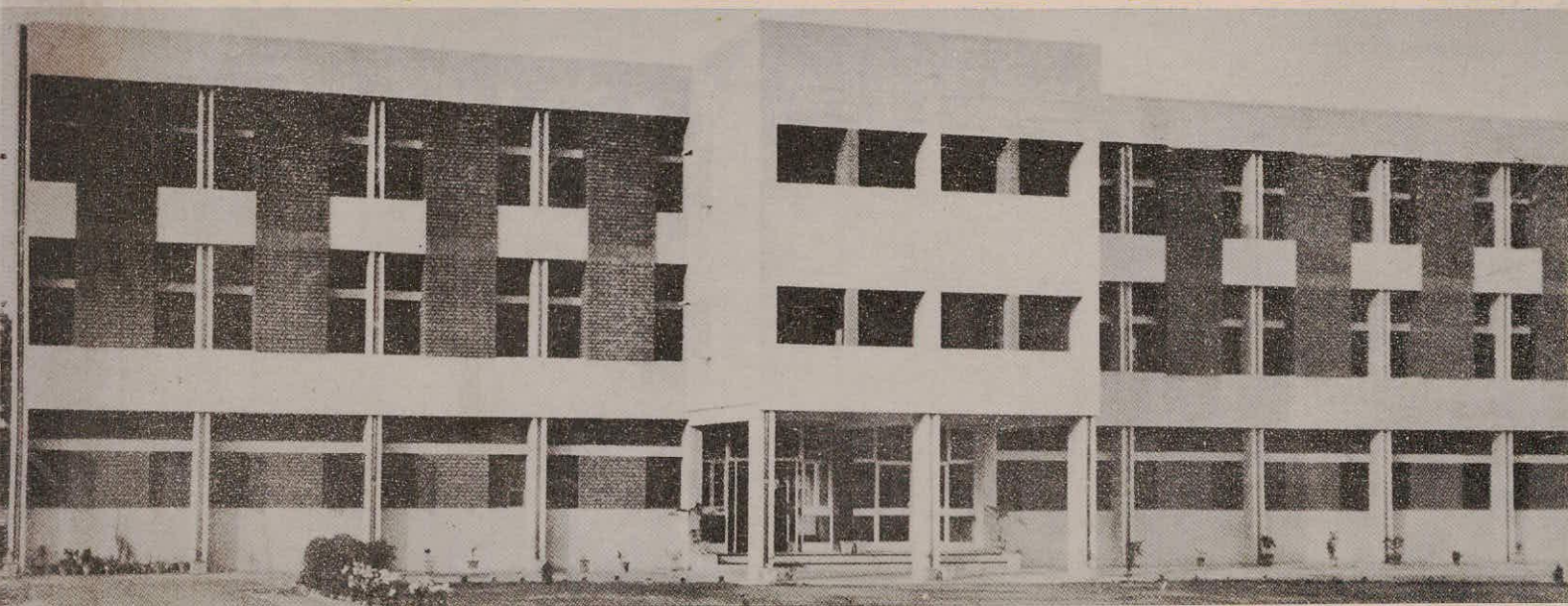


annual report
1985-86

national
institute of hydrology



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NATIONAL INSTITUTE OF HYDROLOGY

ANNUAL REPORT 1985-86



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1. INTRODUCTION

1.1 General

The National Institute of Hydrology was set up in December 1978 by Government of India as a registered Society under the Societies Registration Act 1860 fully aided by Ministry of Water Resources (formerly Ministry of Irrigation and Power, Department of Irrigation). The Institute is located at Roorkee. The Union Minister of Water Resources is the President of the Society and Secretary to Government of India, Ministry of Water Resources is the Chairman of the Governing Body.

The Institute is located within the campus of University of Roorkee on 6.5 acres of land provided by it on long term lease to the Institute. The main building of the Institute is in use since December 1982. A Laboratory Block has been constructed during the year and infrastructural facilities are gradually becoming operational.

1.2 Objectives

The National Institute of Hydrology has been established :

- (i) To undertake, aid, promote and coordinate systematic and scientific studies in theoretical and applied hydrology so as to improve the present practices in planning, design and operation of water resources projects.
- (i i) To cooperate and col aborate with other national and international organistations in the field of hydrology.
- (iii) To establish and maintain a research reference library in pursuance of the objectives of the Society and equip the same with books, reviews, magazines, newspapers and other relevant publications, and
- (iv) To do all other such things as the Society may consider necessary, incidental or conducive to the attainment of the above objectives.

1.3 Work Review

During the first five years, the Institute had laid emphasis on creation of necessary infrastructural facilities like buildings, recruitment of staff, training of manpower and provision of computer facilities generally with a view to conduct computer oriented studies in the 8 priority areas of research that were defined by the Governing Body and Technical Advisory Committee. The Institute has procured, implemented and tested a number of computer programmes covering the areas of frequency analysis, rainfall-runoff modelling, flood estimation, reservoir operation and groundwater modelling.

The Institute has acquired a sophisticated fourth generation VAX-11/780 computer system with various peripherals including a colour graphic terminal under the UNDP project. Besides this, a number of computer peripherals, an automatic hydrologic station and some field and laboratory equipment have also been procured under this project. The Institute has established a good library equipped with scientific and technical books and journals in hydrology and related areas. The British Council has also contributed some books and technical literature for the library. The UNDP project has also provided training to 17 scientists in diversified areas representing various components of the hydrologic system. The former Director of the Institute and a senior scientist also undertook study tours under this project. The Chief Technical Adviser and 4 consultants visited the Institute under the project and helped in the development of its research programme.

The Institute carried out various activities as per the studies and research programme during the year 1984-85. The reports pertaining to the period 1979 to 1984 were finalised and got printed. Additional studies and research were initiated during 1984-85, and 38 reports were prepared, and got printed and circulated to state and central government organisations.

During the year 1985-86 various activities and works as per the approved programme were carried out. 64 reports of various categories Review Notes, User's Manuals, Status Reports, Technical Notes, Case Studies, and Manuals were finalised and were printed for circulation to state and central government agencies. Besides studies and research in various scientific divisions, the technology transfer activities through organisation of workshops and seminars, and visits to states were also carried out. Workshops covering Unit Hydrograph Techniques, VAX-11/780 Computer System, Flood Frequency Analysis, Ground Water Modelling and Observation, Processing and Analysis of Precipitation Data were conducted at Roorkee. Workshops on Flood Frequency Analysis were also organised at Guwahati and Calcutta. A seminar was also organised on Flood Frequency Analysis at Delhi on September 30, 1985.

The EFC Memo for the development and expansion of the Institute during the Seventh Five Year Plan period (1985-90) was finalised during the year under report. At the time of establishment of the Institute, it was realised that in order to carry out different activities at national level and to meet the objectives, it would be necessary to have a well balanced growth of facilities including computer, laboratory and field oriented research, use of latest technological development in the areas of instrumentation, electronics, remote sensing, nuclear techniques etc. for conducting research. The current drought situation in many states has focused attention on the need for systematic study of phenomena of drought particularly from hydrological considerations. On realising the gravity of the problem, the Institute has established a Drought Studies Division with effect from 28 February 1986 and it has been included as one of major fields for studies and research at the Institute. During 1985-90 additional scientific divisions, related laboratories and regional centres would be set up in order to establish capability and conducting field oriented studies in different regions of the country. As provided in the plan for 1985-90, during the year 1985-86, the facilities have been created in the 9 major fields of study and four laboratories have been established as given below :

Major Fields :

- (a) Surface Water Analysis

- (b) Surface Water Synthesis
- (c) Integrated Planning
- (d) Ground Water Analysis
- (e) Ground Water Synthesis
- (f) Hydrological Investigations
- (g) Remote Sensing Applications
- (h) Information System, Computer Centre and Services
- (i) Drought Studies

Laboratories :

- (a) Ground Water including Water Quality
- (b) Nuclear and Hydrological Investigations (including field investigations)
- (c) Remote Sensing Applications
- (d) Services, Instrumentation Workshop

The laboratory in the area of surface water would be established after the necessary building and other infrastructural facilities for the same have been created.

The Institute has also to cater for the hydrological problems of different regions of the country which are unique due to differences in climate, geography, land use and cover characteristics, soil drainability, environmental conditions, state of development etc. In order to carry out systematic studies in representative and experimental basins, it has also been proposed to set up regional centres, which will have following main activities :

- (a) Review of existing regional formulae and develop suitable revised formulae making use of the data available.
- (b) Prepare year books of typical basins.
- (c) Establish representative basins and experimental catchments. Monitor data collection, data compilation, processing and analysis.
- (d) Compile, process and analyse the existing data.
- (e) Interact with state agencies and extend help in conduct of hydrological studies.

The activities relating to the establishment of four regional centres as proposed in the EFC Memo have been initiated and it is expected that two regional centres would come into being during the next financial year.

In order to carry out the programme of work envisaged under EFC Memo proposal, the strength of scientists, scientific staff and other supporting staff will have to be considerably enhanced and infrastructure facilities improved by way of increased office space, laboratory blocks, auditorium and information museum-cum-recreation centre and trainee's hostel etc. At the time of establishment of the Institute, the University of Roorkee had provided some residential accommodation funded by UP Government. To house the present staff and proposed staff during the Seventh Five Year Plan, residential accommodation in the form of staff colony will be essential and has been proposed.

The Institute is, therefore, growing and proceeding in the right direction towards the fulfilment of objectives laid down at the time of establishment of the Institute. The studies and research activities are gaining momentum, and the expertise created in the Institute will contribute significantly to the assessment of water resources and their planning for optimal utilisation.

2. ORGANISATION AND MEETINGS

2.1 Society

The National Institute of Hydrology Society is the apex body and meets atleast once in a year. It reviews the progress and performance of the Institute towards the attainment of the objectives and gives such policy directions, as it may deem fit, to the Governing Body. The membership of the Society is given in Appendix-I.

During the year 1984-85, the meeting of the Society could not take place due to unavoidable reasons. The Fifth Annual General Meeting was held on April 2, 1985 to consider and approve the Annual Report and audited accounts for 1983-84. At this meeting the progress and performance of the Institute during 1983-84 was also reviewed.

The Sixth Annual General Meeting held on November 15, 1985 reviewed the progress and performance of the Institute during the year 1984-85, and approved the Annual Report and audited accounts for the year 1984-85.

2.2 Governing Body

The Governing Body is the executive body of the Institute to pursue and carry out the activities as per objectives of the Society, and implement the policy directions and guidelines laid down by the Society. The Governing Body exercises all executive and financial powers of the Society. The Governing Body is required to meet atleast once in each quarter of the financial year. The membership of the Governing Body is given in Appendix-II.

As per the requirements, four meetings of the Governing Body are required to be held in a year. These meetings were held on April 19, 1985; July 16, 1985; October 16, 1985 and January, 29, 1986. Several decisions concerning the administration of the Institute, creation of Regional Centres and Drought division; creation and recruitment of additional posts of scientists and other staff, creation of infrastructural facilities and amendment of working rules were taken up. Programme of studies and research of the Institute for 1985-90 was approved; and performance and progress of the Institute during 1985-86 were reviewed at these meetings and suggestions made for furthering the activities of the Institute. During the year revised budget for 1985-86 and budget proposals for 1986-87 were also considered and approved.

2.3 Technical Advisory Committee

The Technical Advisory Committee (TAC) is responsible for the technical scrutiny of the research programme of the Institute for inclusion in the Annual/Five Year Plans/External Assistance including

proposals for expansion of the Institute and recommend priorities. The Committee is expected to meet atleast once in six months. The membership of the Committee is given in Appendix-III

Two meetings of the Committee were held on April 24, 1985 and January 16, 1986. The programme of studies and research was discussed at these meetings. The technical programme of the Institute prepared for 1985-90 was considered by the Committee and organisational structure, research programme, establishment of laboratories, and initiation of field and laboratory research were considered; and recommended for inclusion in the EFC Memo proposal for 1985-90. The interaction with state governments and other organisations and activities for transfer of technology were also discussed by the committee. Three Working Groups for scientific divisions were also constituted.

2.4 Working Groups

As decided by the Technical Advisory Committee at its 12th meeting held on 24th April 1985, 3 working groups for the eight divisions of the Institute were constituted for reviewing the studies and research programme of the Institute. These working groups have Director of the Institute as Chairman, and members drawn from central and state government organisations and academic and research institutions. The membership of these working groups is given in Appendix-IV. The working groups provide interaction and coordination of the Institute with different organisations. These groups also review the studies and research work being carried out and advise on further studies to be taken up in each division.

Meetings of these working groups were held as given in Appendix-V. At these meetings the work programme of the Institute for 1985-90 was considered alongwith the work carried out till date and the suggestions made by various members were noted for appropriately incorporating in the work programme of the Institute.

2.5 High Level Technical Committee on Hydrology (HILTECH)

The High Level Technical Committee on Hydrology was constituted by the Government in 1982. The National Institute of Hydrology provides the secretariate to this committee. The main functions of HILTECH are to collect state of hydrological research in the country and to disseminate it; identify the areas of hydrology which need immediate attention; encourage national institutions to take up research, sponsor research and promote education and training programmes; foster collaboration with other countries, & coordinate effective participation by India in International Hydrological Programme of UNESCO and Operational Hydrology Programme of WMO, to disseminate information and improve standards to advise central and state government agencies, to carry out technical scrutiny of schemes and research programme of National Institute of Hydrology and examine its expansion proposals. The membership of this committee is drawn from various organisations in the country having interest in monitoring, evaluation, analysis and utilisation of water resources as is presented in Appendix-VI.

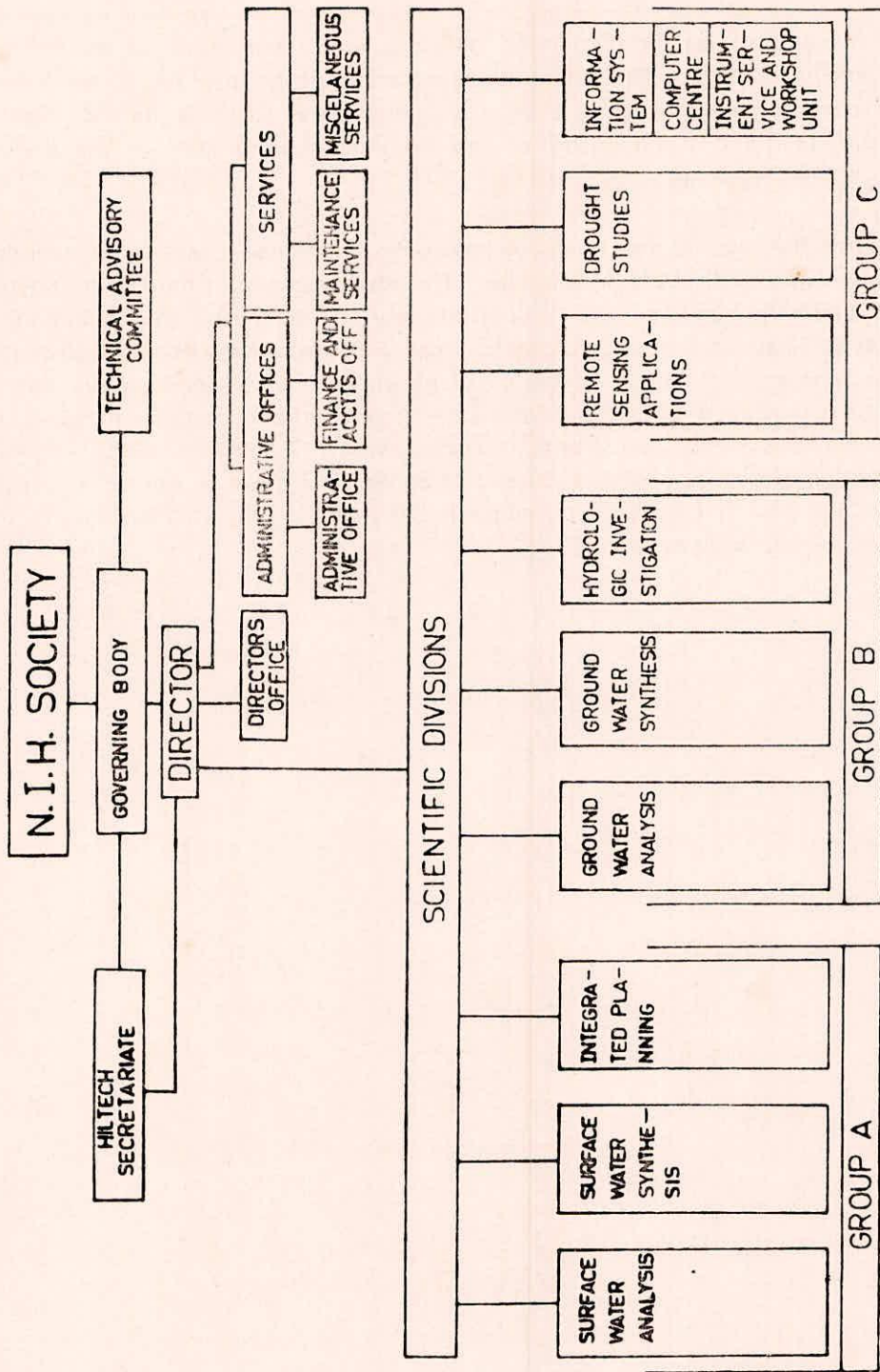
Four meetings of the HILTECH were held on May 16, 1985 at Delhi; August 19, 1985 at Hyderabad; December 3, 1985 at Delhi and February 14, 1986 at Nasik during the year. The committee has seven panels and three subcommittees to provide support to HILTECH in discharge of its functions. The composition of these panels and sub-committees is given in Appendix-VII.

