME

Fig. 7.3 HYDROMETRIC NETWORK IN THE LONG TERM PROGRAMME



RIVER BASIN AREA

Name of River Basin	
I.	MAHAKALI RIVER
II	SOUTHERN BORDER RIVER GROUP NO.1
III.	KARNALI RIVER 1. HIGRA KARNALI 2. MUGU KARNALI 3. SINJATOLA 4. SETI WEST 5. BHERI 6. KARNALI MAIN (OTHERS)
IV.	BABAI RIVER
V.	SOUTHERN BORDER RIVER GROUP NO.2
VI.	RAPTI (WEST) RIVER
VII.	SOUTHERN BORDER RIVER GROUP NO.3
VIII.	NARAYANKIANDAKI RIVER 1. TRISULI 2. BUDHI 3. MARSYANGDI 4. SETI (GANDAKI) 5. KALI GANDAKI 6. RAPTI (GANDAKI) 7. NARAYANKIANDAKI MAIN (OTHERS)
IX.	SOUTHERN BORDER RIVER GROUP NO.4
X	BAGMATI RIVER
XI.	SOUTHERN BORDER RIVER GROUP NO.5
XII.	KAMALA RIVER SYSTEM
XIII.	SOUTHERN BORDER RIVER GROUP NO.6
XIV	SUN KOSHI/SAPTA KOSHI RIVER 1. BHOTE KOSHI 2. TAMA KOSHI 3. DUDH KOSHI 4. ARUN 5. TAMAR/TAMUR 6. SUN KOSHI MAIN (OTHERS)
XV.	SOUTHERN BORDER RIVER GROUP NO.7
XVI.	KANKAI RIVER
XVII.	SOUTHERN BORDER RIVER GROUP NO.8

LEGEND

Symbol and description	Number
Basic Station	10
Primary Station	38
Secondary Station	62
Sediment Observation	20
Water Quality Observation	11
Snow & Glacie gauge	5

	Basic Station (10)	Primary Station (38)			Secondary Station (62)	
	Rainforcement	Minimum Repair	Rainforcement	Establishment	Rainforcement	Establishment
Immediate Programme	(10)	(14)				
Long-Term Programme			(34)	(4)	(25)	(17)

