ACHIEVEMENTS REVIEW COMMITTEE (2010-2017)

REPORT

National Institute of Hydrology, Roorkee

An Autonomous Society under Ministry of Water Resources
River Development & Ganga Rejuvenation
Government of India

September, 2018

The Committee

1. **Mr. M. Gopalakrishnan** ……. Chairman
   Former Secretary General
   International Commission on Irrigation & Drainage (ICID)

2. **Mr. A. B. Pandya** ……. Member
   Former Chairman
   Central Water Commission

3. **Dr. P. P. Mujumdar** ……. Member
   Professor
   Indian Institute of Science, Bengaluru

4. **Dr. Saleem Romani** ……. Member
   Former Chairman
   Central Ground Water Board

5. **Dr. A. K. Sikka** ……. Member
   IWMI Representative - India
   New Delhi

6. **Mr. C. P. Kumar** …... Member-Secretary
   Scientist 'G'
   National Institute of Hydrology
   Roorkee

ACKNOWLEDGEMENT

The Achievements Review Committee is grateful to the Ministry of Water Resources, River Development & Ganga Rejuvenation for giving it an opportunity to review the working and achievements of National Institute of Hydrology (during the period 2010 - 2017) in making recommendations for an enhanced performance of the Institute in future, for which a possibility exists.

We are also thankful to Director and other Scientists of National Institute of Hydrology for extending desired support and feedback to the Committee.

(A. K. Sikka)	**(Saleem Romani)**	**(P. P. Mujumdar)**	**(A. B. Pandya)**
Member, ARC	Member, ARC	Member, ARC	Member, ARC

(M. Gopalakrishnan)
Chairman, ARC

M. Gopalakrishnan
Former Secretary General
International Commission on Irrigation & Drainage (ICID)
Chairman, Achievements Review Committee (2010-17), NIH

The President
National Institute of Hydrology Society
& Hon'ble Union Minister for Water Resources, RD & GR
Government of India, Shram Shakti Bhawan
New Delhi – 110001.

Date: September, 2018

Subject: Report of the Achievements Review Committee to assess performance of the National Institute of Hydrology (NIH), Roorkee.

Reference: MOWR Order Numbers 11/7/2017-E-II, dated 11th September, 2017 and 11/7/2017-E-II, dated 8th June, 2018.

Sir,

The Chairman and the Members of the Achievements Review Committee (2010-2017) are pleased to submit the Report (in duplicate) of the Achievements Review Committee on performance of the National Institute of Hydrology, Roorkee for the period 2010-2017.

The Committee thanks the Ministry of Water Resources, River Development & Ganga Rejuvenation for giving it an opportunity to study and assess the working of NIH in detail and provide recommendations for enhancing performance of the Institute in future.

With regards,

Yours faithfully,

(**M. Gopalakrishnan**)
Chairman, ARC

Encl: Two copies of the Report.

Executive Summary

The Achievements Review Committee

The President of the National Institute of Hydrology Society constituted the present Achievements Review Committee (ARC) to evaluate the performance of the National Institute of Hydrology, Roorkee for the period 2010-2017. The terms of reference (TOR) of the Committee were: 'to quote'

(a) To review the achievements of the NIH during the period from 01.04.2010 to 31.03.2017 vis-à-vis the objectives outlined in Clause - 3 of its Memorandum of Association;

(b) To review the achievements in respect of Plan schemes of NIH during 12^{th} Five Year Plan;

(c) To consider the role of the different bodies such as Technical Advisory Committee, Coordination Committee and Working Group etc. towards fulfillment of the objectives and suggest modifications in the working procedures of the Institute, if called for;

(d) To identify and assess the factors which facilitated or impeded the achievements of the objectives; and

(e) To advise on the areas of studies and research, which may be undertaken by the Institute, in coming 10 to 15 years.

The ARC reviewed the performance and achievements of the Institute in accordance with the above TORs. The ARC's appraisal in this Report contains seven chapters. Each chapter gives a detailed analysis and appraisal.