2.6 Institute Personnel

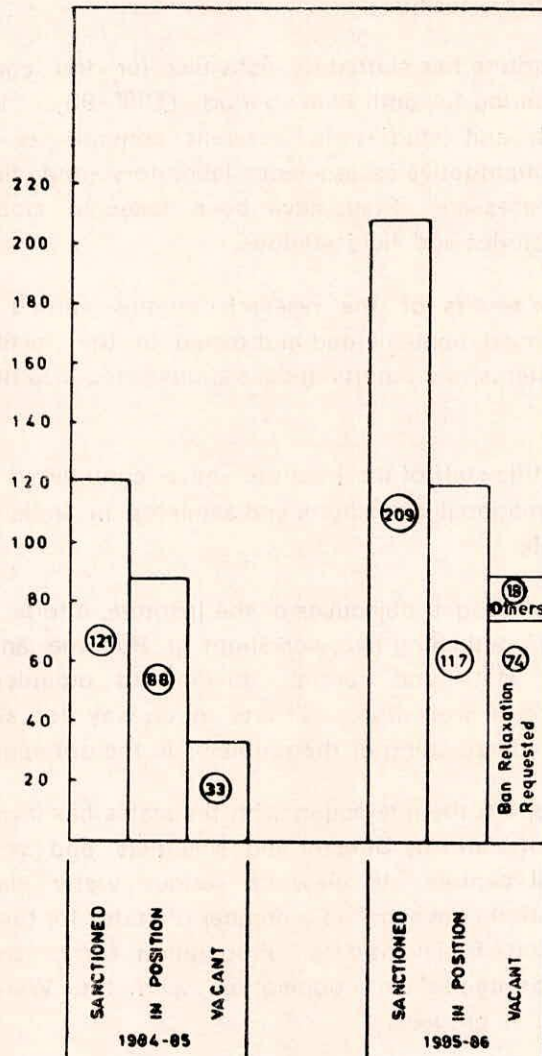
The Institute has nine scientific divisions and three units of administration, finance and miscellaneous services. The organisational structure of the Institute is presented in Chart-I. Out of 121 posts sanctioned during sixth plan period, the Institute had 22 scientists, 35 scientific supporting staff and 31 administrative and other supporting staff at the beginning of the year, leaving 33 vacant posts.

During the year, 68 new positions have been sanctioned besides the recruitment of non-plan staff provided for HILTECH Secretariate. The advertisement for the vacant posts at different levels were issued and selections held. During the year one Scientist F (on promotion), two scientist C, 7 scientist B, 22 supporting scientific staff, Chief Administrative Officer, Assistant Engineer and 12 other supporting staff joined. Other positions will be filled as soon as the ban on recruitment of these posts is relaxed. 17 scientists and other staff left the Institute for personal reasons, promoted or reverted back to their parent organisations leaving 117 Scientific and other personnel in position. The position of staff as on 1.4. 1985 and 31.3. 1986 are given in Appendix VIII, and status of staff during 1984-85 and 1985-86 is presented in bar chart II. The staff available in the Institute during the year is given in Appendix-IX.

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE ORGANISATIONAL STRUCTURE



BAR CHART FOR STATUS OF STAFF POSITION



3. ACTIVITIES DURING 1985-86

3.1 General

The Institute completed its first phase of establishment and development during 1979-85 which also involved UNDP assistance. The main emphasis during this period had been on creation of some of the essential infrastructural facilities like buildings, recruitment and training of manpower, provision of computer and library facilities.

During 1985-86, the Institute has started its activities for the consolidation, expansion and diversification as proposed during Seventh Plan period (1985-90). While continuing with the computer oriented research and studies in different components of hydrologic cycle, their interaction as well as their quantitative assessment; laboratory and field oriented research has been considered equally necessary. Steps have been taken to create necessary infrastructural facilities by setting up laboratories and field stations.

For dissemination of the results of the research studies carried out in the Institute and transfer of technology developed, implemented and tested in the Institute to various state and central government organisations, the reports under various categories have been prepared and are being widely circulated.

The scientists and scientific staff of the Institute have contributed to and participated in a number of national and international workshops and seminars in India and published a number of papers in scientific journals.

Towards achieving the envisaged objectives of the Institute, efforts of technology transfer to states have been initiated by conducting five workshops at Roorkee and one each at Guwahati and Calcutta. A number of state and central government organisations have deputed their engineers and scientists to these workshops. Efforts are on way for setting up regional centres for greater interaction and understanding of the problems in the different regions of the country.

During the year under report, the interaction with the states has increased significantly. Visits have been made to number of states by Director and scientists and actions have been initiated for establishment of regional centres. In view of serious water shortages created by recent drought, scientists of the Institute have visited a number of states for first hand assessment of the drought severity and collection of relevant data. Preparation for organising a two day seminar on 'Drought Management Strategies' in cooperation with the Water Resources Development Organisation, Karanataka are in progress.

Proposals for international collaboration have been initiated for obtaining knowhow and expertise in different problem areas of hydrology. The secretarial work of HILTECH and ARCCOH was being handled by the Institute and publication of the 'Hydrology Review' journal was resumed.

Construction of two storey laboratory block and extension to the administrative building have been completed. The quarterly newsletter of the Institute is being published regularly. The staff and scientists of the Institute are being encouraged to use Hindi in regular correspondence and in technical matter as well. Recreation and welfare facilities have been given due importance. NIH Recreation Club organised various cultural and sports activities during the year.

3.2 Studies and Research Activities

The studies and research activities of the Institute encompass different phases and the component processes of the hydrological cycle, their interaction and the influence of human activities on the quantity and quality of water resources. The research activities in the Institute were undertaken in the following 9 scientific divisions which include 3 new divisions namely; Remote Sensing Applications, Hydrological Investigations, and Drought Studies, which were added during 1985-86 :

- A. Surface Water Analysis
- B. Surface Water Synthesis
- C. Integrated Planning
- D. Ground Water Analysis
- E. Ground Water Synthesis
- F. Hydrological Investigations
- G. Remote Sensing Applications
- H. Drought Studies
- I. Information System

The results of studies and research work have been brought in the form of Review Notes, Technical Reports, Case Studies, User's Manuals, and Manuals; and these have been circulated to various state and central government organisations. A list of scientific and technical reports prepared during the year under report is given in Appendix-X.

3.2.1 Surface Water Analysis

The research activities in this division were carried out in the areas of stochastic hydrology, hydrometeorology and hydraulic and hydrologic routing. A number of review notes, case studies and user's manuals have been prepared covering important areas such as time series analysis, forecasting models, hydrometeorological studies, network design, effect of flood plain and channel processes on flood routing. Further studies have been initiated in the areas of atmospheric-land surface process modelling, estimation of snow cover and snow melt runoff modelling, overland flow, modelling of moving storms etc.

(i) Statistical approach

In the flood frequency analysis approach for estimation of design flood, annual series is generally used. Recently many technical articles have indicated advantages in using partial duration series approach particularly for situations where available data is limited. A case study for comparison of annual flood series and partial flood series approaches using 32 years data of Mortakka site in Narmada Basin was attempted. It has been seen that the results obtained by using a partial duration series model with exact theoretical approach are quite promising and have smaller sampling variance in comparison with annual flood series.

Time series analysis models and forecasting models are two very important areas of stochastic hydrology. Considerable research activities and applications to actual field problems have been reported in technical literature in recent years. In order for systematic study of these developments, review of literature in these two areas was taken up. Review of time series models indicates that for application of such models for Indian conditions (wherein non-monsoon flows in many rivers are almost negligible), it would be necessary to incorporate suitable modifications. Forecasting techniques have considerable potential for application particularly for real time operation of water resources systems and flood control operation of reservoirs. In this case also, it may be necessary to incorporate suitable modifications due to typical seasonal nature of flow in Indian rivers.

(ii) Hydrometeorological studies

Statistical analysis of long term monthly and annual rainfall data in Belgaum district were analysed using serial correlation, polynomial regression and cross correlation techniques. The analysis generally did not reveal any trend or periodicities in the full series. However, some falling trend was noticed in the rainfall series of Belgaum station in recent years.

To examine the suitability of recording raingauges for providing short duration precipitation data, a review of the available recording raingauges was undertaken. The vibrating wire strain gauge developed in Denmark seems to be quite promising for this purpose.

The raingauge networks designed for climatological purposes are sometimes found to be inadequate to provide realistic areal estimates of rainfall for hydrological purposes especially in regions of high spatial variability of rainfall. In view of this at the request of Rajasthan Irrigation Department network design of raingauges in Rajasthan has been undertaken and the rainfall normals updated using rainfall data upto 1980. Some of the latest techniques like cross correlation were used to determine an adequate network.

(iii) Rainfall runoff relationship

A number of empirical and semi-empirical approaches have been in use in India for the estimation of runoff from rainfall for the estimation of dependable water yield, design flood peak etc. A review of the available rainfall-runoff relationships has been made to assess their reliability for estimation of runoff from ungauged catchments and those with inadequate data.

(iv) Channel routing

Review notes on two important aspects of channel routing have been prepared, namely, effect of flood plain on flood routing, and effect of channel processes on flood flow and routing. Though different approaches were available for treating the effect for flood plain, the complexity involving meandering rivers makes modelling a complicated process. Some of the available models are applicable only to the rivers for which they were developed. Five channel processes namely, resistance to flood flow; general aggradation or degradation; planform modifying the characteristics; stage discharge relations; and shape of the hydrograph were identified. The review revealed that the river environment undergoes changes at varying rate and the changes may be seen in 10 to 30 years. A single high flood could change the river shape significantly. A user manual for using the Kalinin-Milyukov flood routing procedure which takes the slope of water profile also into account was prepared.

3.2.2 Surface Water Synthesis

The research activities in this division were carried out in the areas of flash flood studies, hydrologic routing, hydrological data processing, unit hydrograph studies and watershed modelling. A number of review notes, case studies and user's manuals have been prepared on the problems related to the above areas.

(i) Flash Flood Studies

For many parts of the country particularly for small basins flash floods pose serious problems. Many aspects are required to be studied for understanding this phenomena. These include meteorological and hydrological factors, man made activities etc. A review note has been prepared for bringing together all relevant information on the subject.

(ii) Dam Break Analysis

With the increasing encroachments of flood plains, the consequences of failures of dams become serious as was experienced in the case of Machu-II dam failure in Gujarat. The DAMBRK programme of National Weather Service, U.S.A. has been used for the analysis of this dam failure. Suitable failure pattern has been assumed and simplifications have been made with regard to gate openings. Two reports have been prepared dealing with data requirement and preparation, and application of this programme.

(iii) Flood Routing

The conventional flood routing procedure like Muskingum method generally available in text books do not have specific provision for incorporating the lateral flow in a river reach. A simple method based upon least squares technique has been developed to directly take into account the lateral flow and its validity has been demonstrated using test data.

(iv) Hydrological Data Processing

In dealing with hydrological data for different purposes one encounters various data related problems such as inconsistency, missing data, systematic and random error, broken records, outliers etc. For processing of such data, a systematic approach is necessary. A user manual has been prepared which provides details of the steps involved in processing of hydrologic data.

(v) Unit Hydrograph Studies

For dealing with ungauged and limited data situations in hydrologic design, it is necessary to develop suitable relationships between parameters of hydrological model e.g. unit hydrograph and catchment and climatic characteristics such as length, area, slope, mean annual rainfall etc. In the hydrological literatures many such studies and approaches have been reported. These have been reviewed and classified and presented in two review notes.

(vi) Tank Model

Tank model for analysis of daily and flood flow is a simple conceptual rainfall-runoff model developed in Japan. Such models are used for both humid and non humid basins. Tank model for daily analysis is capable of simulating the snow melt runoff. Two users manuals have been prepared for the application of these models.

(vii) Regional Flood Frequency Analysis

The study of three different techniques of regional flood frequency analysis viz., index-flood method, method based on the application of power transformation technique and the method based on regional parameters of Wakeby distribution and James-Stein corrected means have been made. The data of 18 stations of sub-zone 3-d, Mahanadi basin have been used in this study.

3.2.3 Integrated Planning

The division is assigned to work in the areas of reservoir operation, optimal allocation of water resources in a basin, resources management modelling in a watershed, forest influences on hydrologic cycle, sediment yield studies and water quality modelling studies. A number of technical reports, users manuals, review notes were prepared.

(i) Operation of Reservoirs

Streamflow varies in space and time. However, the demand exceeds the streamflow not only during non-monsoon season but also during the pre-monsoon, break monsoon and post monsoon seasons. Accordingly it becomes imperative to store the available water during monsoon for purposes like irrigation, power generation, water supply etc. Hence it will be necessary to optimally operate the reservoirs for beneficial uses. A manual on multi-purpose operation of a reservoir was prepared. A computer model for the optimum reservoir operation using dynamic programming approach was developed and documented. A user's manual for this study was prepared which would be of use for field engineers. Review notes on sedimentation in reservoirs was also prepared. A project proposal for the operation of Sabarmati system was prepared on the request of Government of Gujarat.

(ii) Water Quality Modelling

DOSAG model which was developed by Texas Water Development Board was procured and was implemented and tested on VAX-11/780 system. The model can calculate the BOD and the

minimum DO concentration in a particular stream system. An Indian river is considered for a case study and the data is being procured. A water quality laboratory, for conducting water quality surveys and analysis for generating data to be used in modelling, was established.

(iii) Forest Influence on Hydrological Parameters

The manipulation of forest vegetation in upland watersheds may be one way to alter the water budget of a catchment. The report brings out status of important research work done so far in India on the hydrological behaviour of forested catchments. Attempts have been made to review the effect of forests and forest management practices on hydrological parameters. The report attempts at emphasising the future research needs also. The influence of forests on their environment forms part of a vast and complex relationship between environment and forest vegetation. In this context, forests influences on various hydrological parameters, viz., rainfall, interception, infiltration, evapotranspiration, ground water, water yield, floods, water quality etc. have been described in the report which are based on studies conducted in India and abroad.

(iv) Sediment Yield from different Land Uses

The problems of erosion and subsequent sediment yield are very wide spread and are of great concern to hydrologists and water resources engineers. The phenomena of sedimentation affects the reservoirs, lakes, rivers and other water bodies. In this report, an attempt has been made to present the results of various experimental studies conducted by researchers in India for the amount of soil loss/sediment yield for different land uses. From the results of various studies a summary table has been derived which specifies ranges of sediment yield for each land use.

3.2.4 Ground Water Analysis

The research activities in this division were carried out mainly in the area of ground water balance (determination of elements), soil water accounting, return flow from irrigation, canal and stream, groundwater analysis in hard rock areas and stream aquifer interaction.

(i) Estimation of Evapotranspiration

Many investigators have studied rate of evaporation from soils where water table is at shallow depth. The rate of evaporation may be controlled by either the capacity of the atmospheric environment to evaporate water or the capacity of the soil to transmit water to the surface. A review note has been prepared which gives in detail the methods for estimation of evapotranspiration which consider both the soil properties and meteorological factors. It has been found that evaporation rate decreases with water table depth, more steeply in coarse textured soils than in fine textured soils.

(ii) Soil Water Accounting

The Soil Conservation Service method is the most widely used method for soil moisture accounting and estimating runoff amounts from agricultural watersheds. The soil type, land use and the hydrologic conditions of the cover are the various watershed factors that have been considered in this procedure. Further the relationships between rainfall and runoff for three antecedent moisture conditions are presented in the form of curve numbers. In light of the SCS method, a technical note has been prepared which examines the validity of this method for soil moisture accounting in basins of different land use.

(iii) Seepage study from Parallel Canals

Analytical solution has been derived for prediction of rise in water table due to seepage from two parallel canals. For this study it has been assumed that the water table is at large depth below the canal beds. It has been found that in the absence of any natural drainage the water table rise is conspicuous upto large distances from the canals. The zone in between the canals becomes stagnant and is vulnerable to water-logging problems.

(iv) Parameterisation of Hydrogeological Factors

Relationship of transmissivity with specific capacity for wells having negligible storage has been given by Walton. These graphs are used for estimation of transmissivity provided storage coefficient is known a priori. In the present study similar graphs have been developed considering well storage and variation of pumping rate with drawdown. The following cases have been considered : Case 1 - the pumping rate is independent of drawdown and is constant, Case 2 - the pumping rate is a linear function of drawdown. A set of type curves for a two aquifer system separated by an aquiclude has been presented. Use of the type curves for parameter estimation has been demonstrated using synthetic drawdown data. It has been shown that these type curves can provide a fairly accurate means for determining transmissivity and storage coefficient of individual aquifer from pump test conducted in a well open to two aquifers.

(v) Performance of Large-diameter well

Unsteady flow to a large-diameter well in a confined aquifer has been analysed for the case where the pumping rate is a quadratic function of drawdown. Results have been presented for variation of well discharge with drawdown and recovery of well storage with time. Variation of specific capacity of large-diameter well with time for different well storage has been studied. The relationships between transmissivity and specific capacity at various time after the onset of continuous pumping have been presented for different values of well storage and specific yield which can be used for estimating transmissivity.

(vi) Duration of Test Pumping

An attempt has been made to establish useful guidelines and procedures to decide the minimum and maximum duration of the test pumping. It has also been attempted to give the details of the parameters which may influence the decisions regarding the length of the pumping test.