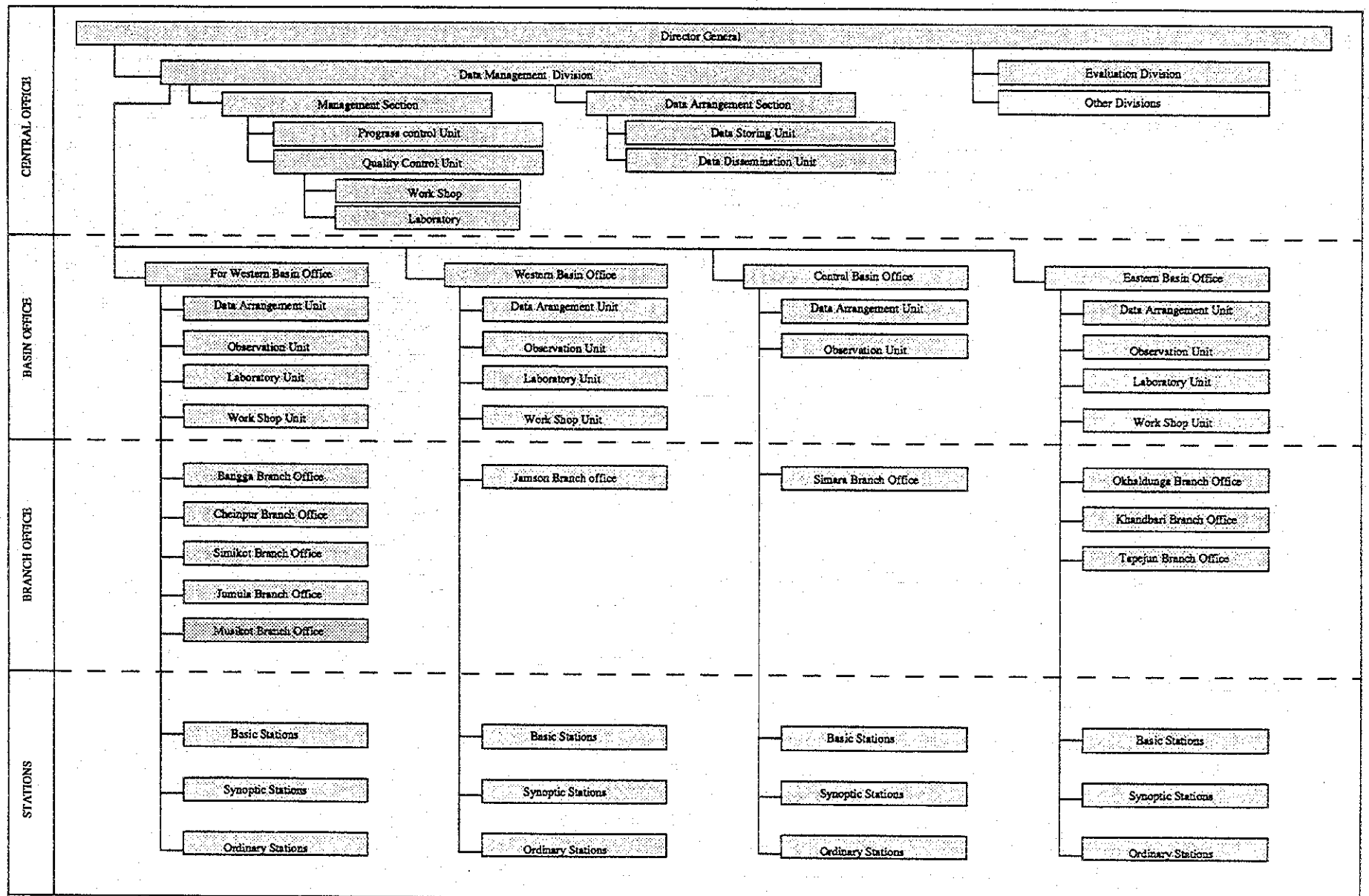


Fig. 7.4 ORGANIZATION OF THE DHM FOR THE LONG TERM PROGRAMME

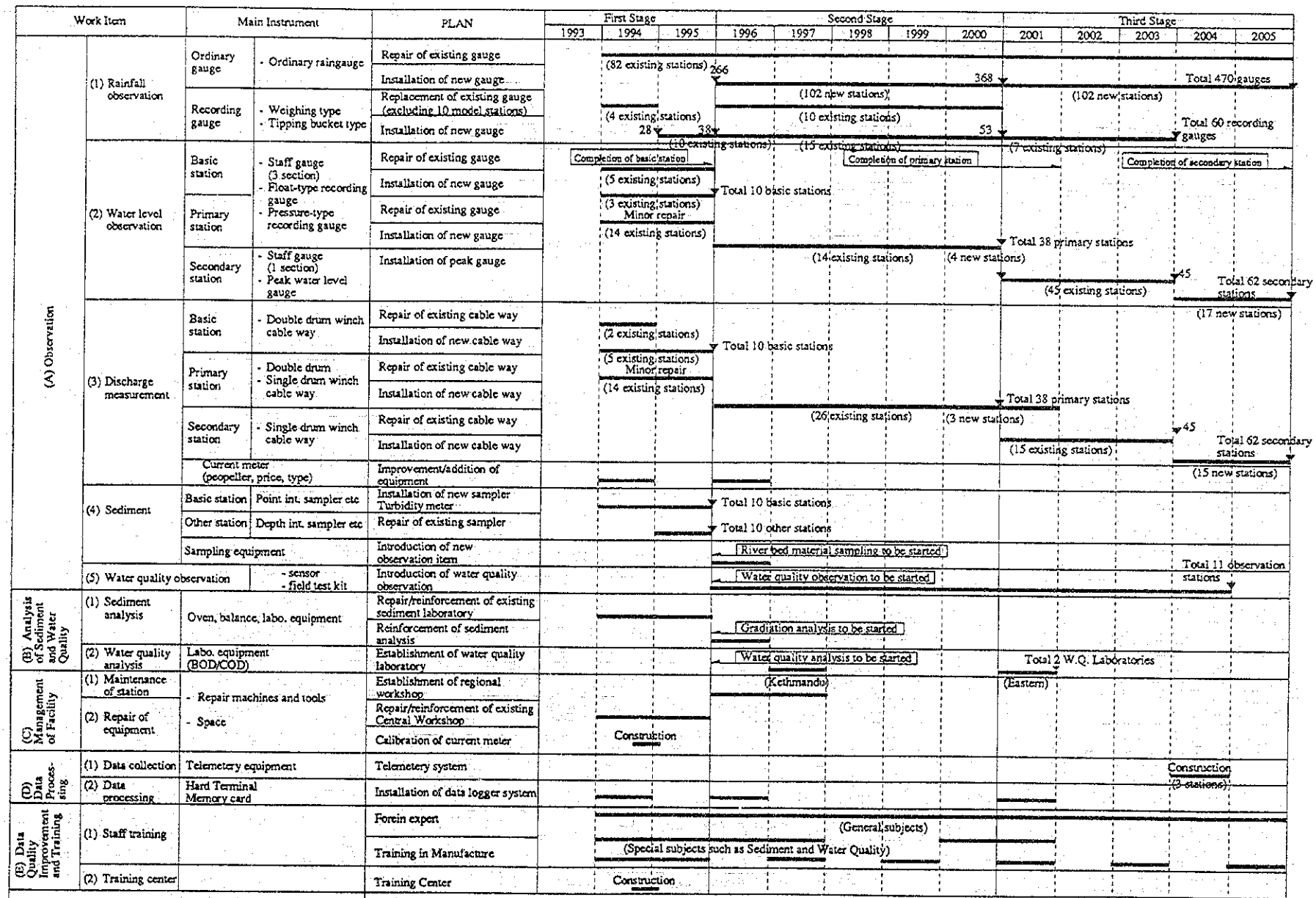


Fig. 7.5 IMPLEMENTATION SCHEDULE FOR OBSERVATION SYSTEM

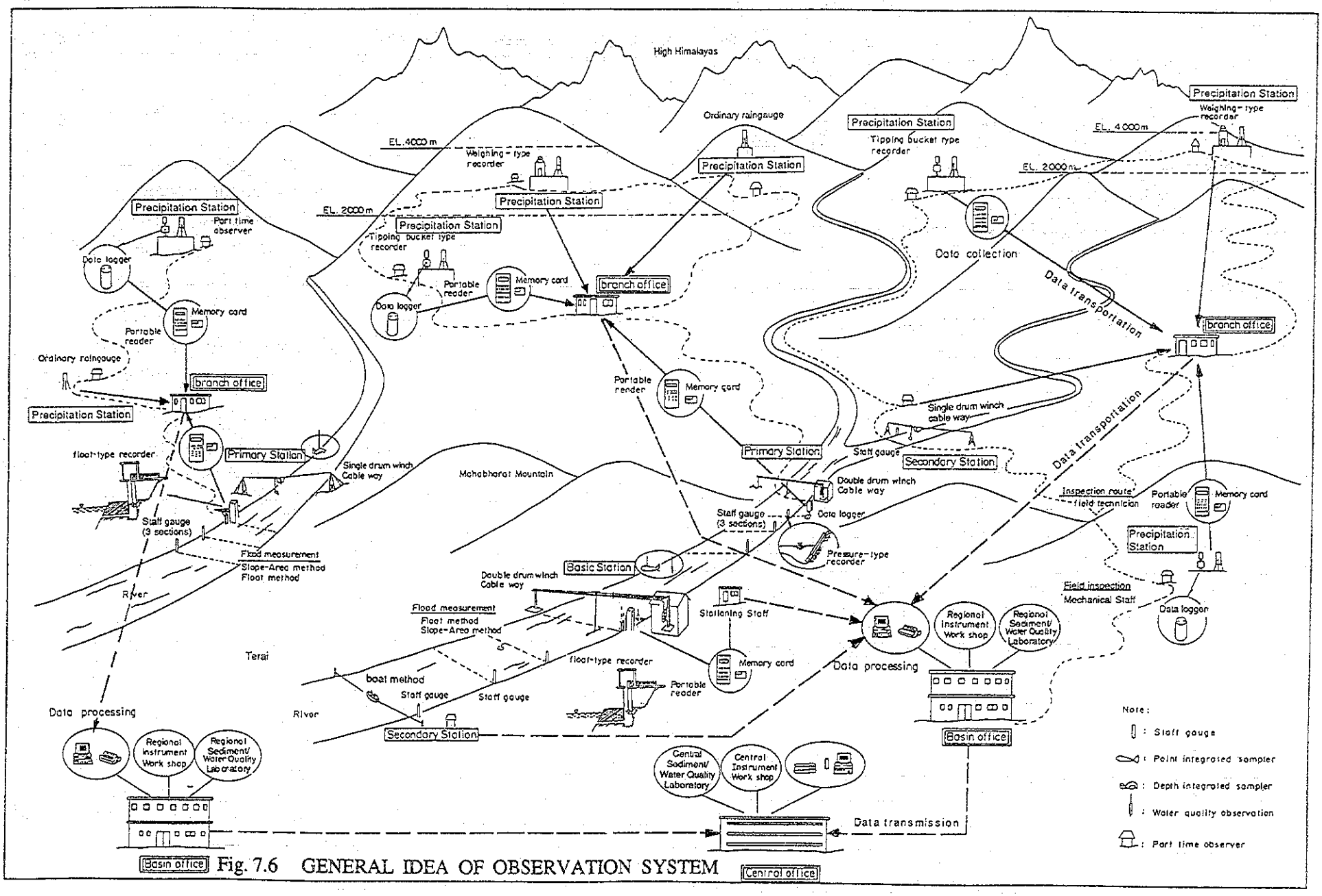
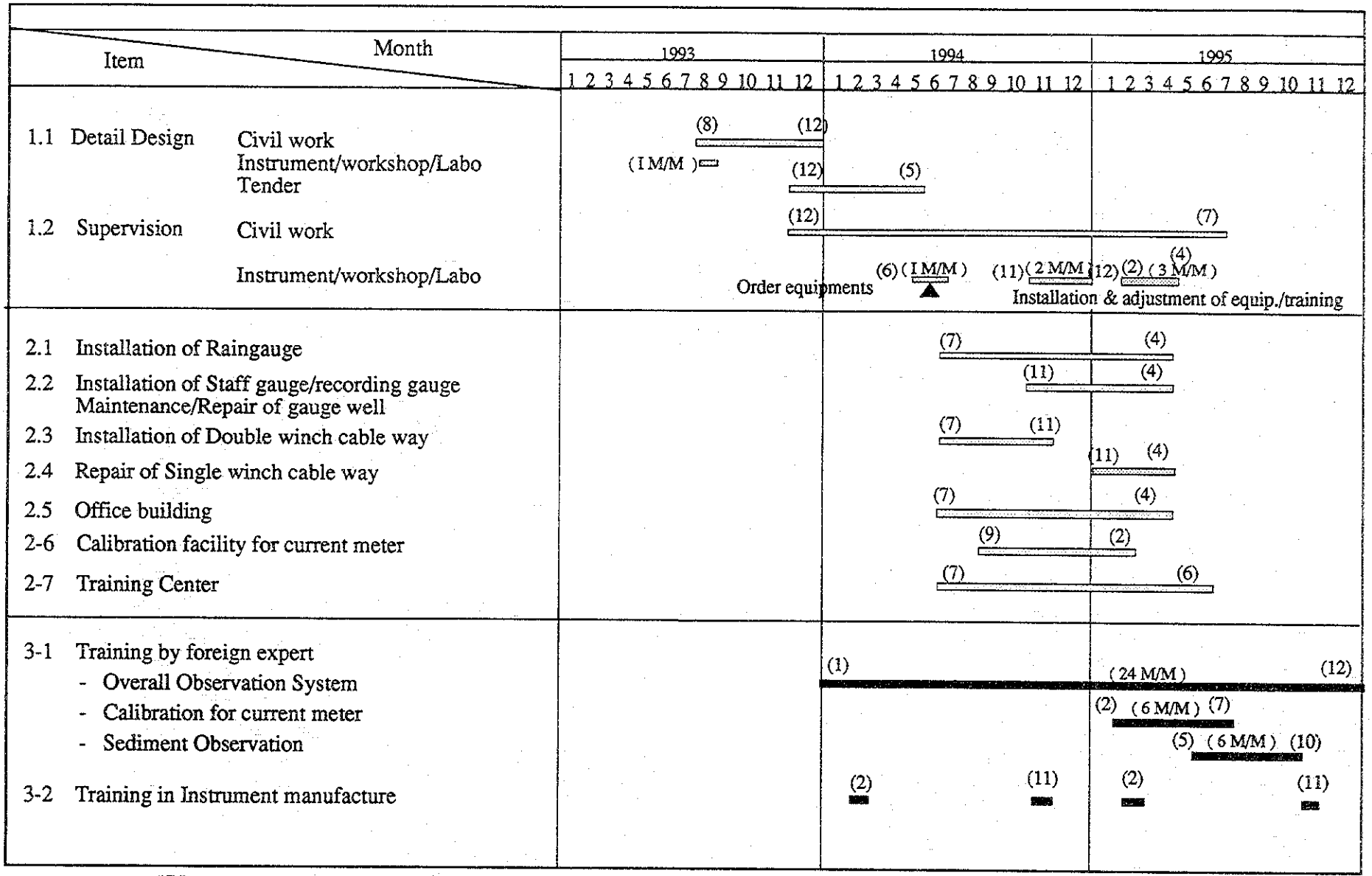


Fig. 7.6 GENERAL IDEA OF OBSERVATION SYSTEM

Fig. 8.1 IMPLEMENTATION SCHEDULE OF OBSERVATION FOR THE IMMEDIATE PROGRAMME



ANNEX F

DATA MANAGEMENT SYSTEM

NATIONWIDE HYDRO-METEOROLOGICAL DATA MANAGEMENT PROJECT

ANNEX F DATA MANAGEMENT SYSTEM

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1. OUTLINE OF THE STUDY

1.1 Objective of the Study

The objectives of the Study are:

(1) to formulate, improvement and expansion plans for nationwide hydro-meteorological data management systems which comprise following systems;

   a) hydro-meteorological observation network system

   b) data management system

(2) to effect technology transfer to Nepalese counterpart personnel in the course of the Study.

1.2 Study Area

The study area covers the whole country of the Nepal.

1.3 Scope of the Study

(1) Collection and review of available data and information related to the Study

   1) socioeconomic parameters

   2) meteorology and hydrology

   3) topography and geology including aerial photography

   4) river basin condition including flood damage records

   5) existing projects and plans for flood mitigation and drainage

   6) existing projects and plans for regional and sectorial development

   7) existing projects and plans for water resources development

   8) existing projects and plans for watershed conservation and management

   9) existing land use and future plan

   10) existing condition of communication system and future plan

   11) others

(2) Review of existing systems; hydro-meteorological observation network system and data management system

1) hydro-meteorological observation network system, including field reconnaissance.

a) gauges distribution

b) operation conditions of observation equipment including workshop

c) observation staff

d) observation criteria

e) operation and maintenance rules

f) organization

2) hydro-meteorological data management system.

a) methods and procedures; collection of original data from gauging sites, processing, storage and dissemination

b) equipment and facilities including assessment of capacity of existing computer facilities

(3) Formulation of improvement and expansion plans for hydro-meteorological observation network system and data management system.

1) formulation of long-term programme

a) establishment of principles for long-term programme

b) conceptual design of system

c) comparative study of alternatives

d) cost estimation

e) organization and institutional arrangement

f) selection of priority projects

2) implementation of model system

a) identification of model system

b) detail design

c) installation of necessary equipment

d) monitoring and experiment

e) operation and maintenance plan

f) staff training by using model system

3) formulation of immediate programme

a) preliminary design

b) cost estimation

c) implementation schedule

d) organization and institutional arrangement

e) project evaluation

1.4 Activities

Duration of the Study was for 29 months in total from March 1991 to July 1993. This Study was made dividing into two phases as follows:

1) Phase I : Study on Long-Term Programme
(for 19 months from March 1991 to September 1992)

2) Phase II : Study on Immediate Programme
(for 10 months from October 1992 to July 1993)

To help to formulate practicable Long-Term Programme by taking account of the results of several attempts ways, the Model System for the observation system and data management system was installed on March 1992 and monitored from April 1992 to December 1992.

The general trainings to instruct how to operate the Model System were held in March, June and December and the local training were held when the Study Team visited in the field and at each Regional Offices through monitoring works.

The Long-Term Programme and Immediate Programme were completed by the attempting of the Model System and the results were arranged and reported as the final report submitted on July 1993.

The overall work flow for this study was as shown in Fig. 1.1 and the Manning Schedule was as shown in Fig. 1.2.

1.5 Methodology for the Development of the System

Generally, system is developed dividing into four stages, planning stage, design stage, programming stage and testing stage.

In the planning stage, the problems on the present system and the requirement of users are analyzed. From these results, the necessary functions for the object system is determined and the conceptual design is carried out. The general idea made by the conceptual design is evaluated and the significance for development is made clear.

If the significance is accepted by the object organ, the system is designed in the basic design and detail design stages. In the basic design, the system is designed in the view point that what to do with the system. In the detail design, the system is designed in the view point that how to realize necessary functions with the system. In the design stages, the structure for data input, output, processing, cord and file are determined and the system is divided into several sub-systems.

In the programming stage, the programs for each sub-systems are wrote according to the basic policy determined by planning and design stages.

Finally, this system is tested dividing some testing levels such as module test, link test, system test and using test. After these test, the system is delivered to the users.

In this study, the Long-Term Programme and Immediate Programme were studied. Referring the scope of works, this study must carry out up to planning stage. Because the Long-Term Programme aim to plan conceptual design and the Immediate Programme aim to carry out up to evaluation level.

To help to formulate more practicable Long-Term Programme, the Model System was designed, installed and monitored. Analyzing the results of the Model System, the Long Term Programme was completed. The Immediate Programme was planned by selecting the urgent parts from the Long-Term Programme to improve the present system.

Actually, the Long-Term Programme and the Immediate Programme was planned according to the following procedures:

1) The surrounding conditions such as communication, transportation, related project with the DHM and electricity in Nepal were surveyed as shown in Chapter 3.