In order to make an assessment of the performance and achievements and to arrive at the suggested recommendations, the ARC visited NIH headquarters and one of its Regional Centre at Bhopal, held discussions with Director, Scientists and other staff, and gathered information on the scientific activities of the institute.

The Committee also met Mr. R. D. Singh (Ex-Director, NIH), Mr. S. Masood Husain (Chairman, CWC), Mr. N. K. Mathur (Member - D&R, CWC), Mr. Pradeep Kumar (Member - RM, CWC), Mr. S. K. Chaturvedi (Director - R&D, MoWR), besides other Government Institutions with an interest on what the NIH carries out, like IARI, DST and IITs. On invitation of the ARC, Dr. Man Singh (Project Director, WTC, IARI, New Delhi), Dr. A. K. Keshari (Professor, IIT-Delhi) and Dr. Neelima Alam (Scientist E, DST) attended the meeting held for consultation and provided their Institutional views on the functioning of NIH and their expectations with regard to the future research areas of NIH, a term of reference of ARC.

The Committee critically reviewed the scientific achievements in terms of basic and applied research and other activities undertaken by the Institute during the period 2010-2017.

Institutional Characteristics and Governance

The NIH has to be an organization which, on one hand, would provide R&D support in hydrology to all agencies which are engaged in various activities like field investigations, data collection, planning, design and operation related to water resources development, management and multi-objective, multipurpose utilizations, and on the other hand, it has to be an **apex national body** dealing with various aspects **of hydrological sciences**.

The functioning of the organization is regulated by and subject to the provisions of the Memorandum of Association (MOA) and Rules and Regulations (RAR) framed by the promoters of the Society as per provisions of the Act. The articles of the MOA and RAR may be changed, altered or amended only as per procedures prescribed in the RAR for the purpose.

As per MOA, the following have been empowered as the **Authorities of the Society**:

> (i) President, (ii) Vice-President, (iii) Governing Body, (iv) Director, and (v) Such other persons/bodies, committees or panels as may/shall be constituted or appointed and authorized by the President, Society or Governing Body.

The R&D matters of the Society are decided by a **Technical Advisory Committee** (TAC) which is assisted by the Working Group (WG) for the six scientific divisions at headquarters and by the Regional Coordination Committees (RCCs) for the six Regional Centres located in different hydrological regimes of the Country. The roles and functions of these Committees have been discussed in Chapter-2 and suggested changes have been presented in Chapter-4 of this Report.

Appraisal on TOR-1:

The ARC has made an effort in assessing and appraising the performance of NIH on all the four counts of its dominant objectives i.e., to undertake, to aid, to promote and to coordinate systematic and scientific work in all aspects of hydrology. The details of performances and achievements of the Institute for both headquarters and regional centres including their critical appraisals have been given in Chapter-3.

Despite the lesser strength of Scientists in a few scientific divisions at headquarters, the ARC is of the view that the achievements and performance of scientific activities of various divisions during the review period, were commendable.

The ARC noted that over the period 2010-2017, the strength of Scientists at Regional Centres (except Guwahati) remained more or less uniform. As regards the quantum of hydrological problems of these regions, the available strength is quite inadequate and needs augmentation. Notwithstanding this constraint of inadequate strength at Regional Centres, the performance and achievements of them are found very good.

Appraisal on TOR-2:

The Committee also reviewed the performance and achievements in respect of Plan Schemes of NIH during the period April 2010 to March 2017 (including XII Plan period of April 2012 to March 2017). The XII plan schemes of NIH were sanctioned under **"**Research and Development Programme in Water Sector" at a total budget of Rs. 89.60 crore.

During the period (2010-2017), the Institute with its scientific divisions at headquarters and the Regional Centres pursued 181 research studies. As creditable outputs of the research studies undertaken and completed during the period, the Scientists of the Institute, both at headquarters and regional centres, brought out 1284 publications, in addition to the in-house technical reports.