3.2.5 Groundwater Synthesis

The research activities in this division were carried out in the areas of water balance studies, ground water modelling and development of type curves for large diameter wells which have adequate storage in them. A number of Review Notes, Case Studies and User's Manual are being prepared covering these important areas:

(i) Water Balance Studies

The water balance studies serve as a means of solution to improve theoretical and practical hydrological problems. On the basis of water balance approach, it is possible to make a quant-

ative evaluation of water resources and their change under influence of man's activities. Hence such studies are important part of water resources planning and management of river basins as they identify and quantify these resources. A case study for the water balance studies in the Upper Ganga Canal Command Area was taken up on the request of U.P. Govt. The data that are required for the study are being procured. The data requirements have been formatted and format has been provided to UP Irrigation Department for providing the necessary data in the required format. With the available data at the Institute, the work in this direction has been initiated.

(ii) Groundwater Modelling

With the advent of fast computers numerical modelling using the finite difference approach has become more popular in view of its advantages. The US Geological Survey has developed a 'Modular Three Dimensional finite difference groundwater flow model'. This model was procured and was implemented and tested on VAX-11/780 computer system. The modular structure of the programme consists of a main programme and a series of highly independent modules grouped as packages. Each package deals with a specific feature of hydrologic system which has to be simulated, like the flow from rivers, recharge from rainfall etc. or specific method of solving linear equations which describe the flow system. This programme being very versatile, is being used for the ground water studies in the Upper Ganga Canal Command area.

(iii) Analysis of pump test data from large diameter wells

Large diameter wells with huge amount of storage are predominant in the country. Using Thies/Hantush curve for the analysis of pump test data from these wells give erroneous values for aquifer parameters. Suitable type curves for well with storage are, hence, necessary. These type curves were developed using the finite element technique and a technical note on "Flow towards well with storage in leaky aquifers" was prepared. The parameters on which these type curves depend were identified. From the analysis of type curves, the storage effected zone both in space and time were demarcated. The determination of transmissivity of the aquifer from the early time pumping history is indicated.

3.2.6 Hydrological Investigations

The activities of this new division were many fold viz. applications of nuclear techniques, geophysical methods, data acquisition system, telemetry systems and signal analyser for data transmission, and applications of microprocessors for hydrological studies.

In the field of nuclear hydrology, neutron moisture probe is being employed for soil moisture movement studies in the unsaturated zone. A research paper and a technical report were published. Literature was reviewed and a review note on environmental isotopes for hydrological studies was prepared. In order to relate moisture content to the resistance of soil layers, geophysical surveys were initiated in the campus of the institute. Initially terrameter and meggar were employed. A review note on geophysical investigations for hydrological studies and one technical report on geophysical investigations for soil moisture studies were prepared. Technical notes on data acquisition system, telemetry systems and signal analyser for data transmission were prepared for developing microprocessor based hydrologic data acquisition systems.

(i) Soil Moisture Studies

The studies of soil moisture movement were carried out in the campus of National Institute of Hydrology with the aims to assess the variability of soil moisture storage over the area, to provide regular measurements of the changes in soil moisture storagess for the hydrological water balance and to get semi quantitative information concerning evaporation rates and recharge through the soil. The soil moisture profiles were taken at few sites, different depths and times which enabled a study of field capacity and vertical movement of water during redistribution. The knowledge of spatial distribution of soil moisture has yielded information on the water movement as well. An attempt has also been made to review the status and potentialities of the neutron probe.

(ii) Nuclear Applications

The review report on the applications of environmental isotopes for hydrological investigations describes the status and potentialities of environmental isotopes in relation to the various hydrological and hydrogeological problems. The report deals with the applications of tritium, carbon-14, naturally occurring isotopes and stable isotopes, Deuterium and oxygen-18 particularly for water balance studies of lakes and reservoirs.

(iii) Acquisition Systems

Microcomputer and microprocessor are increasingly being used in a number of hydro-meteorological sensors. Signal analyzers also comprise of these microprocessor circuits. Keeping in view the latest developments in instrumentation technology, the Institute has taken up the design and development of a general purpose data acquisition system which ultimately will be used for collection of hydrometeorological data.

3.2.7 Remote Sensing Applications

Remote Sensing Applications Division has been set up in this year. Initial thrust of research activity has been contained in two areas, viz. i) snow line and snow cover mapping, and ii) land use and land cover mapping. An Image Processing software available from Space Application Centre, Ahmedabad has been implemented and tested in the Institute's VAX-11/780 computer. Peripherals which are required to make it efficiently operational are earmarked. The studies are being carried out under following main heads :

(i) Snow Cover Mapping

Snow and ice constitute to be major component of world water resources and it is very relevant for India because the major northern rivers originate from the glaciers in the Himalayas. Location, recognition and measurement of the snow and ice by conventional means is a time consuming and hazardous job. Remote Sensing methods have unique detection capabilities to overcome these problems because of high albedo of snow in the visual portion of the electromagnetic spectrum. Further, snow's albedo is reduced substantially in near infrared spectrum. Using these properties and using remote sensing technique, snow has been conveniently identified and used for snow melt runoff studies and flow forecasting by hydrologists. A review note has been prepared in order to take a stock of the state of art in this area.

(ii) Land Use and Land Cover Mapping

Land use plays a major role in determining the various hydrologic processes after the incidence of precipitation. All the major components of hydrologic cycle viz, runoff, evapotranspiration, infiltration are influenced by the prevailing land use of a catchment. Land use map prepared from remotely sensed data could be prepared conveniently and be used as an input data for runoff modelling. Repeativity of remotely sensed data is admirably suited for change detection of land use in an area. A review note has been prepared to collate the state of art in land use mapping by using remote sensing technique. A visual interpreted map of upper Yamuna catchment upto Tajewala has been prepared using satellite imagery with the equipment so far procured in the laboratory. Limited digital checking has been made in this interpretation with the help of image processing software procured from SAC, Ahmedabad. A report on this case study has been prepared.

3.2.8 Drought Studies

In view of the current drought situation in many states of India and realising the gravity of problems, the National Institute of Hydrology, Roorkee, has established a 'Drought division' with effect from 28th February 1986. This division would emphasize on hydrological aspects of drought, development of drought management strategies both long & short term including reactive measures. Immediately after setting up of the Drought division, scientific and technical teams were sent, during the month of March, 1986, to the States of Karnataka, Gujarat, Madhya Pradesh, Maharashtra and Andhra Pradesh to conduct an on-the-spot survey of drought affected areas to collect necessary information/data pertaining to drought so as to know the extent of drought, recommended or existing drought control measures and to study the impact of drought for the development of future drought management strategies. The subsequent field visits are also underway and efforts would continue to collect further information and data, to see the severity of the problem and to observe the improvements made by on-going drought management/relief measures. Efforts are also on way to analyse and interpret the data to study the extent of drought and to develop suitable short and long term drought management strategies including reactive measures and develop approach to plan preparedness measures.

During the year the Institute also initiated a proposal of holding a seminar on 'Drought Management strategies' which is aimed at evolving management strategies in drought affected states. The Water Resources Development Organisation (WRDO), Govt. of Karnataka has agreed to organise the seminar at Mysore, Karnataka.

3.2.9 Information System

The management of computer centre with VAX-11/780 computer system and its peripherals forms one of the main activities of this division. Efforts have been made to obtain hydrological data and computer programmes on magnetic tapes. The research activities of this division are mainly in the area of data storage and retrieval system, software for micro-computers and accounting system. Computer software for BBC microcomputers has been developed in BASIC language for various hydrological problems, which has been transmitted to the Brahmaputra Board, Guwahati for their own use.

(i) System Specific Programme Inputs for Documented Programmes

FORTRAN is now used on all major computer systems. Major versions in vogue are FORTRAN, FORTRAN II and FORTRAN IV. A FORTRAN programme developed for a particular computer can not be executed as such on other type of computers. This report describes various modifications necessary for successfully implementing a FORTRAN programme on DEC-2050, PDP-11 and UNIVAC-1100, which was originally developed on VAX-11 and vice versa.

(ii) Development of Management Information System

This research work is aimed to design and implement a Management Information System Package for the employees of National Institute of Hydrology, Roorkee. This utility package computerizes the whole process of pay roll accounting and personal information. The tasks which the package performs are : validation of incoming raw data (available on disk), its organisation and thereby creation of master files, information retrieval from the master files and maintenance of the master files. The work provides a useful accounting package for NIH which prepares a concrete platform for building up a complete Management Information System.

The number of reports published/prepared are presented in Chart No. III.

3.2.10 Workshops and Seminars Organised by NIH

Towards fulfilling the objective of technology transfer and having interaction with states and central government organisations dealing with water resources, the Institute organised a series of workshops at Roorkee and in some states on the following important areas :

1. Unit Hydrograph Techniques
2. Vax-11/780 Computer System
3. Flood Frequency Analysis
4. Ground Water Modelling
5. Observation, Processing and Analysis of Precipitation Data

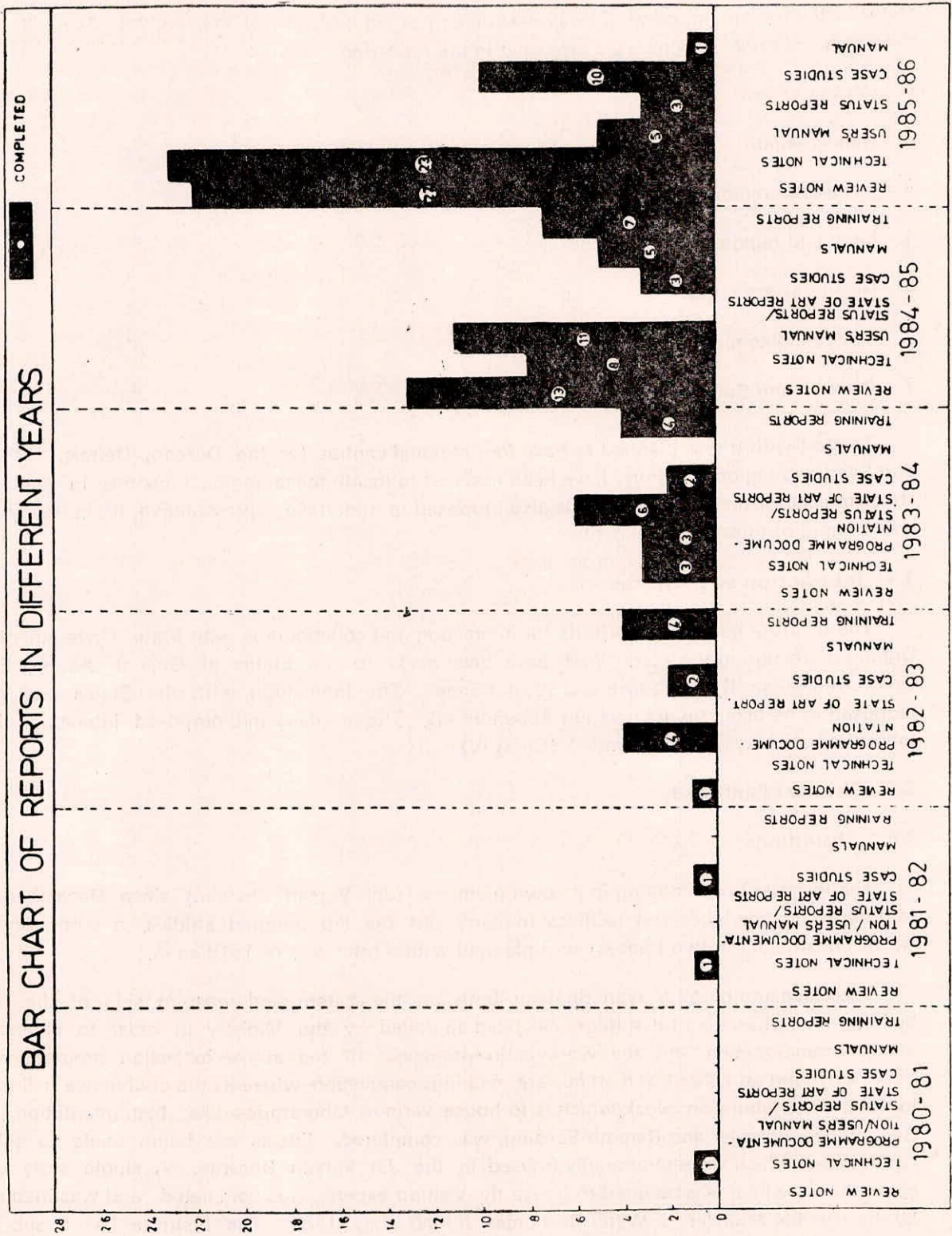
These workshops provided the practicing engineers and scientists of various organisations, an opportunity to learn the techniques and methods of analysis which have been implemented and developed at the Institute.

The Institute also organised a one day seminar on Flood Frequency Analysis at CBIP, New Delhi on 30th September, 1985. The main purpose of this seminar was to provide a forum for discussions on the recent developments and advances made in this important area. Discussions and deliberations in the seminar provided useful ideas for identification of areas for further studies. The details of workshops and seminars organised are given in Appendix XI.

3.3 Regional Centres

The Society and Governing Body of the National Institute of Hydrology had desired that Regional Centres of the National Institute of Hydrology might be set up to take care of the

BAR CHART OF REPORTS IN DIFFERENT YEARS



problems of different regions, so that the scientists of the Institute can actively interact with the states in the region and develop an understanding of the problems of the region. Keeping this in view seven regional centres were proposed in the following regions :

1. Deccan region
2. Deltaic region
3. Himalayan region
4. Semi arid region
5. North Eastern region
6. Ganga Plains region, and
7. Western and Southern coastal region

To start with it was planned to have four regional centres for the Deccan, Deltaic, Himalayan and Semi arid regions. Efforts have been initiated to locate these regional centres in one of the states in each of these regions. It is also proposed to undertake representative basin study under one or more of these regional centres.

3.4 Interaction with States

The Institute has initiated efforts for interaction and collaboration with State Governments and Organisations during the year. Visits have been made to the States of Gujarat, Assam, Punjab, Orissa, Rajasthan, Uttar Pradesh and West Bengal. The interaction with the States and studies proposed to be taken up are given in Appendix XII. The progress and proposed interaction in the form of a bar chart is also appended (Chart IV).

3.5 Physical Facilities

3.5.1 Buildings

The Institute is functioning in its own premises (Jal Vigyan Bhawan) since December 1982. In order to provide laboratory facilities to carry out the lab oriented studies, a laboratory block (to be constructed in two phases) was planned with a total area of 1518 sq.m.

The extension of Jal Vigyan Bhawan both on the eastern and western side of the present building, in 4 phases on three floors has been approved by the Ministry in order to increase the office accommodation and the work is in progress. Of the above extension programme, two floors, covering an area of 315 sq.m., are nearing completion where as the conference hall is being located. The laboratory block which is to house various laboratories like, Instrumentation, Water Quality, Groundwater and Remote Sensing, was completed. Efforts are being made to shift the laboratories, which were temporarily housed in the Jal Vigyan Bhawan. A single story experts guest house which was planned to house the visiting experts, was completed and was inaugurated by the Hon'ble Minister for Water Resources during July 1985. The Institute has a sub-station

STATUS OF INTERACTION WITH STATES

	GUJARAT	KARNATAKA	N.E. REGION	ORISSA	PUNJAB	RAJASTHAN	UTTAR PARDESH	WEST BENGAL
6. CONSULTANCY	+++++		+++++		+++++			
5. WORKSHOP								
4. RAINFALL STUDIES AND NETWORK DESIGN		—				—		
3. HYDROLOGICAL STUDIES								
2. REGIONAL FLOOD FORMULAE								
1. HYDROLOGY YEAR BOOK	+++++						+++++	

LEGEND

- COMPLETED
- ++++ TAKEN - UP
- TO BE TAKEN UP

with a feeder provided by the U.P. State Electricity Board. Pending the work on the LT, the supply is being provided to the campus through the sub-station. The tube-well was made operational and arrangement for water supply to the various buildings in the campus is being done through the distributory grid. The sewerage system in the campus was completed and the street lighting was taken up by University of Roorkee. Temporary workshop building has been constructed to house the instrumentation and service workshop. Land scaping of the campus has been planned and is being implemented by constructing a fountain, providing proper land scaping and lawns.

3.5.2 Infrastructure

Uninterrupted Power Supply (UPS) system procured under UNDP grant was installed and made operational to provide the uninterrupted power supply to the computer system during hydel breakdown. As an auxillary unit, this requires battery bank which can give 220 volts D.C. supply, was also installed and commissioned. The UPS system could supply power only for a period of one hour and as such to cater to the needs during major hydel breakdowns, a 125 KVA diesel generating set was procured and installed.

Telephones for the officers and general purpose telephones were provided by the University of Roorkee from the grant paid by the Institute. A separate board has been provided in the University exchange and a cable with a capacity upto 50 lines was laid to cater to the needs of the Institute. Presently telephones were provided in the administrative building which will be later extended to laboratory block and experts' guest house.

Bitumonous roads in the campus have been planned and the University of Roorkee has been requested to provide the necessary estimates for the same. It is expected that work will commence shortly.

The work related to the Low Tension side of sub-station was entrusted to U. P. State Electricity Board and is expected to be completed soon.

3.6 Computer Centre

The VAX-11/780 system which was procured under UNDP is made operational. It is a fourth generation computer with 32 bit architecture, multi user, multi programme and time sharing system. The maintenance of the computer system was assigned to M/s Computer Maintenance Corporation Limited. A number of computer peripherals such as line printer, card reader and ADM-220 terminals, additional memory and multiplexer have been added to enhance the capabilities of the system. Calcomp digitizer is expected shortly. The Digital Image Processing Software (SACIPS) which was procured from Space Application Centre, Ahmedabad has been installed for the use of the remote sensing applications in hydrology. The scientists and scientific staff are using the computer system through interactive terminals and card reader for research and consultancy projects. The utilisation of the computer is in the order of 50%. In view of its various capabilities like color graphic terminal, calcomp hard copier, the computer facility was also made available to Government and Semi-Government organisations like SERC, University of Roorkee, CES Water Resources and Management Consultancy etc. on payment basis. The personal computer PRO-325 is also installed and is being used as word processor for printing of reports and other administrative and scientific works. The detailed configuration of the computer system is given in Appendix XIII.