2) Present condition such as organization and roles, data flow, data items, dissemination data, cord system, computer system, software, file structure for the present system, data collection and processing was surveied as shown in Chapter 4.

3) Referring the results of these surveys, the present system was analyzed. From this analysis, the problems and improvement items were studied.

4) The suitable general idea for the Data Management System in the Long Term Programme was supposed preliminarily. To formulate more practicable idea for this system, the Model System was designed, installed and monitored according to the supposed general idea.

5) Referring the monitoring results, the necessary functions for the Data Management System were determined and the Long-Term Programme was completed.

6) From the Long-Term Programme, the urgent matter to improve present system was selected and the Immediate Programme was planned.

The general study flow was as shown in Fig. 1.3.

2. GENERAL IDEA FOR PLANNING

2.1 General

One of the objective of this Study was to formulate improvement and extension plans for nationwide hydro-meteorological data management system. This system consists of two sub-systems, those are hydro-meteorological observation network system and data management system. This ANNEX F dealt with only the data management system.

The data management system was planned for the Department of Hydrology and Meteorology (DHM). The DHM is responsible to fulfill the role of observation, management, analysis and dissemination of hydrological and meteorological data including forecasting and the other information. Among these functions of the DHM, the data management system deals with the data collection, data processing, data storage, data dissemination and management work.

The Long Term Programme and Immediate Programme were planned to formulate this data management system. The Long Term Programme is the plan presenting improvement and reinforcement idea for the existing data management system in the DHM. The Immediate Programme aims to improve the existing data management system urgently to manage reliable data without large expansion of the system.

Before finalizing these system, the Model system was planned, designed and installed in this study term to attempt several ways planned in the Long-Term Programme and help to formulate more practicable programme.

2.2 Proposed Programme

(1) Basic Policy

The data management system will be developed with two phases, the Long Term Programme and the Immediate Programme. The target year for the Long Term Programme is 2005 and that for the Immediate Programme is 1995.

The object observation data to be processed by the data management system will be precipitation, water level, discharge, sediment and water quality except for real time data for flood control purpose.

The object works for the data management system are data collection, data processing, data storage, data dissemination, training and management for those works.

The data management system will be developed aiming to manage data correctly, quickly, easily and economically.

(2) Organization

The data management system will be operated by the DHM. The DHM will consist of one Central Office at Kathmandu, four Basin Offices at Nepalgunj, Pokhara, Kathmandu and Biratnagar, ten Branch Offices and fourteen meteorology and hydrology stations as shown in Fig. 2.1.

(3) Data Flow

The observed data and information will be collected by the Branch Offices and Basin Offices. The Branch Office will send them to the Basin Office, instruct observers, observe and inspect and maintain station. The Basin Office will carry out same functions of Branch Office and enter them into computer by keyboard, digitizer or ram card reader according to the recording style, process and store to the data base. The processed data will be sent to the Central Office by public line and entered into computer at the Central Office. The Central Office will check them finally, store and disseminate data, train and manage the system as shown in Fig. 2.2. Each computer will be connected to each other by local area network (LAN) and global area network as shown in Fig. 2.3.

The data management work will be carried out according to the annual schedule as shown in Fig. 2.4.

(4) Structure of the System

The data management system will consist of two main sub-systems, data arrangement system and management system. The data arrangement system will also consist of four sub-systems, data collection system, data processing system, data storing system and data dissemination system. The management system will consist of five sub-systems, progress control system, quality control system, evaluation system, training system and data quality research system as shown in Fig. 2.5.

(5) Data Processing

The data will be processed by computer as shown in Fig. 2.6. Each processing work can be classified with four processing cycle, any time processing, monthly processing, half of year processing and yearly processing as shown in Table 2.1. The software for the data management system will be developed dividing into the development unit according to the processing cycle as shown in Fig. 2.7.

(6) Data Base

The data base at the Central Office and the Basin Offices will be managed by the data management system (DBMS) to store data safely and manage it easily as shown in Fig. 2.8.

(7) Implementation Schedule

In order to approach and accomplish the target of the Long-Term Programme steadily and completely, implementation of the Programme is divided into three stages.

The first stage: target year of 1995

The first stage concentrates to improve quality of the hydro-meteorological data by strengthening the existing hydro-meteorological observation and data management system without big expansion. The general idea for the first stage are as shown in Fig. 2.9 as the Immediate Programme.

The second stage: target year of 2000

The second stage is highlighted as "Observation System Expansion Stage" and targets to expand the hydro-meteorological observation network to the interim scale and to introduce new observation items such as sediment and water quality. For the data management system, the optical system to make backup for original data will be installed at the Central Office in 2000.

The third stage: target year of 2005

The third stage is the final stage of the Long-Term Programme and aims to complete the observation network to the minimum required one and to improve the system of data dissemination to the users to publish the observed data within the next observation year. The general idea for the third stage are as shown in Fig. 2.3 as the Long-Term Programme.

2.3 Effects of the Programme

The effects of the proposed programmes, the Long-Term Programme and the Immediate Programme can be expressed the five key words, rationalization, correctness, reliability, well management, and good service as follows:

(1) Rationalization

The data management work will be rationalized by unified procedure for data processing, systematical data checking and data processing with computer.

The procedure will be unified by the manual for the DHM data management work and the training that will train staffs on data processing and checking. All staffs will be able to manage data with unified procedure and it will rationalize their work.

The data checking work will be also rationalized because of computer. The computer will make necessary materials for data checking such as hydrograph, isohyetal map, area mean precipitation, correlation factor, runoff coefficient, rating curve, gauge height - area curve, gauge height - velocity curve and so forth automatically.

The computer will be also used for data processing and it will rationalize data processing work especially such as total, estimation of daily mean water level, discharge and sediment transportation and flow duration curve.

(2) Correctness

The proposed data management system will improve data quality by training, systematical data checking, and evaluation of observer, data processing staffs, observation result, data quality and effect of training annually.

(3) Reliability

All procedures for the observation and data processing, observation condition, error condition, data correction condition and original data will be made open to the public. The user will be able to check data by themselves and reproduce data processing process.

The DHM will check the reliability of observation network by analysis on hydrological and meteorological characteristics in Nepal.

The DHM will publish data book every year and the user will be able to refer the latest data on schedule.

For the safety of data, original and processed data will be stored as following way:

1) The data will be stored at the Regional Office and also at the Central Office. If the data will be damaged because of disaster or fire, the back up data will remain.

2) The data will be stored into optical disk for back up. If the memory of computer or original data will be damaged, the duplication will remain.

3) The data base will check the user for safety when they come to connect to the computer. It will also check the virus.

4) The stored data will be stored safely by refusing to be taken away from the store room. Instead of taking them away, they will be duplicated by the photo copy machine or on floppy disk.

(4) Well Management

The system will be managed well by the Progress Control System, Quality Control System and Evaluation System regularly.

(5) Good Service

The DHM will improve services as follows:

1) The DHM will disseminate new observation item such as water quality and river bed material to users.

2) The user will get necessary data by on-line.

3) The DHM will establish the counter to dialogue with users and investigate the requirement of them.

4) The DHM will disseminate data at the Central Office and at the Basin Office.

3. SURROUNDING CONDITION

3.1 Communication

The major communications medium in Nepal is telecommunication and postal services as follows:

(1) Telecommunication

Nepal Telecommunications Corporation (NTC) was established in 1976. The NTC made the Basic Plan for the Telecommunication Network in 1978 and has extended and improved telecommunication network based on that plan.

In 1982, the telecommunication network in Nepal consisted of 14,066 telephone with 13,248 telephone subscribers, 23 telephone exchanges including 4 XB automatic exchange site with 11,000 line unit capacities, 16 common battery manual exchange sites, with 4,500 capacities and 3 magneto manual exchange sites with 80 capacities, one international telecommunication site with 40 capacities and 82 short wave sites. The network of telephone exchange site and main line was distributed in Kathmandu, Pokhara and Terai Area only. Although there are 80 Regional, Zonal, District Centers in Nepal, 19 Centers had exchange site or line. Other places were connected with short wave wireless equipments.

From 1982 to 1983, the feasibility study on Rural Telecommunication network Improvement Project was studied and the Study planned rural telecommunication network that covered whole Nepal except for Himaraya Mountain Range. It planned to construct 63 public call offices, 3 exchange sites and 56 repeater stations by UHF or SHF way dividing four phases. Among these phases, phase I and II were selected as priority plan and the construction work was started in 1986. At present, the phase I and II have been completed and some parts of phase III started to construct. The outline of the rural telecommunication network plan was as shown in Fig. 3.1.

(2) Postal Services

The network of post office consisted of 2,232 post offices in 1990 including 5 district post offices, 478 area post offices and 1,679 additional post offices. One post office shared the area of in average about 70 km^2. In the mountain area, the density of that was lower than 70 km^2 per one post office especially in the Himaraya Mountain Range as shown in Table 3.1 and Fig. 3.2.

In the remote area, the condition of postal service is not so good, because most of post offices do not serve register mail and the mails without registration are sometimes lost on the way.

3.2 Transportation

The development of transportation has been influenced of topographical and climatological condition in Nepal. In the northern and the central area in Nepal, most of land is covered with mountain and hill and the transportation consists of mainly trail network which is still extensively well-used. However, that in the southern part consists of plane area and is well developed comparing to that in the northern part.

The transportation mainly consists of road, airline, railway and ropeway in Nepal. Among these transportation way, road and airline are essential part in Nepal as follows:

(1) Road

In 1989, the total length of roads in Nepal was 7,006 km which comprised 1,745 km (25%) in the eastern Development Region, 2,575 km (37%) in the Central Development Region, 1,310 km (18%) in the Western Development Region, 826 km (12%) in the Mid-Western Development Region and 550 km (8%) in the Far-Western Development Region as shown in Fig. 3.3.

During the period 1984-1989, the road length of Nepal increased at an average rate of 4% per annum, especially 14% about gravel roads. However the increase rate of black top roads was only 2% per annum during the same period. Ratio of the paved road to the total road length was 35%, 50%, 54%, 28% and 13% for each region from east to west, and the average ratio was 41%. Relatively, the Central Development Region dominates regarding the road facilities, and the Far-Western Development Region occupies the lowest position.

In the mountain and hill area, the road mainly consists of trail network which is still extensively well-used.

Department of Roads (DOR) takes charge of the development and maintenance of roads in Nepal. The DOR has chosen priority road development projects which are to be completed up to 2000 on the basis of the basic policy shown below:

1) East-West Highway should be completed,

2) One North-South Highway should be constructed for each zone and the access road from this highway to Regional Head Quarter should be also completed, and

3) The second East-West Highway should be linked.

But it will be very difficult to complete these priority programmes judging from the results of the seventh plan that shows the percent of completion of road construction being only 52.9%.

(2) Airway

In the mountain and hill area,the black topped and gravel road are not developed well in Nepal because of topography. The network of airline is one of the main transportation ways in those areas. But the flight is sometimes cancelled because of bad weather and lack of planes. Especially in the mountain area in the rainy season, the number of flight cancel becomes big. The domestic airline network is given in Fig. 3.4.