3.7 Laboratories

To initiate laboratory oriented studies, the following laboratories have been made operational :

- (a) Water Quality Laboratory
- (b) Remote Sensing Laboratory
- (c) Instrumentation Laboratory
- (d) Nuclear Hydrology Laboratory

The above laboratories have the following capabilities :

- (a) Water Quality Laboratory

The water quality laboratory has the capability of doing routine water quality sample analysis, monitoring of river water quality and surveillance of water bodies.

- (b) Remote Sensing Laboratory

This laboratory is working for remote sensing applications in hydrology. Visual interpretation for Upper Yamuna catchment and part of upper reach of Ganga catchment has been done and land use maps have been prepared. Image processing software has been installed in VAX-11/780 computer system of NIH which is being used for image analysis, processing and land use classification of Upper Yamuna Catchment. Further studies for other areas have been planned to be undertaken soon.

- (c) Instrumentation Laboratory

The Service and Instrumentation Workshop is developing a microprocessor based data acquisition system for hydrological studies. It would also cater to the day-to-day needs of various equipment in different laboratories of the Institute.

- (d) Nuclear Hydrology Laboratory

Soil moisture profiles using neutron probe have been carried out in the NIH campus which can be later extended to the field.

Pending completion of the laboratory block, these laboratories were housed in the Administrative building. Basic equipment which have been procured during this year is given in Appendix XIV.

A field station to measure the parameters of meteorological and hydrologic data using the conventional equipment has already been installed in the campus. To enhance the capabilities of this station, an Automatic Hydrologic Station (AHS) with data acquisition system for obtaining the real time data and processing the same through a microprocessor is planned and the equipment was ordered under UNDP grants. Further a lysimeter to study soil moisture, soil temperature, percolation loss in the irrigated fields and evapotranspiration losses, is being procured.

3.8 International Cooperation

In keeping with the objectives of the Institute and as also suggested by the Tripartite Review Committee of UNDP project at its meeting on 4th Dec. 1984, the institute has been actively pursuing avenues of international cooperation for getting the latest knowhow in watershed modelling, reservoir operation, land surface modelling and representative basins.

(a) Cooperation with Danish Hydraulic Institute (DHI)

Though a number of watershed models are available very few have the capability to predict changes in land use such as deforestation, recultivation or irrigation. The models shall be such as

- * to be able to account for changes within specific parts of the catchment
- * the model components be based on sound physical laws to permit extrapolation beyond the range of calibration

The DHI has extensive experience in field investigations and physical and mathematical model studies in hydraulic and water resources engineering.

The DHI in collaboration with Institute of Hydrology (UK) and SOGREAH (France) has developed 'System Hydrologique European' (SHE) model. The SHE model is well suited for prediction of changes in the hydrological regime caused by large scale or small scale irrigation projects and can be of assistance in

- (i) Agricultural water management including irrigation strategies, leakage of nutrients, salinity problems etc.
- (ii) Ground water/surface water interaction (water logging and conjunctive use).
- (iii) Effects of large scale land use changes such as soil erosion, irrigation, deforestation etc. on water resources.

The proposed project for NIH and DHI cooperation envisages transferring the SHE model including necessary mathematical modelling knowhow and computational expertise from DHI to NIH so as to enhance the practical applications of the modelling technique for Indian river basins.

(b) Other Collaboration Projects

Proposals for active collaborative research projects with other international research organisations were being pursued.

Under a collaborative research project with the Leichtweiss Institute of Water Research it is proposed to have technical collaboration in

- (i) Representative and experimental basins and
- (ii) Water availability in reservoirs

Under loan assistance from Japan it is proposed to set up an experimental facility with Rainfall simulator. It is also proposed to take up a collaborative Project under USAID between NIH,

Gujarat Irrigation Deptt. and Louisiana State University for developing watershed models based principally on the geomorphological characteristics of catchments.

3.9 Library

The Library of the Institute has been functioning since 1980. It has a wide collection of books, reports, papers and journals in the areas of Hydrology, Water Resources and allied disciplines. During the Year under report, Library procured 428 books and subscribed 25 Foreign and 18 Indian Journals. At the end of March 1986 the Library had 3166 books, 1565 reports, 928 papers, 227 Standards, 30 Microfiche and 1667 maps.

A Computer based library information system has been developed for dissemination of information about literature available in the library.

3.10 High Level Technical Committee on Hydrology (HILTECH)

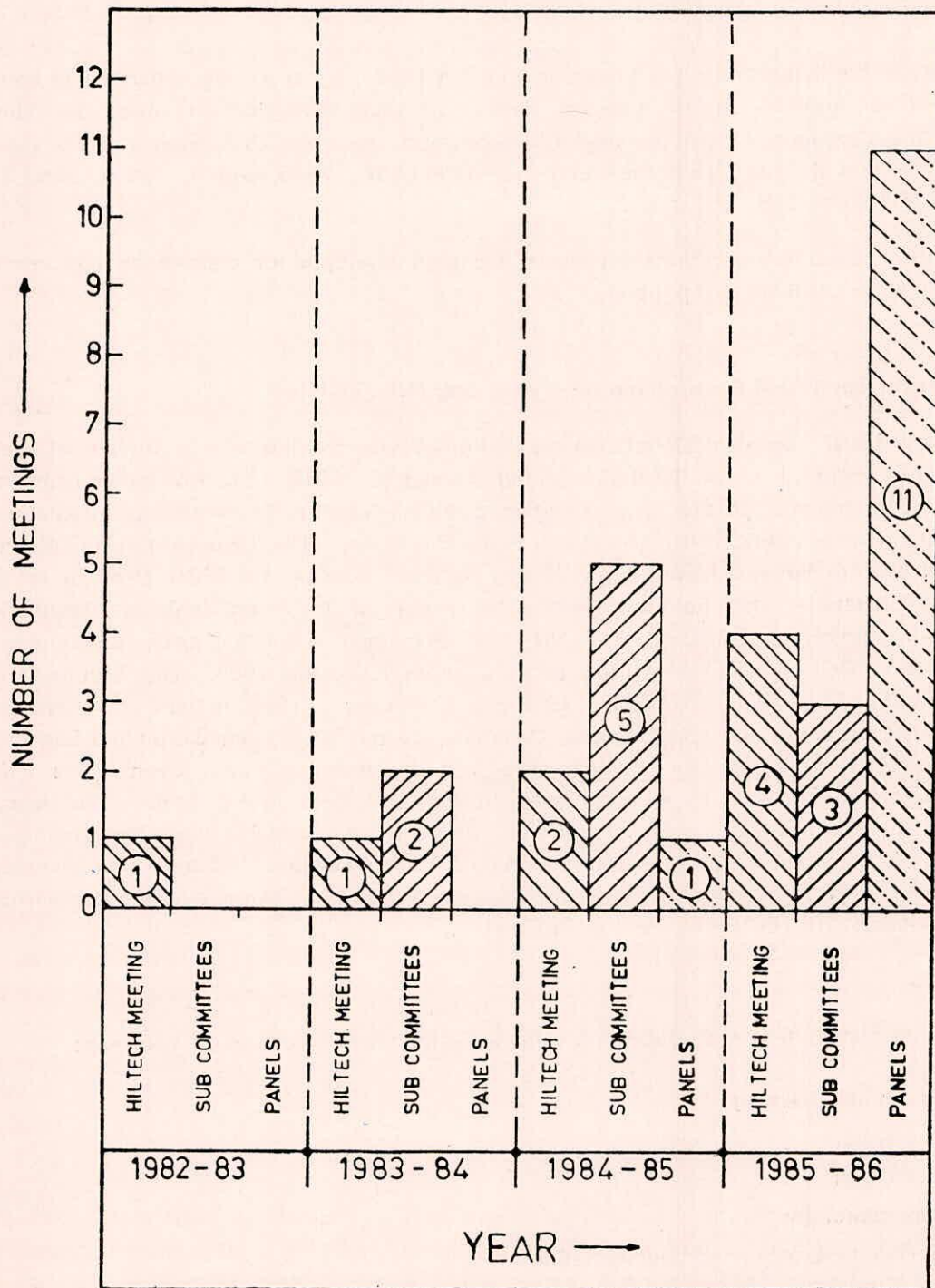
The High Level Technical Committee on Hydrology was constituted vide Ministry of Water Resources, Government of India Resolution dated August 18, 1982. This Committee came into existence with the transfer of the responsibilities of Indian National Committee for International Hydrological Programme from CSIR to Ministry of Water Resources. The Secretariat of this Committee stands attached to National Institute of Hydrology and is known as HILTECH Division of the Institute. The Secretariat also functions as the Secretariat of the Asian Regional Coordinating Committee on Hydrology (ARCCOH). The HILTECH Secretariat which has been functioning in R. K. Puram, New Delhi has been shifted to Roorkee in November 1985. The fifth and sixth HILTECH meetings were held on 16th May, 1985 and 19th August, 1985 at Delhi and Hyderabad under the Chairmanship of Shri N. K. Sarma, Chairman, Central Water Commission and Shri C. S. Hukmani, Chairman, Brahmaputra Board. The sixth meeting has been the first occasion wherein the HILTECH meeting was hosted and held in a State. The seventh and eighth meeting were held in Delhi and Nasik under the Chairmanship of Shri M. A. Chitale, Chairman, Central water Commission on 3rd December, 1985 and 14th February, 1986 respectively. The eighth meeting held at Nasik was hosted by Government of Maharashtra. Year-wise activities of HILTECH are presented in Chart V.

3.10.1 Panels

HILTECH has constituted seven panels on various disciplines of Hydrology. They are :

- (i) Education and Training
- (ii) Surface Water
- (iii) Ground Water
- (iv) Hydrometeorology
- (v) Water Quality, Erosion and Sedimentation
- (vi) Snow and Ice
- (v) Water Resources System

BAR CHART OF YEARWISE ACTIVITIES OF HILTECH



The second meeting of panel on Education and Training and first meeting of all other panels were held during the year. It has been recommended by the panels to prepare State of Art papers on various topics.

3.10.2 Sub-Committees

The following are the sub-committees constituted by HILTECH.

- (i) Expert Review Group for IHP Phase III Plan
- (ii) Draft Country Plan
- (iii) Steering Committee
- (iv) Editorial Advisory Board of Hydrology Review Journal
- (v) Interaction between research organisations, unversities and user agencies.

As per the decision taken earlier in 6th HILTECH meeting, the Expert Review Group for IHP Phase III has been merged with Subcommittee for Draft Country Plan because of their similar functions. The merged Subcommittee has been named as "Sub-committee on Country Plan on Hydrology".

3.10.3 Support to Research/Courses/Seminars/Workshops etc.

HILTECH has approved and funded the research project "Development of Generalised software on HP-1000 Computer for Unit Hydrograph forecast model and its application' to IIT, Delhi. The work has already been started by Prof. Subhash Chander, Project Investigator. A short course on "Stochastic methods in hydrology and water resources with computer applications" was funded by HILTECH and was held at IIT, Kharagpur in June, 1985. Besides these, following Seminars/ symposia/workshops were also sponsored and funded by HILTECH.

- (i) Seminar on Hydrology with Colloquium on Impact of Water Resources in Agriculture at Hissar, June, 1985.
- (ii) International Workshop on Alluvial River problems, Department of Civil Engineering, University of Roorkee, October, 1985.
- (iii) Symposium on Inadequacy of existing runoff formulae for surface and subsurface drainage, Indian Association of Hydrologists, Roorkee, October, 1985.
- (iv) The third regional training Seminar on Ice and Snow organised by Snow and Avalanche Study Establishment, March, 8.

3.10.4 Publication of Hydrology Review

In order to cope with the backlog, a combined issue of the Journal for the years 1981-83 has been published. The issue of the Journal for 1984 has also been published. The issue of the Journal for 1985 is under preparation. The two issues have been distributed with limited circulation. Since the objectives of the HILTECH, which was constituted in August, 82 are some what different from INC for IHP, it has been decided in the 8th HILT-

ECH meeting to change the title of the Journal to JAL VIGYAN SAMEEKSHA—A Publication of High Level Technical Committee on Hydrology (HILTECH). Actions have been initiated to register the same under this title.

3.10.5 Activities at ARCCOH Secretariat

The ARCCOH Secretariat functioned quite actively during the year. ARCCOH News letter was brought out regularly on quarterly basis. The News letter is sent to all member countries of ARCCOH and various organisations in India. The Secretariat also compiled a 'Directory of Hydrologists' in ARCCOH region which has included about 450 experts of hydrology from various ARCCOH countries.

The third meeting of ARCCOH Steering Committee was hosted by the High Level Technical Committee on Hydrology (HILTECH), India from 18-20 September, 1985 at New Delhi. At this meeting the progress made by ARCCOH in the past was reviewed and recommendations for further strengthening the ARCCOH activities were made. The Committee recommended to appoint 'National Coordinator' of various member countries for activities of ARCCOH. The National Committees of India, Maldives, Pakistan, Papua New Guinea, Malaysia, New Zealand, Mongolia, Bhutan, China, DPR Korea and Burma have already appointed National Coordinators. The Committee discussed the South and Central Asia component of the Major Regional Project for Asia and finalised the possible areas of activities. The proposal for MRP is being finalised at the Secretariat and would be circulated for comments and suggestions to all participating countries. The comments of participating countries will be analysed by the ARCCOH Secretariat and a Preparatory meeting is planned to formulate and finalise the project document for presentation to UNESCO General Conference. The Committee also recommended for preparation of hydrogeological map of Asia and two major groups, keeping in view the geographical location of the countries of the ARCCOH, were formed. The over all convener of this mission is a hydrogeology expert in India for which the Government of India has already accorded approval. The National Coordinators for this mission from various countries are being appointed. The Secretariat is compiling an Annual Bulletin of ARCCOH for calendar year 1985-86. The Annual Bulletin will include details of various hydrological activities held in different ARCCOH member countries.

ARCCOH Secretariat has also appealed to all member countries to support activities of ARCCOH at IHP council and Bureau Sessions. The Secretariat is also drafting the rules and regulations of ARCCOH.

3.11 Consultancy

The institute has been carrying out research studies under two projects sponsored by Narmada Cell and National Water Development Agency. The final reports of the projects "Narmada design flood studies" were submitted in July 1985 and that of the project "Water availability studies of three sites in Mahanadi basin" were submitted in March 1986.

Discussions have been held with Brahmaputra Board for taking up the "Hydrological Studies for Barak Basin". Punjab Government has desired that "Flash Flood studies for Punjab" may be taken up by NIH and analysis of data supplied so far is under progress.

3.12 Participation in Conference and Symposia & Publication by Scientific Staff

The Scientists and scientific staff of NIH participated in the seminars|symposia, workshops and courses and presented papers during the year under report as given in Appendix XV.

A number of papers were also published by the scientists in professional journals. The list of papers published is given in Appendix XVI.

3.13 Visitors

Hon'ble shri B. Shankaranand, President of NIH Society and Union Minister of Water Resources visited the Institute on July 15, 1985. He inaugurated the newly constructed Experts Hostel (Guest House) and addressed the scientists. Hon'ble Shri Nani Bhattacharya, Member, NIH Society and Minister of Irrigation, Government of West Bengal visited the Institute on November 16, 1985. Shri Ramaswamy R. Iyer, Chairman of Governing Body and Secretary (Water Resources), Government of India visited the Institute on November 19, 1985.

Besides them, a number of eminent and distinguished visitors from within country and abroad visited the Institute and some of them delivered lectures to the scientific staff of the Institute. A list of the visitors is given in Appendix XVII.

3.14 Recreation and Welfare Activities

During the year the Club remained quite active and organised various activities for recreation of its members. A Cultural Programme during Quami Ekta week was organised in which various cultures of India were represented. This year alongwith other games, track and field events were organised for staff members which recorded a good response. In a meeting of General Body during the year, it was decided to charge equal subscription from all members of the Club.

3.15 Newsletter

The publication of the quarterly Newsletter of the Institute started in 1984. During the year under report, four issues of the Newsletter have been published in April, July, October, 1985 and January, 1986. Newsletter has been named as "Jal Vigyan Samachar".

Plan and progress of various research activities and technical activities of the Institute are brought out in these Newsletters. These are distributed all over India and the feed back information are reviewed to up date the contents and format of the Newsletter. Attempts are being made to cover various news from the States and to bring out the Hindi version of the Newsletter.

3.16 Hindi Use

In accordance with the official language policy of the Government, efforts were made by the Institute during the year towards the implementation of various provisions of the official language

Act, 1983 and the rules framed there under. The Hindi Salahakar Samiti of this Institute was reconstituted and a number of decisions were taken to increase the use of Hindi in the working of the NIH. All correspondence in regard to Group 'D' staff of this institute is being carried out in Hindi.

A Hindi week was celebrated from November 4 to November 8, 1985 during which it was emphasised upon the personnel of the Institute to use Hindi in their official use as much as possible. To encourage the use of Hindi, a Hindi literature Quiz Contest was organised for the non-Hindi personnel and an open Hindi Essay Competition was organised for all personnel of this Institute. It has also been decided to bring out abstract of technical reports and Newsletters of NIH in Hindi. To begin with a portion of the Newsletter has been brought out from the issue of April, 1986. It is also proposed to bring out some technical papers in Hindi publications. Correspondence has also been initiated for acquisition of a micro-computer in Devnagri script developed by Pilani Institute.