(3) Railway

The Janakpur-Jayanagar Railway (51 km, 2.6 gauge) is the only rail transport in Nepal. It started operation in 1935, mainly rendering services for transport of passengers and goods. Due to lack of proper maintenance and repair, it cannot provide the expected extent of services. Moreover, the recent people's movement had damaged some railway leagues and compartments.

(4) Ropeway

The Kathmandu-Hetauda Ropeway (42 km, 42,000 M. ton annual capacity) has been providing facility for transportation of goods. But due to lack of proper repair and maintenance, its annual capacity has decreased by 25 percent since the year 1974/75.

3.3 Related Project with the Data Processing System in the DHM

3.3.1 UNDP/WMO Project

The UNDP/WMO Project, NEP/78/020-Development of Operational Hydrology Services, was approved in September 1981, started in June 1982 and finalized in December 1987. The object of the study was to develop and strengthen the institutional capability of HMG in hydrological services. The counterpart agency was Department of irrigation, Hydrology

and Meteorology which was divided into Department of Irrigation and Department of Meteorology and Hydrology in 1988.

In this project, seven outputs were incorporated as follows:

1) Reliable operation of river gauging and sediment sampling stations with proper and timely collected data
   a) Complete repair where required on 25 regular stations
   b) Prepare detailed description of 50 regular stations
   c) Install instruments in the field
   d) Strengthen the sediment data collection programme
   e) Improve the operational condition of the regular stations
   f) Improve facilities at any regular stations with priority status where rating curves merit this work.

2) Storage of hydrological data files on computer compatible support
   a) Install computer set with programme for hydrological data base
   b) Make pilot plan for data management system
   c) Review the format of the data collection forms.

3) The establishment of statistical summaries and estimates based on data files
   a) Flow measures such as flood frequency, low flow frequency and flow duration curve
   b) Catchment characteristics, such as land use, dimensions, topography and hydrometric for 73 stations.

4) Printouts of year books containing daily values of river stages and discharges, extreme, monthly and yearly averages, data on sediment transport and water temperature:
   a) Process backlog of data collected during 1977-85 for 50 regular stations
      - Update rating curves for 46 stations
      - Process chart records for 26 stations
      - Enter gauge heights on computer for 49 stations
      - Calculate daily discharges for 46 stations

b) Increase the quantity and quality of data processing
   - Storage cupboards, files and a photocopier have been installed for retention of the processed data and provide copies for clients.
   - A total of 103 station years of sediment concentration values from 15 stations have been entered into computer.
   - Entry staff gauge readings into computer.

5) Supply of quasi-real time operational information
   a) Undertake an in-depth hydrological study of the Bagmati catchment.
   b) Install pilot real time data collection system in one basin. But this activity was cancelled.

6) A team of qualified and motivated professional hydrologists, hydrological technicians and assistants
   a) Strengthening the responsibilities of the field offices
   b) A technical training programme shown as Table 3.8, and

7) Hydrological equipment workshop facilities.

The present data processing system in the DHM was introduced in these outputs as belows:

Computer system were installed at the Central Regional Office in Kathmandu, Western Regional Office in Pokhara and eastern Regional Office in Dharan. These three offices were chosen because of better quality accommodate and more reliable electricity supplies. The aim of these systems were to introduce a decentralized system of data collection and primary processing. One IBM PC XT computer was installed in each three regional offices and one IBM PC AT for data base and two Victor computer sets for data entry were also installed at the Central Office in kathmandu shown as Table 3.2. The component of this system is shown as Fig. 3.5.

Each of these three regional offices entered daily staff gage reading and a summary of the discharge measurement records to IBM PC XT and the entered data were sent to the Central Office in kathmandu by 5.25" floppy disk.

At the Central Office, data were converted to daily discharge after entry of the rating table. Then the daily discharge record was registered into the hard disk of IBM PC AT. After registration, it was possible to rearrange, summarize, plot and print out the discharge and

also provide data by floppy disk to clients as required. Using this system, much backlogs of the data during 1977-85 for 50 regular stations were processed.

Storage cupboards, files and a photocopier were installed for retention of the processed data and provided of photo copies for clients.

3.3.2 German Development Service

In 1986, the GDS decided to send GDS volunteers to the DHM after discussion with the DHM. The DHM officially requested the GDS to send 5 volunteers working as hydrologists in the Hydrological Section and 2 as Electronic Technicians in the Meteorological Section in January 1987. After that, two volunteers arrived at the DHM and the actual activities were started in 1987.

The job descriptions for meteorology were to; 1) establish the workshop, 2) organize the maintenance system, 3) train the counterpart and the workshop staffs, and, 4) repair and maintenance of the electronic equipments.

Those for hydrology were to; 1) train field staff in hydrometric techniques, 2) process river level and discharge data, and 3) maintain instruments in fully operation order.

Up to December 1991, the manpower supported by the GDS to the DHM consisted of 8 volunteers with 143 men-months at the Central Regional Office in Kathmandu, Eastern Regional Office in Dharan, Western Regional Office in Pokhara, Mid-Western Regional Office in Surkhet and the Central Office in Kathmandu.

Almost volunteers were sent to the Regional Offices and have worked closely with the emphasizes on data collection, data processing, on the job training and instrument maintenance.

In 1991, the DHM and GDS organized work shop together at the DHM Central Office in Kathmandu for two days from December 5 to 6 and the results of it was reported as "Planning Workshop to Reinforce Collaboration Between Department of Hydrology and Meteorology and German Development Services". In this work shop, the assignment of volunteer, assignment in training, logistic support and assistance in finding additional funds were discussed and the DHM and the GDS decided to collaborate at least for the next five years from 1992 to 1996.

At present, the volunteers stay at the Eastern, Central, Western and Mid-Western Regional Office and the Central Office and work with the DHM staffs together. They inspect gages, process data including making of rating curve and hydrograph, help to train the DHM staffs, install necessary equipments such as cupboard, file, hard disk and so forth, monitor the condition of data processing and submit report on present DHM condition and recommendation twice a year.

3.4 Electricity in Nepal

Almost of electricity in Nepal is supplied by dams operated by the Nepal Electricity Authority (NEA). The condition of electric supply is not so good at present because of lack of dams in spite of enough water resources.

In 1991, the electricity condition in Kathmandu was not so bad. But that in other places was not so good. In the dry season, the electricity failure occurred everyday. Even if in regional headquarter such as Pokhara, Birendranagar, Dhangadhi, it continued for several hours in a day.

In 1992, power supply was interrupted including Kathmandu for two hours every other day because of lack of rainfall from November when the rainy season just finished.

The electric failure is one of the problems for data processing work by computer.

4. PRESENT CONDITION OF DHM

4.1 Outline of the DHM

The DHM was established under the Ministry of Water Resources in 1988 to disseminate the hydrological and meteorological data and information. The DHM plans the hydrological and meteorological observation network in Nepal, design, construct and maintain the observation stations, collects, processes, stores, analyzes and disseminate data and carry out international cooperation.

(1) History of the DHM

The systematic collection of hydrological data in Nepal was started in 1961 for the power feasibility study in the Kosi River. In 1962, organization for data collection was established as a programme between USAID and HMG. Then the organization became under the Ministry of Irrigation and Power. In 1966 it was changed their name as the Department of Hydrology and Meteorology. In 1972, it was incorporated with Irrigation to form the Department of Irrigation, hydrology and Meteorology under the Ministry of Food, Agriculture and Irrigation. Latter, it became under the Ministry of water Resources, in 1980. In 1988 it was separated into the Department of irrigation and the Department of Hydrology and Meteorology under Ministry of Water Resources.

(2) Organization in 1991

There are twenty one Ministries under the Office of the Prime Minister in the Government. The Ministry of Water Resources has the sole responsibility for planning, implementation and management of water resources development. The Department of Hydrology and Meteorology (DHM) is one of the Departments under the Ministry of Water Resources as shown in Fig. 4.1.

The DHM is responsible to fulfill the role of observation, management, analysis and dissemination of hydrological and meteorological data including forecasting and the other information.

The DHM consists of three (3) Divisions, five (5) Regional Offices and two (2) Sections as shown in Fig. 4.2. These Divisions are Hydrology, Meteorology and Weather Forecasting, and Climatology Divisions. All the Divisions are located in the Central Office at Babarmahal except for Meteorology and Weather Forecasting Division at Kathmandu airport. Two Sections are Administration and Accounts, and Other Technical Services in

the Central Office. Regional Offices are Eastern, Central, Western, Mid-Western and Far-Western Regional Offices. The Eastern Regional Office has a hydrological office and a meteorological office separately, the former is located at Dharan and the latter at Dhankuta. The Central, Western, Mid-Western and Far-Western Regional Offices, in which both the hydrological section and the meteorological section are combined, are situated in Kathmandu, Pokhara, Birendranagar and Dhangadhi respectively. The locations of the Regional Offices are indicated in Fig. 4.3.

The functions of the Divisions, Sections and the Regional Offices are briefly explained below and shown in Table 4.1:

1) The Hydrology Division studies different hydrological aspects, models and glaciers and issues reports on data and study results.

2) The Climatology Division studies different climatological aspects, prepares the reports and provides necessary services to agriculture sector.

3) The Meteorology and Weather Forecasting Division provides weather forecasts and flood warning, and arranges information from abroad.

4) The Administration and Accounts Section administrates and supervises budgets, staffs and properties.

5) The Other Technical Services Section controls construction, operation and maintenance of observation stations, data collection and processing, chemical laboratories and training.

6) The Regional Offices establish observation stations, operate and maintain them, collect data and process.

There are 14 synoptic stations including aeronautical stations, which belong to the Meteorology and Weather Forecasting Division, and five Regional Offices. These stations function is to observe synoptic parameters and give the data every three hours from 5:45 to 17:45 to the Meteorology and Weather Forecasting Division in the Kathmandu airport.

A hydrology station has been established at Chisapani under the control of the Far-Western Regional Office in cooperation with the Karnali Multipurpose Project. This station has the responsibility to observe and maintain river gauging stations, collect and process data, measure the discharge and sediment concentration in western part of the Karnali River.

(3) Observation Network in 1991

The meteorological observation network consists of 14 aero/synoptic stations, 24 agrometeorological stations, 65 climatological stations and 149 precipitation stations. Totally, the DHM operates 252 meteorological stations. The DHM operate also 136 hydrological observation stations including 34 automatical recording gauge, 85 cable ways and 12 sediment sample facilities. The detail on the present observation network was mentioned in the ANNEX E OBSERVATION SYSTEM.

(4) Staffs in 1991

At present, technicians in the Regional Offices consist of 3 Senior Hydrologists, 2 Senior Meteorologists, 5 Hydrologists, 3 Meteorologists, 29 senior Hydro-Meteorological Assistants, 28 junior Hydro-Meteorological Assistants, 26 Field Assistants and 3 Silt Analyst and total number is 102. Among them, 32 technicians belong to 13 synoptic stations.

The 30 vacant seats of personnel including 23 by junior Hydro-Meteorological Assistants (7 of them are in Synoptic stations) exist. Not only the shortage of technicians but also the shortage of trained field technicians is very real problem.

Field technicians under the senior Hydro-meteorological Assistant class are in charge of field activities such as discharge measurement, levelling and river cross section survey, field inspections and minor field maintenance.

In hydrometric stations, a gauge reader, collector, winch operator, and runner who carries sediment sampling bottles to the laboratory are employed as part-time observers. On the other hand, staff of aero/synoptic stations consist of the DHM technicians. And in other meteorological stations a part-time observer takes observations.

Part-time observer's occupation is mostly agriculture, business like small shop owner and employee. His/her qualification is mostly under SLC (School Leaving Certificate) and experience is mostly 10 to 20 years.

Number of staffs in the present Central and Regional Offices is summarized in Table 4.2 and 4.3.

4.2 Object Work for Data Management System

The DHM has the eight main works, observation work, data processing work, other technical work, data storing work, data dissemination work, training work, international cooperation work, and management work as follows.

(1) Observation Work

The observation work includes determination of observation items and planning, design, construction and maintenance of stations, beside observation.

(2) Data Processing Work

Data arrangement work consists of data collection, data processing, and registration of stations on inventory. These data are not only observed data but also information such as inspection reports on stations. Data processing works are calculation of total values and making of data books including checking.

(3) Other Technical Work

There are four types of analysis. One is for study on meteorology and hydrology characteristics in Nepal for academic purposes including development of model. Second is for planning of ideal observation networks. The third is for planning, designing and construction of developing project. The last is weather and flood forecasting. The second one is related with the data management for getting more reliable data.

(4) Data Storing Work

The DHM stores original and processed data, results of analysis and information. The information includes error records, station inspection reports and inventory of stations.

(5) Data Dissemination Work

The DHM offers stored data and results of analysis to everybody.

(6) Training Work

The DHM trains the DHM staffs and observers to observe and process data correctly.

(7) International Cooperation Work

The DHM cooperates with World Meteorological Organization (WMO), the SRRC countries and other foreign organization to promote harmonious development of the world meteorological services. The DHM also cooperates with Germany at present for study on snow and glacier hydrology.

(8) Management Work

The management works for data management are progress control, data quality control and evaluation works on observation and data processing.

These works are related to each other as shown in Fig. 4.4. Among these main works, the object works for the Data Management System in the DHM are data collection work, data processing work, storing work, data dissemination work, hydrological and meteorological analysis for planning on more reliable nationwide observation network, training, and management works such as progress control, quality control and evaluation according to the scope of the study. The general work flow for the object work are as shown in Fig. 4.5.

4.3 Data Flow

The data flow in the DHM was studied in the first field investigation stage in 1991 and the outline of it was as follows:

There are two types of gauging stations with regard to observation staff. One is synoptic stations for meteorological observation. Another is ordinary gauging stations for meteorological or hydrological observation. At the synoptic stations, well trained DHM staffs stay and observe everyday. They send data to the Kathmandu airport every three hours by wireless for weather forecasting, and to the Regional Offices, once a month mainly by mail. From ordinary gauging stations, observers send data by mail once a month to the Regional Offices. Only sample of sediment load and discharge measurement records were brought by manpower. In case that postal service was not available, staff of the Regional Offices collect them when they went to inspect stations or to measure discharge several times a year.

At the Regional Offices, the data sent from observation stations were preliminarily processed by manpower. The processing work includes duplication of the original

records, calculation of average and cumulative values, and development of discharge rating curves and tables and conversion of water level data to discharge.

The original records and data processed at the Regional Offices were sent to the Central Office by staffs of the Regional Offices, for two or four times a year.

Only the Western Regional Office among the five Regional Offices had a computer set, IBM PC XT, installed by UNDP/WMO Project. This office, processed data by using the computer and sends processed data by floppy disks together with the original records once a year.

In the Central Office, the data sent from the Regional Offices were firstly stored in the hydrological or meteorological data acquisition units in the Other Technical Services Section through the Director General. Then, they were entered into the data base and stored temporarily at the acquisition unit until data books were published. When the data books were issued, the data were stored permanently in store houses.

This data flow is illustrated in Fig. 4,6.

At the end of 1991, DHM transferred data processing work from the Central Office to each Regional Offices. In 1992 the JICA Study Team installed personal computer at each Regional Offices. The collected data are processed at the Regional Offices and the processed data are sent to the Central Office by floppy disk.

4.4 Data to be Entered

The DHM operated 252 meteorological stations and 136 hydrological stations in August 1991.

The meteorological network consisted of 14 aero/synoptic stations, 24 agrometeorological stations, 65 climatological stations and 149 precipitation stations. The precipitation stations observe precipitation. The climatological stations observe precipitation and temperature including dry bulb, wet bulb, maximum value and minimum value. The agrometeorological stations observe parameters observed at the climatological stations, and sometimes observe grass maximum temperature, soil temperature, wind, evaporation and sunshine hour. The aero/synoptic stations observe general observation items.

All of precipitation stations were equipped with an ordinary rainfall gauge. Out of total 252 meteorological stations, only 14 recording rainfall gauges, around 6% of the total number, were installed at 13 synoptic/aeronautical and one agrometeorological stations.

The hydrological stations consisted of 136 staff gauges, 34 automatic recorders 82 cable ways and 18 sediment sampling facilities.

Since the object data item for the Long-Term Programme was the precipitation, water level, discharge and sedimentation, the data to be entered into the Data Management System was as follows:

1) daily precipitation records observed at 252 stations
2) continuous precipitation records observed at 14 stations
3) staff gauge reading records observed at 136 stations
4) continuous water level records observed at 34 stations
5) discharge measurement records observed at 82 stations averagely
6) sediment concentration records observed at 18 stations

The daily precipitation records were observed once a day and the amount of data to be entered into computer was averagely 30 in one month. That of hourly precipitation was 720 in one month. In case of staff gauge reading, it was observed three times a day and the amount was 90. The hourly water level was the same with hourly precipitation and that was 720. In case of discharge measurement record, the number of observation depended on budget of the DHM and the average number of observation was from once to three times in one year. The sediment concentration record observed once a day and the amount of data to be entered was 30 in one month. Beside above items, station description, extreme record and rating table were to be entered.

4.5 Dissemination of Data

The Central Office of the DHM disseminates meteorological and hydrological data and information including weather forecasting and flood forecasting.

The hydrological data book serves monthly discharge, maximum discharge, minimum discharge and average discharge including the information of stations. They have been published until 1985. The daily data are also disseminated by the floppy disk, computer

output list and manual duplication. These daily data can be got through the Director General for restricted use.

The monthly meteorological data are disseminated mainly by data book. The data book serves monthly precipitation, air temperature, relative humidity and vapour pressure including the information of station and isohyetal map. They have been published until 1990 and sold averagely 55 pieces for each data book every year as shown in Table 4,4. The list of data book published by the DHM is as shown in Table 4.5 for hydrological data and Table 4.6 for climatorological data. The information of meteorological analysis are also served by report to the related department such as the Department of Irrigation and by the radio programmes. These reports consist of the Preliminary Summary, Daily Report, Monsoon Forecast and Weather in Nepal. The preliminary summary are submitted every week in the monsoon season and every month in the dry season. The daily report are also submitted only in the monsoon season. The radio programmes are broadcasted on Thursday from 7:20 to 7:30 for agriculture and from 7:30 to 7:45 for water resources in the morning.

4.6 Station Code

The station code adopted by the DHM to identify station was determined independently between hydrological stations and meteorological stations as follows:

(1) Meteorological Station

The station code for meteorological stations are numbered using four digits. The first two digits indicate the zone that commences from Far-Western Region and in which the station is located as follows:

Zone	Number	Zone	Number
Mahakali	01	Gandaki	08
Seti	02	Narayani	09
Karnali	03	Bagmati	10
Bheri	04	Janakpur	11
Rapti	05	Sagarmatha	12
Dhaulagiri	06	Kosi	13
Lumbini	07	Mechi	14

The last two digits represent the station number within the preceding.

(2) Hydrology

Each gauging stations are basically expressed by the integral number and the code is classified with the river systems as follows:

1) 100 to less than 200 range Mahakali river system
2) 200 to less than 300 range Karnali river system
3) 300 to less than 400 range Rapti river system
4) 400 to less than 500 range Narayani river system
5) 500 to less than 600 range Bagmati river system
6) 600 to less than 700 range Kosi river system
7) 700 to less than 800 range Kankai river system
8) 800 to less than 900 range Mechi river system

When new gauging station is installed near the old gauging station, the code number for new station is made putting decimal point to the code number to the old one. In this case, the code number becomes actual number.

4.7 File Structure

The DHM stores processed hydrological data and meteorological data in the different computer memory separately and the file structure of each data is defined independently to each other as follows:

(1) Meteorological Data File

The meteorological data files are stored on hard disk under the sub-directory C:¥HPDAT¥01XX. The data file name is expressed by one character and seven digits with extension consisting of two digits. The first character and the first digits shows us the kind of data. The next four digits indicated the station number. The last two digits and the extension shows the observation year. For example, the precipitation data observed at the station, 0601 in 1991 were recorded in the file named P2 0601 19.91. The P2 shows that the data file is for precipitation data.

(2) Hydrological Data File

All hydrological data are stored on hard disk under the sub-directory c:¥HDAT. These data are stored classified with the kind of data following sub-directory under that:

- BAS : for station description, yearbook and inventory files
- DGH : for mean daily gauge height files
- GHT : for staff gauge reading files
- DFL : for mean daily discharge files
- RT : for rating table files
- DM : for discharge measurement files
- DPPM : for mean daily sediment concentration files
- DSFL : for mean daily sediment transport files
- HGH : for hourly gauge height files

The sub-directory c:¥HDAT¥BAS contains the following files and sub-directories:

- BASI.DAT : file for station description data
- YRBOOK.DAT : file for yearbook data
- NOTES : sub-directory for note in yearbook publication
- WINVET.DAT : file for inventory of mean daily gauge height data
- QINVENT.DAT : file for inventory of mean daily discharge data
- YRBSED.DAT : file for sediment yearbook data
- SEDN : sub-directory for notes in sediment yearbook publication
- SINVENT.DAT : file for inventory of mean daily sediment transport
- PINVENT.DAT : file for inventory of mean daily sediment concentration
- DIG : sub-directory for data from digitizer

The sub-directories C:¥HDAT¥DGH, GHT, DFL, DPPM, DSFL and BGH contain for each year one data file. The sub-directories C:¥HDAT¥RT and DM contain for each stations one data file.

To transfer of files from the main data base to the other computer, sub-directory C:¥TEMP was created. This sub-directory contains the following sub-directories:

- GHT : for transfer of staff gauge readings
- DGH : for transfer of mean daily gauge heights
- DFL : for transfer of mean daily discharges
- DM : for transfer of discharge measurements
- BAS : for transfer of yearbook data
- RT : for transfer of rating tables
- HGH : for transfer of hourly water levels

The programmes DBIO, YRBOOK and YRBSED read and/or write automatically from/to these sub-directories. All data in the sub-directory C:¥TEMP can be deleted after transfer.

The detailed file structure in the data base is as shown in Tables 4.7 and 4.8.

4.8 Computer System

The DHM processes and stores hydrological data and meteorological data with separate system as follows:

(1) Computer System for Meteorological Data

The meteorological system comprised one IBM PS/2 80 for data base with 43 MB hard disk and two IBM PS/2 30 for data entry without hard disk at the Central office in 1991.