All the letters received in Hindi were replied in Hindi. During the Year 1985-86, 197 letters were received in Hindi and 349 communications were sent in Hindi. Annual report of the NIH is being published bilingually in Hindi and English.

4. FINANCE AND ACCOUNTS

During the year under review the Government of India, Ministry of Water Resources (Formerly Department of Irrigation, Ministry of Irrigation and Power) provided an amount of Rs. 65 lakhs as grant-in-aid to the Institute. In addition, the grant-in-aid of Rs. 3.00 lakhs was released for the HILTECH Division (Secretariat of High Level Technical Committee on Hydrology). The actual expenditure of the Institute during the year after taking into account the amount carried forward from the previous year was Rs. 65.85 lakhs and Rs. 3.64 lakhs on the HILTECH Division. The accounts of the Institute for the year have been audited by M/s. Satyendra and Co., Chartered Accountant, Roorkee and a Copy of audited statement of account consisting of receipt and payments accounts, income and expenditure account and the balance sheet as on 31st March, 1986 duly certified by the auditors is given at Appendix XVIII. It will be seen from the auditors report that additions worth of Rs. 13.55 lakhs were made to the fixed assets of the Institute during the year.

The replies to the auditors observations have been submitted separately to the Governing Body of the Institute.

5. ACKNOWLEDGEMENTS

The different activities of the Institute have progressed well under the blessings of the President of the Society and direction and guidance from Chairman of the Governing Body and Technical Advisory Committee and members of the Society, Governing Body and TAC. Support and help from UNDP, UNESCO, Department of Economic Affairs and from officers of Ministry of Water Resources (formerly Department of Irrigation, Ministry of Irrigation and Power), Central Water Commission, India Meteorological Department, University of Roorkee and several other central and state government organisations is gratefully acknowledged. Whatever has been achieved by the Institute since its establishment, in particular during the year under report, would not have been possible without their help and guidance. The Institute also acknowledges the help and cooperation received from members of Working Groups and scientists and engineers from many academic and research organisations.

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Govt. of Gujarat,
GANDHINAGAR

Shri M.Y. Oke,
Chief Engineer (Irrigation),
Govt. of Maharashtra,
BOMBAY

MEMBERSHIP OF WORKING GROUPS

WORKING GROUP	— I : (a) Surface Water Analysis (b) Surface Water Synthesis (c) Integrated Planning
CHAIRMAN	Director, NIH, Roorkee
CONVENER	Scientist F, NIH, Roorkee
MEMBERS	<p>(A) FROM CENTRAL GOVERNMENT ORGANISATIONS</p> <ol style="list-style-type: none"> 1. Nominee of Central Water Commission, NEW DELHI 2. Nominee of India Meteorological Dept., NEW DELHI 3. Nominee of Central Arid Zone Research Institute, JODHPUR 4. Nominee of Brahmaputra Board, Guwahati, Assam 5. Nominee of Central Electricity Authority, NEW DELHI 6. Nominee of Snow and Avalanche Study Establishment, Manali 7. Nominee of Department of Environment, NEW DELHI <p>(B) FROM STATE GOVERNMENT ORGANISATIONS</p> <ol style="list-style-type: none"> 8. Nominee of Chief Engineer, Gujarat Irrigation Department, Gandhinagar, Gujarat 9. Nominee of Chief Engineer (Water Resources), U.P. Irrigation Department, Lucknow 10. Nominee of Chief Engineer (Water Resources), Karnataka Irrigation Department, Bangalore 11. Nominee of Chief Engineer (D & R), West Bengal Irrigation Dept., Calcutta. <p>(C) FROM ACADEMIC AND RESEARCH INSTITUTIONS</p> <ol style="list-style-type: none"> 12. Dr. Subhash Chander, Professor in Civil Engineering, Indian Institute of Technology, NEW DELHI 13. Dr. S. Ramaseshan, Professor in Civil Engineering, Indian Institute of Technology, Kanpur 14. Dr. B. S. Mathur, Co—ordinator, School of Hydrology, University of Roorkee, ROORKEE

15. Shri D. C. Das, Joint Commissioner (SC), Ministry of Agriculture, Shastri Bhawan, NEW DELHI
16. Dr. P. Khanna, Professor in Environmental Engineering, Indian Institute of Technology, BOMBAY
17. Dr. G. N. Yoganarasimhan, Professor, W. R. D. T. C., University of Roorkee, Roorkee

WORKING GROUP—II :

- (a) Ground Water Analysis
- (b) Ground Water Synthesis
- (c) Hydrologic Investigations

CHAIRMAN

Director, NIH, Roorkee

CONVENER

Scientist F, NIH, Roorkee

MEMBERS

(A) FROM CENTRAL GOVERNMENT ORGANISATIONS

1. Nominee of Water Technology Centre, I. A. R. I., New Delhi
2. Nominee of N. A. B. A. R. D., Bombay
3. Nominee of National Water Development Agency, New DELHI
4. Nominee of Central Ground Water Board, NEW DELHI
5. Nominee of Water & Power Consultancy Services, NEW DELHI
6. Nominee of Central Water Commission, NEW DELHI

(B) FROM STATE GOVERNMENT ORGANISATIONS

7. Nominee of Chief Engineer, Ground Water Department, Jodhpur, Rajasthan
8. Nominee of Director, State Water Directorate, West Bengal, Calcutta
9. Nominee of Centre for Water Resources Development and Management, Calcutta
10. Nominee of Chief Engineer, Ground Water Department, Tamil Nadu, Madras

(C) FROM ACADEMIC AND RESEARCH INSTITUTIONS

11. Dr. S. M. Rao, Scientist, Bhabha Atomic Research Centre, Colaba, BOMBAY
12. Dr. C. L. Singh, Professor of Geophysics, Banaras Hindu University, Varanasi
13. Dr. B. B. S. Singhal, Professor, Department of Sciences, University of Roorkee, ROORKEE
14. Dr. R. Sakthivadivel, Professor, Guindy College of Engineering, Madras
15. Dr. B. H. Briz Kishore, UGC Scientist, Centre for Water Resources, Jawahar Lal Nehru Technological University, A. P. Hamayun Nagar, Hyderabad—500 028.

WORKING GROUP—III (a) Remote Sensing Applications
(b) Information System

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CONVENER Scientist F, NIH, Roorkee

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2. Nominee of Central Water Commission, NEW DELHI
3. Nominee of India Meteorological Dept. NEW DELHI
4. Nominee of Centrai Board of Irrigation & Power, NEW DELHI
5. Nominee of Tata Institute of Fundamental Research, Bombay
6. Nominee of Central Ground Water Board; NEW DELHI

(B) FROM STATE GOVERNMENT ORGANISATIONS

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8. Nominee of Chief Engineer, Irrigation Department, Andhra Pradesh, Hyderabad
9. Nominee of Chief Engineer, Irrigation Department, Madhya Pradesh, BHOPAL

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12. Shri K.P. Sharma, Professor, Civil Engineering Department, University of Roorkee, ROORKEE
13. Dr. D. S. Kamath, Indian Institute of Remote Sensing, Dehradun
14. Dr. N. K. Nanda, Professor, Department of Electronics and Communication Engineering, University of Roorkee, ROORKEE
15. Dr. B. K. Gairola, National Informatic Centre, Electronics Commission, Pushpa Bhawan, NEW DELHI

APPENDIX—V

WORKING GROUP MEETINGS

Working Group No.	Title	Date of Meeting
I	(a) Surface Water Analysis	28. 11. 1985
	(b) Surface Water Synthesis	
	(c) Integrated Planning	
II	(a) Ground Water Analysis	26. 11. 1985
	(b) Ground Water Synthesis	
	(c) Hydrologic Investigations	
III	(a) Remote Sensing Applications	29. 11. 1985
	(b) Information System	

APPENDIX-VI

MEMBERS OF HIGH LEVEL TECHNICAL COMMITTEE ON HYDROLOGY

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Chairman,
Central Water Commission,
Seva Bhawan, R.K. Puram,
NEW DELHI-110066

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National Institute of Hydrology,
ROORKEE
2. Chairman,
Central Ground Water Board,
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3. Director General,
Indian Council of Agricultural
Research,
Krishi Bhawan,
NEW DELHI-110001
4. Director General,
C.S.I.R., Rafi Marg,
NEW DELHI-110001
5. Director General,
Geological Survey of India,
27, Jawaharlal Nehru Marg,
CALCUTTA-700016
6. Director General of Meteorology,
I.M.D.,
Lodi Road,
NEW DELHI-110003
7. Chairman,
Central Board for Prevention &
Control of Water Pollution,
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8. Chairman,
Central Electricity Authority,
Seva Bhawan, R.K. Puram,
NEW DELHI-110066
9. President,
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DEHRADUN-248006
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National Remote Sensing
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Ministry of Works & Housing
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12. Chairman,
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Joint Secretary,
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National Institute of Hydrology
Jal Vigyan Bhawan
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(b) Dr. K. K. S. Bhatia
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(ii) Dr. A. S. Chawla
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Roorkee—247667

**SUB-COMMITTEE ON COUNTRY PLAN ON
HYDROLOGY**

1. The Member (WR)
Central Water Commission
Sewa Bhawan
R. K. Puram
New Delhi—110 066

2. Director
National Institute of Hydrology
Jal Vigyan Bhawan
Roorkee—247667

3. The Chairman
Central Ground Water Board
Krishi Bhawan
New Delhi—110 001

4. The Director General
India Meteorological Department
Mausam Bhawan
Lodi Road
New Delhi—110 003

5. Prof. Subhash Chander
Department of Civil Engineering
India Institute of Technology
Hauz Khas
New Delhi—110 016

6. Mr. M. Y. Oke
Chief Engineer (WR) and
Joint Secretary
Irrigation Department
Mantralaya
Bombay—400 032

7. Shri K. M. Subrahmanyam
Director
Ground Water Department
6—3—906/A/2, Somajiguda
Hyderabad—500 004

8. Dr. S. M. Seth
Scientist 'F'
National Institute of Hydrology
Jal Vigyan Bhawan
Roorkee—247667

APPENDIX VIII

POSITION OF STAFF OF NIH AS ON 1-4-85 and 31-3-86

Sl. No.	Description	Existing as on		Remarks
		1-4-85	31-3-86	
1.	Director	1	1	
2.	Scientist 'F'	1	2	
3.	Scientist 'E'	2	1	
4.	Scientist 'C'	8	8	
5.	Scientist 'B'	12	15	
6.	Assistant Engineer	—	1	
7.	Senior Research Assistant	11	15	
8.	Research Supervisor	—	—	
9.	Research Assistant	4	5	
10.	Senior Computer Operator	—	—	
11.	Junior Engineer (Civil)	—	—	
12.	Junior Engineer (Elect.)	—	—	
13.	Technical Assistant (Photography)	—	—	
14.	Works Supervisor	—	1	
15.	Senior Draftsman	—	—	
16.	Technician Grade II	—	—	
17.	Draftsman	1	1	
18.	Senior Laboratory Assistant	1	—	
19.	Laboratory Assistant	1	1	
20.	Computer Operator	2	1	
21.	Mechanic Grade I	4+1**	5	
22.	Lineman	1	1	
23.	Tracer	1	2	
24.	Lab. Attendent	—	5	
25.	Lib. Attendent	—	2	
26.	Lab. Attendent (Sub-Station)	—	—	
27.	Lab. Attendent (Tube-well)	—	1	
28.	Chief Admn. Officer	1	1	

Sl. No.	Description	Existing as on		Remarks
		1-4-85	31-3-86	
29.	Finance Officer	1	—	
30.	Senior Personal Assistant	1	1	
31.	Section Officer	—	—	
32.	Superintendent	—	2	
33.	Personal Assistant	3	3	
34.	Stenographer	2	4	
35.	Upper Division Clerk	4	4	
36.	Receptionist	—	1	
37.	Lower Division Clerk	8+2**	9	
38.	LDC (Telex)	1	1	
39.	Driver	2	3	
40.	Horticulture Assistant	1	1	
41.	Photocopier Operator	1	1	
42.	Ammonia Printer Operator	1	1	
43.	Messenger/Chowkidar	7	15	
44.	Mali	1	1	
45.	Daftari	—	—	
46.	Safai Karmchari	1	1	

** Ad hoc

APPENDIX IX

INSTITUTE PERSONNEL

DIRECTOR

Dr. Satish Chandra

SCIENTIST 'F'

Dr. S.M. Seth

Dr. G.C. Mishra

w.e.f. 24.6.1985

SCIENTIST 'E'

Dr. G.C. Mishra

Upto 23.6.1985

Dr. P.V. Seethapathi

SCIENTIST 'C'

Shri K.S. Ramasastry

Shri K. Ethirajan

Shri A.K. Bhar

Shri Bhaskar Dutta

Upto 10.9.1985

Dr. K.K.S. Bhatia

Shri A.K. Sikka

Dr. B. Soni

Dr. P.S. Datta

Upto 6.6.1985

Shri Ramesh Chand

w.e.f. 15.5.1985

Shri M. Perumal

w.e.f. 4.2.1986

SCIENTIST 'B'

Shri A.B. Palaniappan

Shri S.R.B. Dhason

Upto 31.1.1986

Shri M. Perumal

Upto 3.2.1986

Shri R.D. Singh

Shri A.G. Chachadi

Shri S.K. Jain

Shri N.K. Goel

Shri V.K. Lohani

Smt. Deepa Karwade

Shri Lalit Kumar

Upto 5.12.1985

Shri D.K. Raghu	Upto 31.3.1985
Shri V.C. Goel	
Shri Anil Kumar	w.e.f. 30.10.1985
Shri S.K. Singh	w.e.f. 1.11.1985
Shri C.P. Kumar	w.e.f. 22.11.1985
Shri J. Hari Krishna	w.e.f. 25.11.1985
Shri Madan Kumar Santoshi	w.e.f. 8.1.1986
Shri Rakesh Kumar	w.e.f. 12.2.1986
Shri Nikhilendu Nikhil	w.e.f. 28.2.1986
ASSISTANT ENGINEER (CIVIL)	
Shri P.K. Pramanick	w.e.f. 12.2.1986
SENIOR RESEARCH ASSISTANT	
Shri A. T. Jayaseelan	Upto 20.9.1985
Shri U. C. Kothiyari	Upto 30.4.1985
Mrs. Asha Sinha	
Mrs. P. Nirupma	
Shri S. K. Verma	
Shri Pratap Singh	
Dr. (Mrs) Rama Devi Mehta	
Shri Rajeev Agarwal	Upto 8.11.1985
Dr. C. K. Jain	
Km. Anuradha Bhatia	
Shri Anil Kumar Garg	
Km. Vibha Jain	w.e.f.4.11.1985
Shri D. C. Sharma	w.e.f.11.11.1985
Shri C. P. Kumar	w.e.f.17.8.1985 to 21.11.1985
Shri Anjani Kumar Nigam	w.e.f.26.11.1985
Shri Rakesh Kumar	w.e.f.29.11.1985 to 11.2.1986
Shri Ravi Kumar	w.e.f.11.12.1985
Shri Tara Chand Ravi	w.e.f.18.12.1985
Shri Ashok Kumar Gupta	w.e.f.28.11.1985
Shri Yogesh Panwar	w.e.f.14.2.1986
Shri S.K. Goel (Adhoc)	w.e.f.3.3.1986
RESEARCH ASSISTANT/TECHNICAL ASSISTANT	
Shri J.M. Rathore	
Shri Pankaj Garg	

Shri Rajan Vatsa	
Miss. Vibha Jain	Upto 3.11.1985
Shri Tanveer Ahmad	w.e.f.9.8.1985
Shri Achal Kumar Goyal	w.e.f.20.12.1985
WORKS SUPERVISOR	
Shri Rajeev Kumar Gupta	w.e.f.20.11.1985
COMPUTER OPERATOR	
Shri R. D. Sharma	Upto 4.10.1985
Mrs. Veer Bala Goel	
DRAFTSMAN	
Shri Narendra Kumar	
TRACER	
Shri Rakesh Kumar Garg	
Shri N.K. Varshney	w.e.f.25.11.1985
S.L.A. (STORES)	
Shri Tanveer Ahmad	Upto 8.8.1985
MECHANIC	
Shri C.P. Singh	
Shri Jamil Ahmad	
Shri Rajiv Goel	Upto 17.6.1985
Shri Lal Singh	
Shri Yogendra Kumar Sharma	w.e.f.16.9.1985
Shri Suresh Kumar Mishra	w.e.f.31.12.1985
HORTICULTURAL ASSISTANT	
Shri Sukh Pal Singh	
LINE MAN	
Shri M.B.D. Sharma	w.e.f. 8.7.1985
LABORATORY ASSISTANT	
Shri Mahendra Pal Singh	
CHIEF ADMINISTRATIVE OFFICER	
Shri Y.P. Sareen	Upto 18.4.1985
Shri K.S. Saha	w.e.f. 3.10.1985
FINANCE OFFICER	
Shri R.R. Agarwal	Upto 31.10.1985
SENIOR PERSONAL ASSISTANT	
Shri S.S. Kanwar	

SUPERINTENDENT

Shri R.D. Garg

w.e.f. 2.4.1985

Shri S.S. Bhandari

w.e.f. 17.2.1986

P.A. CUM-ADMN.-ASSISTANT

Shri Rajesh Goel

Shri S.P. Singh

Shri A.K.Chatterjee

UPPER DIVISION CLERK

Shri A.P. Chamoli

Shri H.K. Arora

Shri Dharam Pal

Shri S.C. Gulati

STENOGRAPHER

Miss Mary Dias

Shri N.I. Siddiqui

Shri P. Panikar T.