(2) Computer System for Hydrological Data

The hydrological system was introduced by UNDP/WMO Project. In 1991, the hydrological system included one IBM PC-AT for data base with 32 MB hard disk and one IBM PC-XT for analysis with 10 MB hard disk at the Central Office and one IBM PC-XT with 30 MB hard disk for regional data base at the Western Regional Office. That computer at the Western Regional Office stored also meteorological data as shown in Fig. 4.7.

Beside above, one IBM compatible computer for general purposes and one read only optical disk device for back up of data were installed at the Central Office in 1992.

The DHM had one IBM PC-XT for data entry without hard disk at the Eastern Regional Office, one digitizer and one X-Y plotter and two IBM compatible computers for data entry without hard disk at the Central Regional Office installed by UNDP/WMO Project. These equipments have been broken.

4.9 Data Base Software

(1) Meteorological Data Base

The DHM has been developing the meteorological data base software by themselves with the language BASIC. The software for climatology data has been developed. That for

other parameters such as sunshine and wind are under developing at present. This software has the function to check logical error and statistical error.

(2) Hydrological Data Base

The hydrological data base software was developed by the UNDP/WMO Project in 1987. In 1990, that software was revised by the staff of the DHM to install it to the computer at the Western Regional Office.

It can store staff gauge reading record, hourly water level, rating curve, sediment concentration record, discharge measurement record, extreme value and station description record, edit, display, output to printer and floppy disk with ASCII cord and process data. It can also draw hydrograph on display and paper by X-Y plotter and enter data by digitizer. It will be able to estimate daily mean water level from staff gauge reading and also hourly water level, daily mean discharge from the daily mean water level and rating table, and sediment transportation record from daily mean discharge and sediment concentration record. The outline of process flow is as shown in Fig. 4.8, and the structure of software are as shown in Table 4.9.

4.10 Present Condition of the Regional Office in 1991

There are five developing regions, Eastern Region, Central Region, Mid-Western Region and Far-Western Region in Nepal. The DHM established Regional Offices for each developing regions.

(1) Eastern Region

1) Organization

There are two offices in Eastern Region. One is for meteorological data in Dhankuta and another is for hydrological data in Dharan. Under the office in Dhankuta, there are four synoptic stations. They are Dhankuta, Okhaldhunga, Taplejung and Biratnagar synoptic station.

Only Eastern Regional Office, meteorological and hydrological section is divided and the works of meteorology and hydrology have not been combined. Even if there is a hydrological gauge near from the meteorological gauge, the meteorological inspector does not take care the hydrological gauge.

2) Staff

There were one chief works for senior hydrologist of gazetted class II and he also works as hydrologist of gazetted class III. There were one meteorologist of gazetted class III, five senior hydro-meteorological assistants of no gazetted class I, one silt analyst of no gazetted class I, three junior hydro-meteorological assistants of no gazetted class II, two field assistant of no gazetted class III and one lab boy of no gazetted class IV in Eastern Regional Offices as technician.

There were one senior hydro-meteorological assistant of no gazetted class I, one junior hydro-meteorological assistant of no gazetted class II and one field assistant of no gazetted class III in every synoptic station. But only in Taplejung synoptic station, there was no senior hydro-meteorological assistant as technician shown as Table 4.2. Beside the DHM staffs, one GDS staff are dispatched.

3) Condition of Data Collection

There were 28 hydrological stations and 53 meteorological stations in Eastern Region and the distribution of them is as shown in Fig. 4.9.

The condition of hydrological and meteorological data collection was good and almost all the data were sent to the Eastern Regional Office within three months.

Recording charts of automatic rain gauges and water level gauges, and discharge measurement record are collected and forwarded by staffs of the Regional Office irregularly. Sediment sample bottles are carried by bottle runners employed by the DHM to the laboratory of the Regional Office irregularly once a month.

a) Meteorological Data

The condition of data collection was good shown as Table 4.10. There were 54 stations listed in the table. Among these stations, there were two stations that condition was not good. The index numbers of those stations were 1311 and 1323. These stations were near by Dharan. The access was very good from the office at Dhankuta.

b) Hydrological Data

There was no register for data collection. Asking the staffs at Eastern Regional Office, the condition of data collection was investigated and it was as shown in Table 4.11. According to that table, the condition of data collection was good. All of the data were collected within one month.

4) Data Processing

The Eastern Regional Office has a computer of IBM PC-XT for data entry without hard disk installed by UNDP/WMO Project. But it was broken when earthquake occurred in 1987. After that, the data was processed manually.

The condition of data processing for meteorological data was not so bad. But the condition of hydrological data was not so good referring Table 4.12. Among of 28 stations operated by the office, the rating curves only for 4 stations were processed up to 1990. Up to 1989, those of 8 stations were processed. That number was about 29% of all stations. The Eastern Regional Office determined priority for data processing. The first priority stations were stations asked to be processed urgently by the Central office. The second priority stations were the priority station which have been determined as the priority stations by the Central Office. The index numbers of those priority stations were 600.1, 604.5, 670, 680, 690, 695, 728, 730 and 795. The lowest priority stations were the stations established and transferred from other organizations. The index numbers of the transferred stations were 598, 599, 688.7, 689 and 799. The rating tables of these lowest priority stations had not been processed.

5) Data Arrangement

There was no register for data collection. But Dhankuta office made register and decided to start recording. The letterhead was used as register for data sending to the Central Office.

The data were filed and kept in the cupboard. Dharan office put labels behind the file. It was easy to find objective data. But Dhankuta office did not put label behind the file. It was not so easy to find for outsides.

Dharan office put the pictures of gauging stations on the wall pointed the installed place on the map. Those pictures are very useful to maintain gauging stations.

6) Sending of Data

The data were sent to the Central Office twice a year by the staffs.

(2) Central Regional Office

1) Organization

The Central Regional Office was divided from the Central Office and established in 1990. Under the Central Regional Office, there was one synoptic station at Simara.

2) Staff

There were one senior meteorologist of gazetted class II, one hydrologist of gazetted class III, one meteorologist of gazetted class III, three senior hydro-meteorological assistants of no gazetted class I, five junior hydro-meteorological assistants of no gazetted class II and two field assistants of no gazetted class III in the Central Regional Office as technician in 1991. In the Central Regional Office, there is one GVS staff.

There were one senior hydro-meteorological assistant of no gazetted class I and one field assistant of no gazetted class III at Simara synoptic station as technician.

3) Data Collection

Although the density of post office distribution is highest in Nepal, about 50 km2/office, and the network of road is well developed in the Central Region, only 55% hydrological data were collected within five months. The 90% meteorological data is on the contrary seat within three months. The cause of bad condition for data collection did not result only from topographical/traffic conditions and access to post offices but managerial problem. The distribution of stations in the Central Region is as shown in Fig. 4.10.

a) Meteorological Data

There were 73 stations listed in the Table 4.10 in the Central Region.

The data sent from four stations of 0907, 0909, 0911, and 1024 had not arrived at the Central Regional Office within six months. The number was about 5.5% of total stations in the Central Office. The stations of 0907, 0909 and 0911 were in plane area and near the paved road. The station of 1024 was also near the paved road and in Kathmandu.

The condition of data collection from the stations which index number were 0919, 1002, 1103 and 1119 was also bad. This number was 5.5% of the all stations. The station of 1002 was in remote area. The station of 1103 was also in remote area but near from paved road. The station of 0919 was not so far from big town. The station of 1119 was plane area and near from east-west highway.

The reason why the condition of data collection above seven stations of 0907, 0909, 0911, 1024, 0901, 1103 and 1119 was not good was not only because of access. That of other stations, about 90% of all stations, was not so bad.

b) Hydrological Data

There were 41 stations listed in Table 4.11. The data recorded at 10 stations of 420, 446.2, 446.8, 447, 447.9, 450, 460, 507, 589 and 620 had not arrived at the Central Regional Office within six months. That number was 24% of all stations in the Central Region.

The stations of 420, 450, 460 and 589 were near by east-west highway. The number of 507 was very near from Kathmandu. The number of 447 and 446.8 was near by road. It takes four hours by car from Kathmandu to these gauges. The access of these stations was not so bad. the number of 446.2 and 620 was not so far from post office.

Although, inspector went to the field so much according to the Fig. 4.9 and the condition of traffic was not so bad comparing to other regions, the condition of data collection in the Central Region is not so good.

4) Data Processing

The condition of meteorological data processing was not so bad. The condition of hydrological data processing was not so good as shown in Table 4.12. There were much backlogs of rating curves without processing. But the German volunteer begun to process it.

5) Data Arrangement

There was a register for data collection. But the condition of data arrangement was not so good.

6) Data Sending

The Central Regional Office was in the same building of the Central Office. The data were brought to the computer room directly.

(3) Western Regional Office

1) Organization

The Western Regional Office is in Pokhara. Under the Western Regional Office, there are two synoptic stations. One is at Pokhara and another is at Bhairahawa.

2) Staff

There were one chief working for senior hydrologist of gazetted class II, one hydrologist of gazetted class III, one meteorologist of gazetted class III, three senior hydro-meteorological assistants of no gazetted class I, one silt analysis of no gazetted class I, four junior hydro-meteorological assistants of no gazetted class II, three field assistants of no gazetted class III and one lab boy of no gazetted class IV as technician in Western Regional Office. There were senior hydro-meteorological assistant of no gazetted class I and one field assistant of no gazetted class III in Pokhara synoptic station as technician. there were one senior hydro-meteorological assistant of no gazetted class I, one junior hydro-meteorological assistant of no gazetted class II and one field assistant of no gazetted class III at Bhairahawa synoptic station, shown as Table 4.2. Besides the DHM staff one GDS staff is dispatched.

3) Data Collection

There are fifty seven meteorological gauging stations and 25 hydrological stations in the Western Region as shown in Fig. 4.12. Among these stations, the arriving date from 18 stations is investigated. The investigation revealed that the data from these 18 stations were collected within one or two months. From this fact, the condition of hydrological data collection may be judged to be good.

The 84% of meteorological data are collected within three months in the Western Regional Office. Almost stations of which data collection is delayed are in the northern part of the Western Region. This part is the mountainous and high altitude area and the density of post office is low.

a) Meteorological Data

There are 57 gauging stations in Western Region referring Table 4.10. The data of 43 stations arrived at Regional Office within one month, those of 46 stations arrived within two months and those of 50 stations arrived within three months. The 75% of the data were collected within one month, 80% of the data were collected within two months and 87% were collected within there months.

The index numbers of the stations that condition of data collection is not good are 0608, 0610, 0612, 0702, 0715, 9801, 0806, 0811, 0815, 0821 and 0823. The stations of 0608, 0610, 0612, 0801, 0806 and 0823 are in remote area. And the station of 0702, 0715, 0811, 0815 and 0821 are near from covered road.

b) Hydrological Data

The detailed information about hydrological data collection could not get in first field investigation in 1991.

4) Data Processing

The UNDP/WMO Project installed the computer IBM PC-XT for data entry without hard disk at the Western Regional Office. The GDS put hard disk into that computer later and copy the revised software for hydrological data base and also the programme for data entry of temperature and precipitation into the computer. The record sent from gauging stations are processed by the computer at Western Regional Office and they can be transferred into the data base at the Central Office with floppy disk. The Western Regional Office have already entered almost of the current and historical data into computer.

Referring Table 4.12, the 26 stations were listed in that table and the rating curve and rating table of 9 stations were processed up to 1989. The number was about 35% of all stations in the Western Regional Office.

It was difficult to measure more than three times a year because of lack of the budget in 1991. The number was too small to make rating curve. This was one of the reason why it was late to process it.

5) Data Arrangement

The Western Regional Office has the register for data collection.

When the data were sent to the Central Office, the letterhead recorded the station number, name and period was put with that data. The duplication of the letterhead was also kept at the Western Regional Office.

The processed and original data were filed and kept in the cupboards. But indicator was not put to the file and it took a little time to looking for the object file for outsiders.

6) Sending of Data

The data were sent to the Central Office by floppy disk twice a year and original sheet were sent once a year.

Comparing with other Regional Offices, that number of data transfer was smaller than other Regional Offices. But the data had already entered into floppy disk before they

were sent to the Central Office and as soon as they arrived, they could be entered into the data base though floppy disk.

(4) Mid-Western Regional Office

1) Organization

Mid-Western Regional Office is in Birendranagar alias Surkhet. Before 1990, the hydrological section of Mid-Western Region was in Nepalganj and the meteorological section was in Surkhet. These two sections were combined on February 1990 and the office is in Surkhet now.

There are three synoptic stations under the Mid-Western Regional Office and those are in Surkhet, Jumla and Dang. One senior hydro-meteorological assistant is sent to Dang synoptic station for management of hydrological stations. Because the access from Surkhet to Dang area is not so good and there are seven hydrological stations in Dang area. It is convenience to stay near Dang area for management of these gauges. The sediment laboratory is also at Dan Synoptic Station, because almost of the sediment stations are near from Dang area.

The belongings of some stations in Karanali River Basin were transferred from Far-Western Regional Office to Mid-Western Regional Office. The Far-Western Regional Office was at Chisapani before 1991. Some stations near from Far-Western Regional Office at Chisapani were belonging to the Far-Western Regional Office, even if they were in Mid-Western Region. But the Far-Western Regional Office was transferred to Nepalganj in 1991 and these stations in the Mid-Western Region were transferred to the Mid-Western Region.

2) Staff

There were one chief for senior hydrologist of gazetted class II, one hydrologist of gazetted class II two senior hydro-meteorological assistants of no gazetted class I, one silt analyst of no gazetted class I, one junior hydro-meteorological assistant of no gazetted class II and three field assistants of no gazetted class II, three field assistants of no gazetted class III and one lab boy of no gazetted class IV as technicians in Mid-Western Regional Office. But one senior hydro-meteorological assistant is sent to Dang synoptic station. There was one staff of GDS besides the DHM staff.

There were one senior hydro-meteorological assistant of no gazetted class I, one junior hydro-meteorological assistant of no gazetted class II and one field assistant of no gazetted class IV in each synoptic stations shown as Table 4.2 in 1990.

3) Data Collection

The Mid-Western Region is the largest among five regions in Nepal and the most remote area with high altitude in Nepal. The post office distribution density is about 150 km^2/office, which is half of the national average as shown in Fig. 4.13 and table 3.1. But almost of data are collected within three months as shown in table 4.10 and 4.11.

a) Meteorological Data

There were 44 stations in the Mid-Western Region. Among these stations, the record observed at nine stations were sent for more than three months at once and those station numbers were 0303, 0312, 0401, 0404, 0413, 0415, 0418, 0505 and 0509.

The data observed at nine stations arrived late at Regional Office. Those index numbers of the stations are 0311, 0404, 0406, 0409, 0412, 0414, 0415, 0510, and 0515.

The stations of 0413, 0415, 0418, 0505, 0509, 0409, 0412, 0414, 0415, 0510 and 0515 were in southern part of Nepal near the eastern-western highway. But some of them were collected by Dan Synoptic Station and it took time to arrive to transfer these data to the Regional Office.

The stations that index numbers were 0312, 0404 and 0406 are near the town. Especially 0406 was near Mid-Western Regional office. It was not so difficult to collect data.

The thermometer of 0311 was broken and the record could not be collected.

b) Hydrological Station

There were 27 stations in the Mid-Western Region. Among these stations, eight stations 208, 209, 215, 245, 265, 287, 288 and 360 were not so good condition the data collection. That number was about 30% of the listed stations. Except 360, those stations were near by the boundary between Mid-Western Region and Far-Western Region. Almost of these stations were belonged to the Far-Western Regional Office before and transferred to the Mid-Western Regional Office in 1991. It is because the condition of data collection for these station was not good.

4) Data Processing

Once, the Mid-Western Regional Office had a computer. But it has been broken and brought to the Central Office for repair.

The condition of meteorological data processing was not so bad. But the condition of hydrological data was not good as shown in Table 4.12. Almost of the rating curve had not been processed yet. But the GDS staff started making rating curve.

5) Data Arrangement

There was register recorded the arriving date of the data from gauging station. The chief controlled the data collection if necessary referring this register.

When the data were sent to the Central Office, the letterhead recorded the station number, name and period was put with and the copy of that was kept as the inventory for data sending.

Much data, transferred from Far-Western Regional Office on February 1991, were stored in the cupboard without arrangement.

Almost of the data were filed and stored in cupboard without label.

6) Sending of Data

The data were sent to the Central Office every three months by the staff of the Mid-Western Regional Office.

(5) Far-Western Regional office

1) Organization

The Far-Western Regional Office is in Dhangadhi. Under the Far-Western Regional Office, there are three synoptic stations at Dhangadhi, Dipayal, and Dadeldhura and one hydrology station at Chisapani.

In Chisapani, there is the office of Chisapani Multipurpose Project. To cooperates with Chisapani Multipurpose Project for observation, the hydrology station is installed at Chisapani.

On February 1991, the Far-Western Regional Office was transferred from Chisapani to Dhangadhi. The office of Far-Western Regional Office was small and furniture is not enough for work.

2) Staff

There were one chief of senior meteorological of gazetted class II, one hydrologist of gazetted class III, two senior hydro-meteorologists no gazetted class I, one silt analyst of no gazetted class I, one junior hydro-meteorological assistant of no gazetted class II and two field assistants of no gazetted class II as technician at Far-Western Regional Office. There are one senior hydro-meteorological assistant of no gazetted class, one junior hydro-meteorological assistant of no gazetted class II and one field assistant of no gazetted class III as technician at Dipayal and Dhangadhi synoptic station. There were one senior hydro-meteorological assistant of no gazetted class I and one field assistant of no gazetted class III as technician at Dadeldhura synoptic station. There are one senior hydro-meteorological assistant of no gazetted class I, two junior hydro-meteorological assistants of no gazetted class II and one field assistant of no gazetted class III as technician at Chisapani hydrology station, under Far-Western Regional Office.

3) Data Collection

The Far-Western Regional Office has Chisapani Hydrology station. Some of hydrological data observed in the Karnali River basin are collected by the staffs of this station and it takes time to transfer to the Far-Western Regional Office. This is why 42% of the hydrological data did not arrive at the Far-Western Regional Office within two months as shown in Table 4.11.

Meteorological data collection is very smooth in spite of difficult topographical and traffic condition. Although the Far-Western Region is extended in remote area, all the meteorological data are collected within three months as shown in Table 4.10.

The network for the observation station is as shown in Fig. 4.14.

4) Data Processing

The condition of meteorological data processing was not so bad. But the condition of hydrological data was not so good as shown in Table 4.12. Almost of the rating curve had not been processed yet. But they began to make rating curve by themselves from 1991. The chief was trying to process it by himself. The Chisapani Multipurpose Project Office cooperated with the DHM hydrology station at Chisapani and observed, processed and analyzed together.

5) Data Arrangement

There was not enough cupboards for data arrangement. It seemed to be a little bit difficult to arrange data. But the condition of data arrangement was not so bad, because the number of stations belongings to the Far-Eastern Regional Office was not so much. There was the register recorded the data arriving date.

4.11 Present Condition of the Central Office in 1991

(1) Data Collection

All the processed and original data are sent to the Central Office from the Regional Offices by the staffs with letters describing the station cord numbers, station names and terms of the records, after processing at the Regional Offices. At the Regional Offices, these letters are kept as evidences of the data sending. The original data such as chart, paper form notebook type form and synoptic station form are sent to the Central Office once a year. The other data are sent several times a year. The number of data sending depends on management of each Regional Offices. But the date of data sending is not scheduled in advance. On the occasion of duty trip of the staffs of the Regional Offices to the Central Office, they bring data by the public bus or airplane.

At the Central Office, meteorological acquisition unit in the Other Technical Services Section puts the sign on the data collection register, when the data arrive from Regional Offices and the condition of data collection in 1991 is as shown in Table 4.13. Hydrological acquisition unit also began to put the sign in the same manner as meteorological data into the register. Although the meteorological data were stored in the cupboard with arrangement, the hydrological data were kept in the store room without arrangement.

(2) Data Processing

Basically, the data are processed at the Regional Offices by manpower. Then they are processed at the Central Office by computer in 1991:

1) Meteorological Data Processing

The condition of meteorological data processing was satisfactorily good. The 90% of daily rainfall data observed in 1989 were entered into the data base as shown in Table 4.14 and this work was scheduled to be finished within the year of 1991. The data were checked by the data entry programme of the data base automatically and by the meteorologist.

2) Hydrological Data Processing

The condition of hydrological data processing did not show good progress. The staff gauge reading records observed at 73 stations in 1989 were stored into the data base. That number was about 54% of all stations. The mean daily water level records observed at 18 stations in 1989 were converted from staff gauge reading records as shown in Table 4.16. That number was about 25% of the above stored staff gauge reading records. Discharge rating curves for almost all the priority stations have not been developed for the year from 1986. Consequently, discharge data after 1986 were not available for almost all the priority stations as shown in Table 4.17. Although the number of the stations of which discharge measurement records were stored in the data base was 230, the number of the stations of which rating tables were entered into data base was 64. Only 30% of the discharge measurement records were used to make the rating table. The condition of sediment concentration data entry in 1991 is as shown in Table 4.18. After 1988, almost of sediment data have not been entered into computer. The sediment transportation values are estimated from sediment concentration and daily mean discharge. The condition of sediment transportation data processing is as shown in Table 4.19. After 1985, the value of sediment transportation have not been estimated because of the progress for daily mean discharge value calculation.

The UNDP/WMO Project was started in 1982 and completed in 1987. This project processed observed data up to about 1985. It indicated that the DHM did not develop much data by themselves after that project.

The DHM attempted the detailed data processing schedule by themselves after the UNDP Project. But that plan has broken down, because almost staffs trained in the UNDP project were quit their job or transferred to the section not related to the data processing. After this failure, the data were processed without processing schedule, quality checking and management and much backlogs remained at the Central Office.

The DHM decided to transfer the function of data processing from the Central Office to the Regional Offices. Each Regional Office except for Far Western Region Office began to process data with the assistance of GDS staffs.

(3) Data Dissemination

Only the Central Office offers hydro-meteorological data and results of analysis to the users. The meteorological data and analysis results are disseminated in the form of summary report, data book, computer output, report on weather forecasting and radio

programme. The meteorological data books were published from the record in 1966 to 1986 in 1991. The radio programmes are broadcasted on Thursday from 7:20 to 7:30 for agriculture and from 7:30 to 7:45 for water resources in the morning. The hydrological data and information can be obtained by floppy disk and computer output list for the purpose of water resources project study after getting approval of the DHM. The year books have been also published for the hydrological data until 1985.