w.e.f. 25.5.1985

Shri A.K. Sharma

w.e.f. 11.6.1985

LOWER DIVISION CLERK

Shri P.V.K. Nair

Shri S.P. Sharma

Shri Rajneesh Kumar Goel

Shri Surendra Pal Singh

Shri Yogendra Kumar

Upto 15.5.1985

Shri Vinay Kumar Srivastava

Shri Amar Singh Mehra

Shri T.M. Khan

w.e.f. 1.7.1985

Shri A.S. Kotwal

Shri Pramod Kumar Gupta

w.e.f. 1.1.1986

L.D.C. (TELEX)

Shri S.P. Modi

RECEPTIONIST

Miss Neelam Manrai

w.e.f. 30.8.1985

DRIVER

Shri S.P. Rai

Shri Paltu Ram

Shri Narain Singh

w.e.f. 7.1.1986

AMMONIA PRINT OPERATOR

Shri Surendra Pal

PHOTOCOPIER OPERATOR

Shri Mam Chand

LABORATORY ATTENDENT

Shri Dhan Pal Singh

w.e.f. 3.5.1985

Shri Ravindra KumarDhyani

w.e.f. 3.5.1985

Shri Ashutosh KumarSharma

w.e.f. 8.7.1985

Shri Daya Nand

w.e.f. 12.7.1985

Shri Babu Ram Sharma

w.e.f. 2.8.1985

ATTENDENT (TUBEWELL)

Shri Alok Kumar Sharma

w.e.f. 23.12.1985

LIBRARY ATTENDENT

Shri Rakesh Kumar Gupta

Upto 17.1.1986

Shri Chandra Shekhar

w.e.f. 1.8.1985

Shri Ram Phal

w.e.f. 28.2.1986

MESSENGER

Shri Om Prakash

Shri Madan Singh

Shri Vijay Kumar

MESSENGER-CUM-CHOWKIDAR

Shri Amar Singh

Shri JagdishPathak

Shri Dayal Singh

w.e.f. 3.5.1985

Shri Ashok Kumar Dhiman

w.e.f. 3.5.1985

Shri R.N. Pandey

w.e.f. 3.5.1985

Shri Sunil Kumar Sharma

w.e.f. 3.5.1985

Shri Satish Kumar Kashyap

w.e.f. 3.5.1985

Shri Hari Das

w.e.f. 3.5.1985

CHOWKIDAR

Shri Puran Chand

Shri Ranjit Singh

PEON

Shri Amarjeet Singh

w.e.f. 3.2.1986

Shri Ram Nath

w.e.f. 3.2.1986

MALI

Shri Man Bodh Pathak

SWEEPER

Shri Rakesh Kumar

APPENDIX—X

SCIENTIFIC AND TECHNICAL REPORTS PREPARED DURING 1985-86

REVIEW NOTES

1. Use of Catchment Characteristics for Unit Hydrograph Derivation	RN	15
2. Estimation of ET for Variable Water Table Situation	RN	16
3. Conjunctive Use of Surface and Ground Water	RN	17
4. Time Series Analysis Models	RN	18
5. Comparative Study of Self Recording Raingauges	RN	19
6. Rainfall Runoff Relationship	RN	20
7. Effect of Flood Plain Flood Routing	RN	21
8. Effect of Channel Processes on Flood Routing	RN	22
9. Return Flow from Irrigation	RN	23
10. Environmental Isotopes for Hydrological Investigations	RN	24
11. Range Analysis for Storage	RN	25
12. Sedimentation in Reservoirs	RN	26
13. Hydrological Applications of Microprocessors	RN	27
14. Geophysical Investigations for Hydrological Studies	RN	31
15. Snowline and Snowcover Mapping	RN	28
16. Land use/Land cover Mapping	RN	29
17. Flash Flood Studies	RN	30
18. Design Storm Estimation	RN	32
19. Atmospheric General Circulation Model	RN	33
20. Hydrometeorological Study for Droughts	RN	34
21. Forecasting Models	RN	35
22. Regional Unit Hydrograph	RN	36

TECHNICAL NOTES

1. Rainfall Studies of Belgaum District	TN	14
2. Determination of Seepage from Water Bodies	TN	15
3. System Specific Programme Inputs for Documented Programmes	TN	16
4. Drought Analysis Using Soil Moisture Simulation Approach	TN	17
5. Parameterisation of Hydrological Factors in Ground Water Study	TN	18

6. Duration of Pumping Test for Determination of Aquifer Parameters	TN	19
7. Scientific Information System	TN	20
8. Data Acquisition System	TN	21
9. Data Requirement and Data Preparation for Dam Break Analysis	TN	22
10. Flood Routing with Lateral Flows	TN	23
11. Exchange of Flow Between a River and an Aquifer System	TN	24
12. Vegetative Management for Increasing Water Yield	TN	25
13. Guidelines for Sample Survey for Minor Irrigation Works	TN	26
14. Optimal Reservoir Operation Using Dynamic Programming	TN	27
15. Telemetry System and Signal Analyser for Data Transmission	TN	29
16. Soil Moisture Using Neutron Probe	TN	28
17. Conjunctive Use of Surface and Ground Water	TN	30
18. Estimation of ET Under Variable Soil Moisture Situation.	TN	31
19. Design and Performance of Large Diameter Wells in Hard Rock Areas	TN	32
20. Watershed Resources Management-Development of sub-model 'WATER'	TN	33
21. Development of Data Storage and Retrieval System	TN	34
22. Data Base Management	TN	35
23. Software for Micro-computer	TN	36

CASE STUDIES

1. Regional Frequency Analysis	CS	9
2. Water Balance of Upper Ganga Canal	CS	10
3. Partial Duration series Models	CS	11
4. Network Design Studies for Raingauges in Rajasthan	CS	12
5. Application of Muskingum Cunge Method	CS	13
6. Land Use and Land Cover Mapping for Yamuna	CS	14
7. Soil Water Accounting by SCS	CS	15
8. Flood Control Operation of Reservoir	CS	16
9. DOSAG Model	CS	17
10. Finite Difference Model for UGC	CS	18

STATUS REPORTS

1. Forest Influences on Hydrological Parameters	SR	5
2. Status of Hydrological Studies in Forested Catchments	SR	6
3. Sediment Yield from Different Land Uses	SR	7

USER'S MANUALS

1. Kalinin Milyukov Method	UM	13
2. Application of Tank Model for Daily Analysis	UM	14
3. Application of Tank Model for Flood Analysis	UM	15
4. Single Purpose Reservoir Operation for Irrigation	UM	16
5. Hydrological Data Processing	UM	12

MANUALS

1. Multipurpose Operation of a Reservoir	M	6
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WORKSHOPS/SEMINARS ORGANISED IN 1985-86
WORKSHOPS

TOPIC	PLACE	PERIOD	NO. of PARTICIPANTS	ORGANISATION
		1985		
1. Unit Hydrograph Techniques	Roorkee	April 15-19	7	CWC, BBMB, APID, GID
2. VAX-11/780 Computer System	Roorkee	May 6-10		
3. Flood Frequency Analysis	Roorkee	May 13-17	15	IASRI, RDSO, GID, NWDA, CWC, IMD, UPID, WRDTC
4. Flood Frequency Analysis	Guwahati	Oct., 7-10	37	AID, AFCD, CWC, BB, MEB
5. Ground Water Modelling	Roorkee	Nov., 18-22		
6. Flood Frequency Analysis	Calcutta	Dec., 16-21	33	RRI, WBID, DVC, WB, PWD.
7. Observation, Processing and Analysis of Precipitation Data	Roorkee	Feb., 24-28	14 +5 of NIH	NWDA, IMD, SASE, IASRI, UPID, WBID, GID
		1986		
		SEMINARS		
1. Flood Frequency Analysis	Delhi	Sept., 30, 1985	55	CWC, IMD, NWDA, WBID, GID, UPID, APID, MPID.
CWC = Central Water Commission		NWDA = National Water Development Agency		
BBMB = Bhakra Beas Management Board		IMD = India Meteorological Department		
APID = Andhra Pradesh Irrigation Dept.,		UPID = U.P. Irrigation Department		
GID = Gujarat Irrigation Department		WRDTC = Water Resources Development & Training Centre		
IASRI = Indian Agricultural Statistical Research Institute.		AID = Assam Irrigation Department & Training Centre		
RDSO = Railways Design & Standards Organisation		AFCD = Assam Flood Control Department		
SASE = Snow and Avalanche Study Establishment		BB = Brahmaputra Board		
		MEB = Meghalaya State Electricity Board		
		RRI = River Research Institute		
		WBID = West Bengal Irrigation Department		
		DVC = Damodar valley Corporation		
		WBPWD = West Bengal Public Works Department.		

**INTERACTION WITH STATES AND STUDIES PROPOSED AND TAKEN
UP IN THE STATES**

A. GUJARAT

- (1) Preparation of typical Hydrological Year Book for Machchu I basin
- (2) Proposal for establishment of Regional Centre
- (3) Regional Flood Formulae
- (4) Representative basin studies for Machchu I basin
- (5) Mathematical Model Studies
- (6) Organisation of a Workshop on Design Flood.

B. KARNATAKA

- (1) Preparation of Hydrological year book for Malaprabha River
- (2) Hydrological and water resources study for Malaprabha and Ghataprabha Rivers.
- (3) Study of Rainfall trends in Belgaum District.

C. NORTH EASTERN REGION

- (1) Workshop on Flood Frequency Analysis held on October 7 to 10, 1985.
- (2) Proposal for Establishment of Regional Centre and Representative Basin being formulated jointly with State organisations.
- (3) Hydrological Studies of Barak Basin.

D. ORISSA

- (1) Criteria for design flood with calculated risk-guidelines and manual.
- (2) Help in finalising computer configuration.
- (3) Workshop on Flood Frequency Analysis in April 1986.

E. PUNJAB

- (1) Flash Flood studies in Bist Doab region.
- (2) Problem of Water logging and Salinity in South Western Punjab.
- (3) Workshops on (a) Unit Hydrograph Derivation and Flood Frequency Analysis (b) Storage, Processing and Analysis of Hydrologic Data.

F. RAJASTHAN

- (1) Design of Network of Raingauges and Stage and Discharge measuring sites.
- (2) Design Flood for Flashing Streams.
- (3) Regional Flood Frequency Studies
- (4) Initiation of lake studies
- (5) Drought studies in Barhmer

G. UTTAR PRADESH

- (1) Seasonal Ground Water Balance and monthly mathematical modelling of UGC Command Area.
- (2) Water logging Problem of Sarju Nahar Pariyojna.
- (3) Organisation of a workshop on Unit Hydrograph Techniques.
- (4) Preparation of typical year book of a River basin in U.P.
- (5) Establishment of a representative basin (Pinder river) and Instrumenting it for hydrological response.
- (6) Operation study for Yamuna System upto Tajewala for Hydropower.

H. WEST BENGAL

- (1) Preparation of Hydrological year book for Kalighai Basin.
- (2) Hydrological Studies of Tidal Basin (Saptamukhi river and Tolleys Nala)
- (3) Analysis of Sedimentation data and Empirical Approach to Flood Forecasting for small reservoirs.
- (4) Effect of Deforestation and Afforestation on Runoff and Sediment Yield.
- (5) Workshop on Flood Frequency Analysis at Calcutta from December 16 to 20, 1985.
- (6) Proposal for the Establishment of Regional Centre in West Bengal.
- (7) Ground Water Balance Study and Modelling for Daru Keshwar basin
- (8) Workshop on Ground Water Balance and Modelling at Calcutta.

COMPUTER SYSTEM & FACILITIES**A. Computer System**

- i. Basic equipment including
 - VAX-11/780 CPU
 - 512 Kb of ECC MOS memory
 - REM 03 disc drive with mass bus adopter
 - TEE 16 magnetic tape transport unit with mass bus adopter
 - DZ 11 A asynchronous multiplexer
 - Console sub-system consisting of :
 - *LST 11 microcomputer
 - *RX Oi floppy drive
 - *LA 120 DECWRITER interactive terminal
 - Mounting cabinets
 - VAX/VMS operating system
- ii. Battery back—up for MOS memory
- iii. Floating point accelerator
- iv. 67 Mb disc drive
- v. Magnetic tape drive
- vi. LA 120 matrix printer
- vii. Network link microprocessor
- viii. RM03 disc cartridges (11 Nos.)
- ix. CRT terminal VI 100 AB
 - x. Advanced video options for VT 100 CRT terminal
- xi. Emulex CS 21/F Communication Multiplexer
- xii. Additional memory (1 unit of 512 Kb and 2 units of 256 Kb each)

B. Computer Facilities

- i. CRT terminal VT 105 SP Graphic
- ii. Tektronix Colour Graphic Terminal
- iii. ADM 3A Video Terminal

- iv. Calcomp-31 Colour Graphic System
- v. Uninterrupted power supply and spares with battery packs
- vi. Line printer B 600
- vii. Card reader M200
- viii. Personal Computer PRO 325 (Not installed completely)
- ix. ADM-220 terminals (9 No.)

LIST OF EQUIPMENT PROCURED DURING 1985-86

- a. **Water quality laboratory**
 - 1. Portable Environmental Laboratory
 - 2. Portable Turbidimeter
 - 3. Portable Digital pH meter
 - 4. Digital pH meter (Lab)
 - 5. Conductivity meter
 - 6. Heating Plate
 - 7. Portable Kit

- b. **Remote sensing laboratory**
 - 1. Diazo Printer
 - 2. Large Format Optical Enlarger
 - 3. Microfilm Reader

- c. **Service and Instrumentation Workshop**
 - 1. Oscilloscope Philips Model PM 3217—1 No.
 - 2. Multimeters Philips Model PP 9006 X and PM 2502 and Motwane Model 8 X Mark III—3 Nos.
 - 3. Power Supplies Aplab make—2 Nos.
 - 4. Workshop Tools, 'Wolf' make
 - 5. Digital A.C. Resistivity Meter, Model ACR—1

- d. **Field Laboratory**
 - 1. Hair Hygrograph
 - 2. Dry bulb thermometer
 - 3. Wet bulb thermometer
 - 4. Minimum thermometer
 - 5. Maximum thermometer
 - 6. Automatic Hydrologic Station

PARTICIPATION IN SEMINARS/SYMPOSIA/CONFERENCES/WORKSHOPS

1. B Soni
N.K. Goel Seminar on Water Resources Development-Role of Proper Investigations, The Institution of Engineers, Jabalpur, September 1—3, 1985.
2. K.K.S. Bhatia
A.K. Sikka
V.K. Lohani National Seminar on Soil Conservation and Watershed Management organised by Ministry of Agriculture and Rural Development at New Delhi Sept. 17—18, 1985.
3. Satish Chandra FEISCA Workshop on Water Resources, its Management, and Development, The Institution of Engineers (India), Kathmandu, Nepal, Sept. 21—23, 1985.
4. Satish Chandra
S.M. Seth
K.S. Ramashastri
M. Perumal
R.D. Singh
N.K. Goel Seminar on Flood Frequency Analysis organised by N.I.H., Roorkee and CBI & P, New Delhi held at New Delhi on Sept. 30, 1985.
5. Satish Chandra
S.M. Seth
M. Perumal
R.D. Singh
N.K. Goel Workshop on Flood Frequency Analysis organised by N.I.H., Roorkee and Brahmaputra Board, Guwahati at Guwahati from Oct. 7-10, 1985.
6. S.M. Seth International Workshop on Alluvial River Problems, Civil Engineering Department, University of Roorkee, Roorkee, Oct. 24—26, 1985.
7. Satish Chandra
(Chairman of the session)
S.M. Seth International Congress on Engineering and Environment, Institution of Engineers (India), New Delhi, Nov. 1985
8. K.K.S. Bhatia
V.K. Lohani International Seminar on Environmental Impact Assessment of Water Resources Projects organised by WRDTC, Roorkee at Roorkee from Dec. 14—16, 1985.
9. Satish Chandra Workshop on Flood Frequency Analysis organised by N.I.H., Roorkee and Govt. of West Bengal at Calcutta from Dec. 16—20, 1985.
10. Satish Chandra
Pratap Singh Third Regional Training Seminar on Ice and Snow organised by SASE, Manali at Manali from March 14—April 1, 1986.

TRAINING/COURSES ATTENDED

1. **K.S. Ramashastry** Training Workshop on "Real Time Data for Water Resources Projects Planning and Design" conducted jointly by WAPCOS and CMP at New Delhi.
S.K. Jain
2. **Anil Kumar** Short-term course on "Remote Sensing Techniques applied to Water Studies" at C.S.R.E., I.I.T.. Bombay from Feb. 10—22 1986. Resources
3. **S.M. Seth** Seventeenth Course on Management of R & D Systems organised by Administrative Staff College of India, Hyderabad from March 24—29, 1986

PAPERS PUBLISHED DURING THE YEAR 1985—86

1. Bhar, A.K. : 'Soil Moisture Monitoring' Accepted for publication in J. Indian Association of Hydrologists.
2. Bhatia, K.K.S. and A.K. Sikka : 'Various Procedures for Environmental Impact Assessment' Accepted for Publication in Proc. of the Seminar on 'Environmental Considerations in Planning of Water Resources Projects' to be held at Roorkee, April, 1986.
3. Chachadi, A.G. and Ralph Phraner : 'Analysis of Recovery, J. Indian Association of Hydrologists, Vol. VIII, No. 4, Dec. 1985.
4. Chandra S. : 'Recent trends of Water conservation in drought prone areas', J. Institution of Engineers (India), V. 66, Part CI 1, July 1985.
5. Dhason, S.R.B. : "Multi-reservoir Operation". J. Indian Association of Hydrologists, Vol. VIII, No. 4. Dec., 1985.
6. Ffolliott, P., M. Fogel and A.K. Sikka : "Impacts of Upstream vegetative management on water yield improvement", Accepted for publication in Proc. of the Seminar on "Environmental considerations in Planning of Water Resources Projects" to be held at Roorkee, April, 1986.
7. Goel, N.K. and S.M. Seth : "Tentative spillway design flood estimation for Narmada Sagar Project—A case study, Seminar on Flood Frequency Analysis, New Delhi, Sept. 30, 1985.
8. Goel, N.K. and S.M. Seth : "Data related problems in Frequency Analysis, Seminar on Flood Frequency Analysis, New Delhi, Sept. 30, 1985.
9. Goel N.K. : "Outliers in Frequency Analysis", Seminar on Water Resources—Role of Proper Investigation, Institution of Engineers (India), Jabalpur, Sept. 1 to 3, 1985.
10. Goyal, V.C., S.M. Seth V.K. Bansal and H. Sinvhal : "Microprocessor based instrumentation for Soil Resistivity Studies, XIth Annual Convention of Association of Exploration Geophysicists (India) Bhubaneshwar, Nov. 22—24, 1985.
11. Jain, S.K. and R.D. Singh; 'A Stochastic Approach to Reservoir Capacity Computation' I.A.H. Journal of Hydrology, Vol. VIII, No. 4, Dec. 1985.
12. Jain S.K., V.K. Lohani and G.C. Mishra : 'Water resources planning with environmental considerations' Accepted for publication in Proc. Of the Seminar on 'Environmental Considerations in Planning of Water Resources Projects' to be held at Roorkee, April, 1986.
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18. Perumal, M. and S.M. Seth : 'Need for uniform procedure of Flood Frequency Analysis Seminar on Flood Frequency Analysis, New Delhi, September 30, 1985.
19. Perumal, M., P. Nirupama and S.M. Seth : 'Some Studies on parameter estimation methods of Gumbel EV—I distribution using Monte Carlo Tests', Seminar on Flood Frequency Analysis, New Delhi, Sept. 30, 1985.
20. Perumal, M., S.M. Seth and B. Dutta : 'Tentative spill-way design flood estimation for Sardar Sarovar Project—A case study', Seminar on Flood Frequency Analysis, New Delhi, Sept.30, 1985
21. Perumal, M. and S.M. Seth : 'Regional Flood Frequency Analysis using Power Transformation-case study', Seminar on Flood Frequency Analysis, New Delhi, Sept. 30, 1985.
22. Ramasastri, K. S. Pratap Singh and S.M. Seth : 'Computerized processing and analysis of rainfall data, J. Hydrology, Indian Association of Hydrologists, Vol. VII, No. 3, August, 1985.
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24. Sikka, A.K ; 'Budkyo- Sellers Water Balance Approach—A case study', Accepted for publication in J. Indian Association of Hydrologists.
25. Singh, R.D. and S.M. Seth : 'Regional Flood Frequency Analysis for Mahanadi Basin using Wakeby Distribution', Seminar on Flood Frequency Analysis, New Delhi, Sept. 30, 1985
26. Singh, R.D. : 'Application on efficient smoothed least square technique for unit hydrograph derivation', J. Hydrology Indian Association of Hydrologists, V. VIII, No. 3, August, 1985.
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VISITORS

Visitors from Abroad

Prof. V.P.Singh
Department of Civil Engg.,
Louisiana State University
Baton Rouge, LA 70803, USA

Mr. Brain Albinson
World Bank
Washington D.C., USA

Dr. Audrei Filotti
Chief Technical Advisor
Dept.of Technical Cooperation for
Development
United Nations

Prof. V.V. Alastair
President, Asian Institute of Technology
Bangkok, Thailand

Mr. Suresh Chalise
International Commission for Integrated
Mountain
Development, Kathmandu, Nepal

Mr. C. C. Patel
Inter—Regional Advisor
Water Resources Division
United Nations
New York, USA

Dr. James C. Bathurst
NERC Water Resources Systems Research
Unit, Dept. of Civil Engg.
University of New castle Upon Tyne, U. K.

Mr. Joyce Brown
Dept. of Civil Engg.
Imperial College of Science & Technology
London, England

UNESCO

Mr. W.H.Gilbrich
UNESCO
Head Quarters, Paris

Mr. Javaslav Urban
UNESCO Regional Office
Jakarta

Mr. D. Hauet
Acting Director
Science Operation Division
UNESCO, Paris

Visitors from States

Mr. S.R. Kataria
Director
Design and Research
Irrigation Department
Jaipur

Mr. B. Dev
Chief Engineer (Retd.)
Irrigation Dept.
Govt. of West Bengal

Mr. A.K. Ummat
Chief Engineer (Drainage)
Irrigation Department
Punjab

Mr. S.K. Dasgupta
Chief Engineer (Environment)
Narmada Valley Development Authority
Bhopal

Mr. S. Seshadri
Chief Engineer (Planning & Monitoring)
Narmada Valley Development Authority
Bhopal

Visitors from Central Government

Mr. R. Ghosh
Ex. Chairman
Central Water Commission
New Delhi

Mr. N.K. Sarma
Member (Water Resources)
Central Water Commission
New Delhi

Mr. M.A. Chitale
Chairman
Central Water Commission
New Delhi

Mr. C.G. Desai
Advisor (Irrigation and CAD)
Planning Commission
Yojna Bhawan
Delhi

Visitors from other Organisations

Dr. P.G. Sastri
Prof. Civil Engineering
Regional Engg. College
Warangal (A.P.)

Dr. Bharat Singh
Vice Chancellor
University of Roorkee, Roorkee
Mr. K.K. Framji, Secretary General
International Commission of Irrigation and
Drainage New Delhi

Dr. S. Ramaseshan
Professor
Indian Institute of Technology
Kanpur

Dr. V.V. Dhruvanarayana
Director
CS & WC R & T Institute
Dehradun

314, Ram Nagar
ROORKEE—247667
Phone : 2829
Ref. No.....

SATYENDRA & Co.
Chartered Accountants

AUDIT—REPORT

The Member of Governing Body of
National Institute of Hydrology,
ROORKEE

We have audited the attached Balance Sheet and the Income and Expenditure Account of the National Institute of Hydrology, Roorkee as on 31st March, 1986 and report that we have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit and that in our opinion and to the best of our information and according to the explanations given to us the accounts give a true and fair view :

1. In case of the Balance Sheet, the state of affairs of the Institute as on 31st March, 1986, and
2. In case of Income and Expenditure Account of the surplus for the year ended on that date.

PLACE : ROORKEE
DATED : 12. 08. 1986

for SATYENDRA & CO.,
CHARTERED ACCOUNTANTS.

Sd/-
(S.K. GUPTA)

314, Ram Nagar
ROORKEE—247667
PHONE : 2829
REF. No.....

SATYENDRA & Co.
Chartered Accountants

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has spent a sum of Rs. 65,97,711.06 (Rupees sixty five lacs Ninety—seven thousand seven hundred eleven and Paise six only) during the financial year 1985—86, out of which a sum of Rs. 33,03,231.75 (Rupees Thirty-three lacs three thousand two hundred thirty one and Paise seventy five only, is on acquisition of fixed and other assets and Rs. 32,94,479.31 (Rupees Thirty-two lacs Ninety-four thousand four hundred seventy nine and Paise thirty one only), on revenue expenditure against the grant-in aid of Rs. ₹5,00,000.00 (Rupees Sixty-five lacs only) given to the Director, National Institute of Hydrology Roorkee during the year 1985-86 together with the unspent balance upto 31st March 1985 of Rs. 5,60,013.90 (Rupees Five lacs sixty thousand thirteen and Paise ninety only), thus leaving an unspent balance of Rs. 4,62,302.84 (Rupees Four lacs sixty-two thousand three hundred two and Paise eighty-four only), and the same has been verified with reference to accounting records maintained by the Institute and has been found to be correct.

Sd.
(K.S. SAHA)
FINANCE OFFICER.

PLACE : ROORKEE
DATED : 12.08.1986

Sd.
(SATISH CHANDRA)
DIRECTOR.

for SATYENDRA & CO.,
CHARTERED ACCOUNTANTS.

Sd.
(S.K. GUPTA)

314, Ram Nagar
ROORKEE-247667
Phone : 2829
Ref. No.....

SATYENDRA & Co.
Chartered Accountants

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has spent a sum of Rs. 3,72,412.17 (Rupees Three Lacs seventy-two thousand four hundred twelve and Paise Seventeen only) during the financial year 1985—86, out of which a sum of Rs. 1,18,457.70 (Rupees One Lac eighteen thousand four hundred fifty-seven and Paise seventy only), is on acquisition of fixed and other assets and Rs. 2,53,954.47 (Rupees Two Lacs fifty-three thousand nine hundred fifty-four and Paise forty-seven only), on revenue expenditure against the grant-in-aid of Rs. 3,000,00 (Rupees Three Lacs only) given to the Director National Institute of Hydrology, Roorkee on behalf of High Level Technical Committee on Hydrology during the year 1985—86 together with the unspent balance upto 31st March 1985 of Rs. 81,437.18 (Rupees Eighty-one thousand four hundred thirty-seven and Paise eighteen only), thus leaving an unspent balance of Rs. 9,025.01 (Rupees Nine thousand twenty-five and Paise One only) and the same has been verified with reference to accounting records maintained by the Institute and has been found to be correct.

Sd.

(K.S. SAHA)
FINANCE OFFICER

PLACE : ROORKEE

DATED : 12.08. 1986

Sd.

(SATISH CHANDRA)
DIRECTOR.
for SATYENDRA & CO.,

Sd.

(S.K. GUPTA)

314, Ram Nagar
ROORKEE-247 667
Phone : 2829

SATYENDRA & Co.
Chartered Accountants

Ref. No.....

Date : August 12, 1986

Governing Body,
National Institute of Hydrology,
University of Roorkee Campus,
ROORKEE (U.P.)

Dear Sir,

**Sub : Audit of Accounts of National Institute of
Hydrology for the year ended 31st March, 1986.**

We have completed the audit of the accounts of National Institute of Hydrology for the year ended 31st March 1986, and are enclosing herewith five copies of the balance sheet as at 31st March 1986, and Income and Expenditure Account and Receipts and payments Accounts for the year end-on that date. One copy of the accounts are to be returned to us for our record after the same has been approved by the Governing Body.

Our observations on the accounts are detailed as below :

1. WORKING RESULTS :

During the year under audit, the net revenue expenditure incurred by the Institute works out to Rs. 33, 85, 344.69 as against Rs. 24, 61, 870.44 in the previous year. The net revenue expenditure has been shown as deduction in the balance sheet from the Grants-in-aids received from Government of India, Ministry of Water Resources, New Delhi.

2.1 ASSETS FUND ACCOUNT (N.I.H.)

A Sum of Rs. 26, 22, 221.50 has been transferred to Assets Fund Account from Grant-in-aid being cost of acquisition of fixed and other assets during the year under audit. The details are as under.

(a) Increase in fixed Assets	(+)	12, 87,069.35
(b) Increase in Building Work in-Progress	(+)	8,92,993.85
(c) Increase in advances	(+)	4,63,939.80

(d) Decrease in Deposits	(—)	28,720.00
(e) Increase in prepaid expenses	(+)	6,938.00
		<hr/>
		Total Rs. 26,22,221.00
		<hr/>

2.2 ASSETS FUND ACCOUNT (HILTECH)

A sum of Rs. 1, 18, 457.70 has been transferred to Assets Fund Account from Grant-in-aid being cost of acquisition of fixed and other assets during the year under audit. The detail are as under.

(a) Increase in fixed Assets		68,257.70
(b) Increase in advance		50,200.00
		<hr/>
		Total Rs. 1,18,457.70
		<hr/>

3. ADDITION TO FIXED ASSETS :

During the year under audit a sum of Rs. 13,55,327.05 has been spent on addition to various fixed assets as per details given in schedule 'A' forming parts of these audits. These addition may be approved.

4. BUILDING WORK-IN-PROGRESS :

A sum of Rs. 31, 83, 991.64 has been spent upto 31st March 1986 on the construction of the Guest House which has already been completed but amount could not be adjusted due to final settlement of the bill, and Laboratory Block of the Institute, which is still in progress. The detail are as under :

(a) Advance with U.O.R.		27,47,200.85
(b) Steel and Cement with U.O.R		2,06,075.38
(c) Material at site with U.O.R.		2,30,715.41
		<hr/>
		Total Rs. 31,83,991.64
		<hr/>

5. ADVANCES TO OTHERS Rs. 13,08,988.40

A sum of Rs. 13,08,988.40 is out standing as at 31st March, 1986. The details of the afore said outstanding advances given in schedule-D forming part of accounts. The detailed observation are under :

- (a) **Advance to U.P.S.E.B.** Rs. 5,89,757.00
- (1) This includes a sum of Rs. 4, 95, 454.00 given as advance to Uttar Pradesh State Electricity Board for erecting a sub-station of 250 KW. We have been explained that work has been completed and amount could not be adjusted in the absence of final bill.
- (2) A sum of Rs. 11, 388.00 has been given as advance to Uttar Pradesh Electricity Board for Temporary Connection of line to the Administrative Building. Amount could not be adjusted in the absence of final bill.
- (3) A sum of Rs. 82,915.00 has been given to Uttar Pradesh State Electricity Board for L.T. site preparation. We have been explained that the work is still to be started.
- (b) **Advance for Sateilite DATA Rs. 12,980.00**
- A sum of Rs. 12,980.00 has been given to N.R.S.A. Secunderabad for Satellite Data.
- (c) **Advance for Meteorological Instrument 35,367.00**
- A sum of Rs. 35,367.00 has been given to I.M.D. Pune for Meteorological Instruments.
- (d) **Advance for Cement Rs. 3,08,956.00**
- (i) A sum of Rs. 32,800.00 has been given to the Associate Cement Company Limited Kanpur. Material has been received and amount could not be adjusted in the absence of final bill.
- (ii) A sum of Rs. 2,76,156.00 has been given to M/s. Birla Jute & Industries Limited Satna (M.P.) for cement.
- (e) **Advance for Steel Rs. 1,30,000.00**
- A sum of Rs. 1,30,000.00 has been given to M/s. Steel Authority of India Limited, Navyug Market, Ghaziabad for Steel.
- (f) **Advance for Computer Produced Bibliography Rs. 490.00**
- A sum of Rs. 490.00 has been given to British High Commission New Delhi for Computer Produced Bibliography.
- (g) **Advance for 25 ISI Binders Rs. 530.00**
- A sum of Rs. 530.00 has been given to Indian Standard Institute, New Delhi for 25 ISI Binders, whole amount has been refunded during the year 1986-87.
- (h) **Advance for Rainfall Data of 55 Districts in U.P. Rs. 2,700.00**
- A sum of Rs. 2,700.00 has been given to Indian Communication Net Work Ltd., New Delhi for Rainfall Data of 55 Districts in U.P.

(i) Advance for Rainfall Data in Karnataka Rs. 3,015.00

A sum of Rs. 525.00 for monthly & annual Rainfall Data for 13 states in Karnataka & Rs. 2, 490.00 for providing self recording raingauge data has been given to Additional Director General of Meteorology (Research) Pune.

(j) Advance for supply of books Rs. 1,030.00

A sum of Rs. 1, 030.00 has been given to Central Board for Prevention & Cement Water Pollution, New Delhi for supply of books & publication. The amount has been adjusted during the year 1986—87.

(k) Advance to M/s. Electronics trade & Technology Development Corporation Limited New Delhi Rs. 79,684.80

(i) A sum of Rs. 66,768.00 has been given to M/s. Electronic Trade & Technology Development Corporation Limited New Delhi for six disc pack. The advance has been adjusted in the year 1986-87.

(ii) A sum of Rs. 12, 916.80 has been given to M/s. Electronics Trade & Technology Development Corporation Limited New Delhi for six disc pack. The advance has been adjusted in the year 1986—87

(l) Advance for Diazo Films for Remote Sensing Rs. 1,517.60.

A sum of Rs. 1,517.60 has been to M/s. Optomach Engineers Hyderabad for Diazo Films for Remote Sensing. The amount has been adjusted during the year 1986—87.

(m) Advance for Workshop Rs. 8,000.00

A sum of Rs. 8,000.00 has been given to Executive Engineer Damodar Survey & Investigation Division, I & W Directorate, Calcutta, for Workshop

(n) Advance for 200 Transparency sheets Rs. 1,248.00

A sum of Rs. 1, 248.00 has been given to M/s. Methodex Pvt. Ltd., New Delhi for 200 Transparency sheets.

(o) Advance for Seminar on Drought Management Strategies Rs.50,000.00 (HILTECH)

A sum of Rs. 50,000.00 has been given to Treasurer Seminar on Drought Management WRDO, Bangalore for Seminar on Drought Management Strategies.

6. DEPOSITS :

A sum of Rs. 75,330.00 is deposited as at 31 st March 1986 with various parties. The details of the aforesaid amount are given in schedule 'C' forming part of the accounts.

7. HIGH LEVEL TECHNICAL COMMITTEE ON HYDROLOGY :

As per the Fourteenth Meeting of the Governing Body of National Institute of Hydrology on 9th July 1982, it was decided to transfer the C.S.I.R. Unit of the Indian National Committee for International Hydrological Programme to the National Institute Hydrology. During the year under audit, a sum of Rs. 3,00,000.00 has been received and the net revenue expenditure incurred by the Institute works out to Rs. 2,53,954.47. The net revenue expenditure has been shown as a deduction in the Balance Sheet from the Grant-in-aid received from Government of India, Ministry of Water Resources, New Delhi. A sum of Rs. 51,450.00 has been paid to I.I.T. New Delhi for some research work. No utilisation certificate was shown to us for our verification.