4.12 Training

The qualifications of the Hydrologists and Meteorologists are in general high, equivalent to a university degree, and they have opportunities to participate in technical training programmes offered by WMO, UNDP, UNESCO and other supporting projects. The senior Hydro-meteorological Assistants are experienced and have good technical knowledge transferred from the past supporting projects.

However, young junior Hydro-meteorological Assistants and Field Assistants graduated at School Leaving Certificate and Under School Leaving Certificate grades have difficulties to have such opportunities because their ability of language is insufficient. It is necessary to prepare alternate technical training programmes for them. Just in last year, the DHM in collaboration with GVS started their own training programme on Hydro-meteorology for them in Pokhara. One training programme for the technical staff was executed from October 1991 for a period of three (3) months. The field works are usually taught as on-the-job training by experienced technicians. For gauge readers, at the time of establishment or new employment a short guidance for observation is carried out and occasional spot instructions are given during inspection, if necessary. Their guidance is all verbal. Their main occupation is farming, business, or are employee in other agencies.

There are four German Volunteers at Mid-Western, Western, Central and Eastern Region. One of their activities is to train technicians through field works such as survey, discharge measurements, establishment and maintenance of water level gauging station and data processing.

5. SYSTEM ANALYSIS

5.1 Requirement Analysis

The Study Team investigated the requirement for the data management system by asking some questions to the staffs in the DHM Central Office and the chiefs of Regional Offices. The summary of the requirement were as belows:

1) DHM should offer not only hydrological and meteorological data but also the results of analysis for frequency analysis, low flow analysis, high flow analysis and so on.

2) Some chiefs of Regional Offices wanted to analyze by themselves. But the staffs of the Central Office do not have united opinion. Someone thought that data dissemination is enough for the function of Regional Offices. Someone thought basic analysis such as making of hydrograph was necessary for Regional Offices.

3) The DHM should analyze meteorological and hydrological characteristic by themselves. But according circumstances, the DHM can cooperate with other organization.

It was difficult to investigate the actual requirement, because most of the staffs did not have experience to process data by computer before and they did not have concrete image for the Data Management System. But the concrete requirement for the system was cleared by operating the Model System and they were used to make plan for the Long-Term Programme and the Immediate Programme later.

5.2 System Analysis on Present System in 1991

5.2.1 Problems

According to the investigation on the present condition of the DHM in 1991, some problems were founded as belows:

(1) About data transfer from gauging station to the Regional Office

1) The data are sometimes sent to the Regional Office for two or three months at once.

2) Many stations are far from post offices that serve register mail. There are stations from which it takes one or two days walk to go to such post office.

3) There are observers who do not send data by mail and give it when inspector comes to pays them salary.

4) When observer goes to the post office, sometimes stamps are sold out. In this case, observer cannot send data by mail.

(2) About the works of the Regional Office

1) The data are duplicated by manpower. Sometimes staff makes mistakes to duplicate data.

2) The staff must calculate using calculator without computer. It takes time and staff sometimes makes mistake.

3) The number of the staffs who can make it and the number of discharge measurements is not enough to make rating table. It is difficult to increase the number of discharge measurement because of lack of budget.

4) There is no manual for hydrological data processing and data checking except for operation manual for data base software. For meteorological data, there is a manual but it is too old to use.

5) Desks, chairs and cupboards are not enough at Regional Offices, especially Far-Western Regional Office, Mid-Western Regional Office and Central Regional Office.

6) The inspector sometimes forgets to bring data which have not arrived at Regional Office.

7) The condition of data storing is not so good.

(3) About data sending from Regional Offices to the Central Office

1) Although, original data are sent to the Central Office once a year, the processed data are sent several times a year. When the staff makes mistakes to process data at the Regional Office, it is sometimes difficult to check data at the Central Office without original data.

2) Although the amount of data is not so small and the condition of traffic is not so good, the staff bring them by hand.

3) It is sometimes difficult to make schedule for data processing at the Central Office, because the data are sent to the Central Office irregularly.

(4) About the works of the Central Office

1) There is no useful manual for data processing, data checking and data management, except for operation manual for data base.

2) The staff for data entry works for only four hours a day averagely.

3) There is not staff who has officially responsibility to check data and manage data entry.

4) It is very late to make rating table. Even if the water level records are entered, the discharge can not be calculated without rating table.

5) There is no systematical rule for data dissemination to user. If there is guide or form for data request, it becomes easily to offer data.

6) The condition of data arrangement is not so good. There are not enough and suitable cupboards in data acquisition unit to store data.

7) The meteorological data output are filed and stored into cupboards for referring. Sometimes, the data are lost, because some users bring the data without returning.

8) There is no regular training course on ordinary DHM work for observers and staffs in DHM. The training course how to observe, check data and process data is important to keep quality of data.

5.2.2 Improvement

Analyzing these problems in the view points; correct, fast, economical and comfortable, the main targets to improve present system were found as follows.

1) How to collect data quickly

2) How to duplicate correctly, quickly and comfortably at the Regional Office.

3) How to process correctly and quickly at the Regional Office.

4) How to process rating curve and table correctly, quickly and comfortably at the Regional Office.

5) How to check data correctly, quickly and comfortably at the Regional Office.

6) How to send data to the Central Office quickly and comfortably.

7) How to enter data quickly and economically.

8) How to store hydrological data correctly and quickly at the Central Office, and

9) How to check hydrological data correctly, quickly and comfortably.

6. MODEL SYSTEM

6.1 Purpose of the Model System

The Model System of the hydro-meteorological observation and data management is examined, established and operated for the purpose of:

1) attempting several ways of observation, data collection and data management in the Model System and to help to formulate more practicable Long-Term Programme by taking account of the results of the above attempts,
2) transferring technology through planning, establishment and operation of the Model System,
3) strengthening the existing observation and data management systems by installing new gauges and new management systems including computer facilities in the Model System. New management system includes providing computers and data entry in Regional Offices with manpower training, and
4) accumulating reliable observation data by operating the Model System for a long-term and to use them for detailed meteorological and hydrological studies of the basin.

6.2 Basic Concept for the Model System

The Model System was designed based on following basic concept:

(1) Monitoring Station

The records observed at the river gauging stations and precipitation stations in the model basins, Kaligandaki and Jamuni River Basins, and priority river gauging stations in Nepal were collected, processed and registered into data base to study characteristics of each five development regions in the Model System.

(2) Observation Item

Observation items for the Model System were 1) daily and continuous precipitation, 2) daily and continuous water level, 3) discharge measurement, and 4) suspended sediment concentration. The discharge measurement activity includes those by using floats and measuring surface water profile reading staff gauges.

(3) Items to be attempted in the Model System

The items to be attempted in the Model System were as follows:

1) Study on the necessity of branch office

Ordinary, the Regional Office collects data from gauging station. But there is the case that the branch office, Chisapani Hydrology Station, collects data and sends them to the Far Western Regional Office at present. This data flow is the same with the alternative plan of D-2 (see 6.3). The necessity of branch office for data collection and observation was studied in the Model System by investigating the actual condition of branch office at Chisapani.

2) How to collect data

In this System, the actual condition of data collection by mail was examined. In the Long-Term Programme, the number of precipitation station will be increased, especially in the mountain and hill area. In the Kali Gandaki model basin, the effect of data collection by mail in the remote and mountain area was studied with actual surrounding conditions. The wireless system was also examined for the data collection.

3) How to process data at Regional Office

To try to process data at the Regional Offices by computer, personal computer system was installed at each Regional Offices. Using these computers, processing schedule, staffing, effective training for operation, characteristics such as electric conditions and benefit using computer were examined.

Installing the data logger system in the Kaligandaki river basin, possibility of expansion and effect of this system was also studied for correct, fast and comfortable data processing.

Making the preliminary manual for the Model System, the suitable manual for the DHM was examined by discussing with the staffs in the monitoring term.

In the monitoring term, necessary training menu for the DHM staff was studied and these results were used to plan the training menu for the Long-Term Programme.

4) Annual schedule for data management

Trying the actual data collection and processing works, the effective annual data processing schedule was examined, considering the present staffing, processing speed, fiscal year of Nepal and so on.

5) Effective way of data checking

Making the sample of checking list and manual, the effective way for data checking was studied.

(5) The Way to Avoid to Disturb Present Works of DHM

In the Model System, the observed data were processed actually by the DHM staffs without disturbing of daily work as follows:

1) The data processed by the Model System were entered into present data base system to help present data processing work.
2) Basically, Model System was operated by the present organization and staffing of the DHM, as much as possible.
3) The data were processed by the present software for the present data processing system in the DHM.

(6) Meteorological and Hydrological Study in the Model Basin

For the meteorological and hydrological studies in the model basin, the computer system for analysis was installed at the Central Office. This computer system was also used for new data base system till 1995, after transferring the present data base software and stored data on December 1992, because the remaining memory size of present computer is only 4 MB and it will be too small to use till the target year of 1995 for Immediate Programme.

6.3 Data Processing Mode

In order to find the most suitable data flow and management system, ten (10) alternative plans were made combining some alternative data collection routes and data processing places. These alternative plans were named as A, B-1, B-2, C-1, C-2, C-3, D-1, D-2, D-3 and D-4, as shown in Fig. 6.1. The character of A indicates that there are no Regional Offices and branch offices. The character of B shows there are Regional Offices without branch office and the data are collected by Regional Offices and the Central Office. In case of C, there are Regional Office without branch office and the data are collected only through Regional Offices. The D character shows the data are collected through regional

offices and branch offices. The integral number of the alternative plan shows the difference of the data processing place.

These alternative plans were evaluated from the viewpoints of correct, fast, economical and comfortable operation by the score numbers from 1 to 4. From evaluation, the plans of C-1, C-2, D-1 and D-2 got higher score than other plans for this Data Management System as shown in Fig. 6.1.

Among these preferable four plans, the plans of C-2 and D-2, that are decentralization processing mode, are more suitable than those of C-1 and D-1, that are centralization processing mode, because of the trend, the problems in the present systems and the demands as follows:

1) The DHM transferred the all functions of data processing roles from the Central Office to the Regional Offices. It indicate that the centralization mode was not suitable for the DHM.

2) The UNDP/WMO Project conducted in 1982 to 97 recommended the decentralization mode for data management as the result of that project,

3) The DHM had processed data by centralization processing mode before. But much backlogs remained actually at the Central Office due to insufficient system and less management, and

4) There were demands that the staffs of the Regional Offices wanted to process data by themselves.

After monitoring in the Model System, the evaluation on the suitable mode was carried out again referring the result of the Model System and the final optimizing plan was chosen latter.

The chosen plans, C-2 and D-2, collect and process data at Regional Offices. That data flow is similar to the present data flow of the DHM in 1992. It indicated that the Long-Term Programme must be planned aiming to improve present system of the DHM. Based on above data flow, the roles of each offices in the Long Term Programme were preliminarily determined improving, reinforcing or adding necessary work items to the present data management system as follows.

(1) Work at Regional Offices

1) Data collection from observation stations