8. RECEIPT FROM COMPUTER HIRE CHARGES :

The hire charges on account of Computer has been accounted for on cash basis.

9. REPAIR & MAINTENANCE :

It includes an expenditure of Rs. 3, 60,000.00 on account of maintenance and warranty charges paid to computer Maintenance Corporation, New Delhi for the period from October 1985 to October 1986. Prepaid expenses has not been segregated as per the past practice.

10. ACCOUNTS :

We have also pointed out in our last audit report that the Institute has been maintaining accounts on 'Single Entry System'. The system adopted by the Institute creates difficulties in furnishing complete informations at the time of preparation of various statements and finalisation of accounts.

We, therefore, suggest that the accounts must be maintained on "Double Entry System". It has been explained to us that "Double Entry System" has been implemented in the next year to some extent.

As per past practice, the Balance Sheet and Income and Expenditure Accounts has been prepared on actual basis of accounting whereas the utilisation certificate has been prepared on the basis of actual receipts and payment. In view of this the unspent balance of Grant-in-aid from Government of India as shown in the Balance Sheet differs with the figures shown in utilisation certificate.

Before we conclude our report, We would like to place on record the cooperation extended to us by the office bearers during the course of our audit.

Yours faithfully,
for SATYENDRA & CO.,
CHARTERED ACCOUNTANTS

Sd /-
(S.K. GUPTA)

Phone : 2829
 SATYENDRA & CO.
 Chartered Accountants
 314, Ram Nagar, ROORKEE—247667

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
 BALANCE SHEET AS AT 31ST MARCH, 1986

AS AT 31.3.1985	LIABILITIES	AMOUNT (Rs)	AS AT 31.3.1985	ASSETS	AMOUNT (Rs)
428872.76	Grant-in-aid from Govt. of India, Ministry of Water Resources, New Delhi.	434822.74	3987750.37	Fixed Assets. (At Cost)	53,43,077.42
	Opening Balance		2290997.79	As per Schedule 'A'	
4000000.00	Received from Govt. of India, Ministry of Water Resources, New Delhi.	6500000.00	794848.60	Building Work-in-progress	31,83,991.64
4428872.76				As per Schedule 'B'	
	a) Less cost of acquisition of fixed and other assets transferred to assets fund			Current Assets, Loan & Advances	
1532179.58		2622221.50	4532.00	Advances to U.O.R. and others As per Schedule 'D'	13,08,988.40
	b) Transferred to Income & Expenditure A/c to meet the excess of the expenditure over Income for the yr :		104050.00	Prepaid Expenses	11,470.50
2461870.44		3385,344.69	27983.64	Deposits	75,330.00
434822.74	Grant-in-aid from Govt. of India, Ministry of Water Resources, New Delhi, on account of High Level Technical Committee of Hydrology.	9,27,256.55	3700.00	As per Schedule 'C'	
	Balance brought forward from previous year :	81437.18	607532.30	Cash and Bank Balances	
188000.00	Received during the year :	300000.00	—	Cash in hand	3,264.15
				Imprest with the Divisional Heads	5,700.00
				Balance in S. B. A/c with S. B. I. Roorkee	4,85,602.41
				Margin Money with S. B. I.	6,14,520.00

AS AT	LIABILITIES	AMOUNT (Rs.)	AS AT	ASSETS	AMOUNT (Rs.)
264475.49	Less :				
	Cost of acquisition of fixed and other assets transferred to Assets Fund A/c	118457.70			
	Transferred to Income & Expenditure to meet the excess of expenditure (-)				
183038.31	over Income for the year :	<u>253954.47</u>			
81437.18		9,025.01			
	ASSETS				
	FUND ACCOUNT (NIH)				
5648248.13	Balance brought forward from previous year	7180427.71			
1532179.58	Transferred from GIA	<u>2622221.50</u>			
7180427.71		98,02,649.21			
	ASSETS FUND A/C				
	(HILTECH)				
123707.07	Liabilities for Expenses as per schedule 'E'				
7820394.70	TOTAL	<u>1,10,31,944.52</u>			
				TOTAL	<u>1,10,31,944.52</u>

AS PER OUR REPORT OF EVEN DATE ANNEXED FOR SATYENDRA & CO.

Sd./-
(S. K. GUPTA)
DIRECTOR

Seal
PLACE : ROORKEE
DATE : 12th Aug., 1986.
FINANCE OFFICER

Sd./-

(K. S. SAHA)

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR
31st MARCH, 1986

Phone : 2829
SATYENDRA & CO.
Chartered Accountants
314, Ram Nagar, ROORKEE—247667

PREVIOUS YEAR (Rs.)	EXPENDITURE		CURRENT YEAR		PREVIOUS YEAR (Rs.)		INCOME		CURRENT YEAR	
			Rs.	P.	Rs.	P.			Rs.	P.
14,80,747.72	Salaries, Wages and Allowances		20,09,033.43		73,281.26		Hire Charges of Computer		43,506.62	
61,950.35	Travelling & Conveyance		1,05,574.50		38,020.06		Interest on Savings Deposits		88,959.85	
6,07,573.32	Repair & Maintenance		4,60,210.07		5,345.80		Miscellaneous Receipt		4,559.15	
93,996.32	Printing & Stationery		1,68,530.19		15,000.00		Deposit for Computer Charges		1,500.00	
607.50	Printing of Technical Books		2,39,696.91							
53,349.50	Postage, Telephone & Telex		39,456.25		76,768.69		Receipts from sponsored Project			
3,505.00	Audit Fee		2,500.00				A/c in recoupment of Expenditure			
54,456.44	Electricity and Water Charges		66,706.90				incurred on Narmada Project			
—	Training Expenses		18,832.55				N W D A during the year 1981-			
—	Seminar and Conferences		7,078.00				82 to 1983-84.			
57,947.64	Repair & Maintenance of Vehicle		73,099.29							
57,830.23	Staff Welfare		86,650.75				Transferred from G.I.A. A/C to			
9,737.50	Grant-in-Aid/Subsidies		4,302.00				meet the expenditure for the year			
10,538.40	Hospitality Expenses		15,440.08		24,61,870.44		of N. I. H.		33,85,344.60	
33,316.80	Advertisement		85,248.30							
31,352.10	News Paper & Periodicals		42,283.00				Transferred from G.I.A. A/c to			
7,699.10	T. A. to Candidates		7,587.00				meet the expenditure for the year			
28,616.08	Interest on C. P. F.		42,585.00		1,83,038.31		of HILTECH		2,53,954.47	
45,274.00	Local Cost of U.N.D.P. Project		2,675.00							
31,788.25	Miscellaneous Expenses		35,861.09							
—	Consultancy Fee		10,520.00							
—	Expenditure incurred on High									
1,83,038.31	Level Technical Committee on Hydrology		2,53,954.47							
28,53,324.56	TOTAL		37,77,824.78		28,53,324.56		TOTAL		37,77,824.78	

(XXXXXI)

PLACE : ROORKEE
DATE : 12th August 1986

Sd./—
(K. S. SAHA)
FINANCE OFFICER

Seal As per our report of even date annexed
FOR SATYENDRA & CO. CHARTERED ACCOUNTANTS

Sd./—
(SATISH CHANDRA)
DIRECTOR

Sd./—
(S.K. GUPTA)

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED
31st March, 1986

SATYENDRA & CO.
Chartered Accountants
314, Ram Nager, Roorkee-247667

PREVIOUS YEAR (Rs.)	RECEIPTS	YEAR	CURRENT (Rs.)	PREVIOUS YEAR (Rs.)	PAYMENTS	CURRENT YEAR (Rs.)
	Cash & Bank Balances			14,49,665-45	Salaries, Wages & Allowances	19,68,010-35
9,614-04	Cash-in-hand		26,983-64	61,950-35	Travelling & Conveyance	1,05,574-50
5,80,771-31	Bank Balances		6,07,532-30	93,996-32	Printing & Stationery	1,68,530-19
3,500-00	Imprest with Divisional Heads		3,700-00	49,805-50	Postage, Telephone & Telex Maintenance	32,905-15
	Grants-in-aid Received			6,07,573-32	Payments to Auditors	4,60,210-07
	From Govt. of India, Ministry of Water Resources, New Delhi.		65,00,000-00	3,505-00	Advertisements	2,500-00
40,00,000-00	Grants-in-Aid received from Govt. of India, Ministry of Water Resources, New Delhi on account of High Level Technical Committee on Hydrology.		3,00,000-00	33,316-80	Repair & Material of Vehicle	85,248-30
1,88,000-00	Computer Hire charges		43,506-62	56,026-29	Electric & Water Expenses	71,422-34
73,281-26	Deposit for Computer Services		1,500-00	49,119-94	Seminar & Conferences	59,422-15
15,000-00	Advance/Security Deposit Refunded		58,493-75	—	Staff Welfare	7,078-00
27,077-10	Recoveries of Advances from employees		18,663-00	57,830-23	Printing of Technical Books	86,650-75
53-00	Deducted from Employees		1,796-00	607-50	Trainees Courses	2,39,696-91
38,020-06	Interest from Bank		88,959-85	—	Journals & Periodicals	18,832-55
5,345-80	Miscellaneous Receipts		4,559-15	31,352-10	Consultancy	42,283-00
76,768-69	Receipt in recoupment of expenditure incurred on Narmada Project during the year 1981-82 to 1983-84		—	—	T.A. to Candidates	10,520-00
			—	7,699-10	Grants in Aid & Subsidy	7,587-00
			—	9,737-50	Hospitality	4,302-00
			—	10,538-40	Miscellaneous expenditure	12,610-08
			—	31,868-25	Local Cost of UNDP Project	35,476-09
			—	45,274-00	Furniture & Fixtures	2,675-00
			—	1,26,257-03	Office Equipment	57,029-97
			—	1,62,503-23	Library Books	1,56,555-29
			—	64,371-27	Machinery & Equipment	79,723-87
			—	1,09,649-74	Buildings	1,31,783-05
			—	5,03,627-71	Diesel Engine	71,871-57
			—	—	Purchase of vehicle	2,05,928-00
			—	—	Store & Equipment (Computer)	87,751-20
			—	4,532-00	Prepaid Expenses	62,613-40
						11,470-50

PREVIOUS YEAR (Rs.)	RECEIPTS	CURRENT YEAR	PREVIOUS YEAR (Rs.)	PAYMENTS	CURRENT YEAR (Rs.)
			4,44,823-00	Advance to U.O.R.	12,30,102-00
			1,83,703-86	HILTECH (Hydcom Unit)	3,63,590-07
			1,44,541-70	Advance to other Firms	5,37,171-40
			2,401-00	Advance to Employees	86,845-00
			4,325-65	Other Remittances	53-00
			28,616-80	Interest on C.P.F.	42,585-00
				Cash, Bank Balances :	
			26,983-64	Cash in hand	3,264-15
			3,700-00	Imprest with Divisional Head	5,700-00
			6,07,532-30	Bank Balances	4,85,602-41
				Bank Margin Money	6,14,520-00
				TOTAL	76,55,694-31
<u>50,17,434-26</u>	TOTAL	<u>50,17,434-26</u>			

Sd./-
(Dr. SATISH CHANDRA)
Director

(K.S. SAHA)
Finance Officer

As per our report of even date annexed
For Satyendra & Co., Chartered Accountants

Sd./-
(S.K. GUPTA)

Place : Roorkee
Date : 12th August, 1986. Seal

SATYENDRA & CO.
Chartered Accountants
314, Ram Nagar, Roorkee—247667
Phone : 2829

SCHEDULE—A

Ref. No

**NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
SCHEDULE OF FIXED ASSETS AS AT 31ST MARCH, 1986**

Sl. No.	Particulars	Cost as on 31.3.85 (Rs.)	Addition during the Year (Rs.)	Total (Rs.) Balance as at 31.3.86	As at 31.3.85
1.	Building	23,28,774.44	3,98,968.53	27,27,743.01	23,28,774.44
2.	Furniture & Fixture (Includes Rs. 10,000/- HILTECH)	2,79,056.00	67,029.97	3,46,085.97	2,79,056.00
3.	Office Equipment (Includes Rs. 5341.70 of HILTECH)	3,73,576.94	1,61,896.99	5,35,473.93	3,73,576.94
4.	Computer Machinery (Includes Rs. 12916.00 of HILTECH)	1,82,816.00	75,529.40	2,58,345.40	1,82,816.00
5.	Vehicle	1,28,292.00	87,751.20	2,16,043.20	1,28,292.00
6.	Library Books (Includes Rs. 40000/- of HILTECH)	3,81,856.89	1,30,291.87	5,12,148.76	3,81,856.89
7.	Machinery & Equipment	3,13,378.10	2,27,931.05	5,41,309.15	3,13,378.10
8.	Generator Set		2,05,928.00	2,05,928.00	
	Total Rs.	39,87,750.37	13,55,327.05	53,43,077.42	39,87,750.37

Seal

SATYENDRA & CO.
Chartered Accountants
314, Ram Nagar, Roorkee-247667
Phone 2829

Ref. No.....

SCHEDULE—B

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
BREAK-UP OF BUILDING WORK IN PROGRESS AS ON 31st MARCH, 1986.

	Amount as on 31st March, 85	Amount as on 31st March, 86
1. Advance for building construction work to U.O.R., Roorkee	18,50,053.00	27,47,200.85
2. Steel and Cement with U.O.R., Roorkee	2,10,229.38	2,06,075.38
3. Materials at site (steel) with U.O.R., Roorkee	2,30,715.41	2,30,715.41
Total Rs.	22,90,997.79	31,83,991.64

Seal

SATYENDRA & CO.
Chartered Accountants
314, Ram Nagar, Roorkee—247667
Phone 2829

Ref. No.....

SCHEDULE—'C'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
SCHEDULE OF DEPOSITS AS ON. 31.3.86

Sl. No.	Particulars	Amount as on 31.3.85	Amount as on 31.3.86
1.	Deposits with U.O.R. for computer charges	5,000.00	—
2.	O Y T Deposit	11,720.00	—
3.	Security Deposits for purchase of petrol	1,000.00	1,000.00
4.	Fixed Deposit with State Bank of India Excise Security purpose	55,500.00	55,500.00
5.	Deposit for GAS Cylinder	350.00	350.00
6.	Deposit with U.P.S.E.B. in connection with new building power connection	12,000.00	—
7.	Deposit with U.P.S.E.B. for Sub-Station	8,480.00	8,480.00
8.	Security deposit of Telex	10,000.00	10,000.00
	Total Rs.	1,04,050.00	75,330.00

Seal

SATYENDRA & CO.
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Phone : 2829

Ref. No

SCHEDULE—'D'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
SCHEDULE OF ADVANCES AS ON 31st MARCH, 1986

Sl. No.	Particulars	Amount (Rs.)
1.	Advance to U.P.S.E.B.	
	(a) Advance for Sub-Station	4,95,454.00
	(b) Advance for temporary connection	11,388.00
	(c) Advance for L.T. Site preparation	82,915.00
		5,89,757.00
2.	Advance to I.M.D., Pune	35,367.00
3.	Advance to NRSA, Secundrabad	12,980.00
4.	Advance to British High Commission, New Delhi	490.00
5.	Advance to I.S.I., New Delhi	530.00
6.	Advance to the Associate Cement Co. Ltd., Kanpur	32,800.00
7.	Advance to Indian Communication Net Work Ltd., New Delhi	2 700.00
8.	Advance to Additional Director General of Meteorology (Research), Pune	3,015.00
9.	M/s Birla Jute Industries Ltd., Santa (M.P.)	2,76,156.00
10.	M/s Steel Authority of India Ltd. Navyug Market, Ghaziabad	1,30,000.00
11.	Central Board for Prevention & Control of Water Pollution, New Delhi	1,030.00
12.	M/s Electronics Trade & Technology Dev. Corp. Ltd., New Delhi	79,684.80
13.	M/s Optomach Engineers, Hyderabad	1,517.60
14.	Executive Engr. Damodar Survey & In. Division, I & W Directorate, Calcutta	8,000.00
15.	Treasurer, Seminar on Drought Management, WRDO, Bangalore (HILTECH)	50,000.00
16.	M/s Methodex Pvt. Ltd., New Delhi	1,248.00
17.	Advances to Employees	
	T. A.	29,140.00
	L. T. C.	9,580.00
	Cycle	5,964.00
	Scooter	20,769.00
	Festival	12,060.00
	Departmental Advance N.I.H. Staff	6,000.00
	HILTECH Staff	200.00
		83,713.00
	Seal	Total Rs. 13,08,988.40

(xxxxxvii)

SATYENDRA & CO.
Chartered Accountants
314, Ram Nagar, ROORKEE-247667

Ref. No.....

SCHEDULE 'E'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
SCHEDULE OF EXPENSES AS ON 31st MARCH, 1986

Sl. No.	Heads of Accounts	Amount as on 31.3.86	Amount as on 31.3.85
(A)			
1.	Electricity Charges (Office)	12,621.25	5,336.50
2.	Telephone	1,559.40	2,717.80
3.	Salaries	1,43,906.35	1,01,560.27
4.	Wages	2,592.00	3,915.00
5.	Audit Fee	2,500.00	2,500.00
6.	Telegram Charge	562.50	1,105.00
7.	Maintenance of Car	3,598.30	1,921.35
8.	Employee's recoveries payable	1,796.00	53.00
Total (A)		1,69,135.80	1,19,108.92
(B)			
	Salaries (HILTECH)	5,420.25	4,271.75
	Wages (HILTECH)	—	326.40
Total (B)		5,420.25	4,598.15
Grand Total (A+B) Rs.		1,74,556.05	1,23,707.07

Seal