The Institute (headquarters & regional centres) organized 157 training courses and 65 workshops/conferences/symposia/seminars at different places in the country under its technology transfer and capacity building activities. NIH has undertaken 59 sponsored projects with combined budget of Rs. 13.45 crore and 118 consultancy projects with a combined budget of Rs. 24.79 crore.

During the review period, the Institute procured (i) a good number of library books to enhance the scientific knowledge base, (ii) latest laboratory equipment and (iii) advanced hardware and software in headquarters and regional centres. The Institute has achieved the desired objectives in strengthening and upgradation of library and laboratories at all the units under NIH fold.

Appraisal on TOR-3:

The ARC has critically reviewed the roles of different bodies such as Technical Advisory Committee, Working Group, Coordination Committee etc. in the context of their functioning towards fulfillment of the objectives and suggested modifications in the working procedures of the Institute.

The primary purpose of creating NIH as an autonomous Society was expectedly, to respond quickly to hydrological problems being faced in various regions of the country. Therefore, the working temperament of the Scientists and the disposal of associated administrative issues should be such that scientific outputs/products of the Institute should emerge timely. While working as a team, the Scientists/scientific staff should also be able to maintain an environment of professional competitiveness. Simultaneously, it is important to ensure that the working conditions are the best in the country so as to avoid discontentment. It is in this context that the roles and functioning of different committees have been discussed in Chapter-4.

The Governing Body of NIH has the powers to exercise on all executive and financial matters and to pursue the policy guidelines and directions laid down by the Society including creation and categorization of posts and appointment of personnel to various posts. For this purpose, the Governing Body has made a provision of a Standing Committee as well. However, the ARC has reasons to believe that the present set up of

decision making process is time consuming and at times results into frustration[1]. Typically, Scientists are very productive in the age of 45+ years and loss of a large number of Scientists at this stage is highly detrimental to any research Institute. Therefore, the ARC strongly suggest that all efforts be made to retain talented Scientists in NIH by providing service conditions that are at par with the top institutes in India/abroad.

For taking up R&D and consultancy projects, the Institute has to form consortia with other national and international government, academic and private organizations/ experts based on the expertise requirement of the projects and programs. Also, the Institute has to go for biddings for small and large consultancy projects. It requires quick and time bound approvals for submitting EOI, technical and financial bids and signing of MoU etc. Hence, it is desirable to authorize Director, NIH for granting approvals for appointing Scientists (up to Scientist F level), foreign travel of Scientists (up to Scientist F level by using the funds allocated for foreign travel), signing of MoU with foreign universities/institutes, taking up international collaborative projects and programs after getting the necessary clearances from the concerned ministries.

Appraisal on TOR-4:

In Chapter-5, the ARC has made sincere efforts to identify and assess the factors which facilitated or impeded the achievements of the objectives by an in-depth study of the internal functioning, service conditions in place and by discussing with the Scientists, scientific & non-scientific staff about their grievances and aspirations.

1. The Head of the Institution:

In a way, the stature of an Institute is judged by the positional status and importance attached to the post of its Director. The existing position of the Director, NIH is equivalent to a Joint Secretary (Level 14) to the Government of India. Further, Scientists-G of the Institute are also working in the same scale. Over the years, complexities and challenges in the hydrological and water resources sector have considerably increased the responsibilities of the Director and the senior Scientists. Therefore, the ARC recommend that the post of Director be upgraded to the level of Additional Secretary (Level 15) to the Government of India or its equivalent. Recruitment rules of the Institute may have to be amended once this recommendation is accepted.

2. Regional Centres, the strengths and weaknesses:

The ARC visited one the regional centres and discussed with the Scientists and Head of the regional centre and some stakeholders of the respective region to garner their perception on NIH's role and their usefulness.

The ARC also reviewed relevant information pertaining to other regional centres. It noted that the Regional Centres/Centres for Flood Management Studies have a visibility within the region.

[1] Scientists, namely Dr. N. K. Goel, Dr. M. Perumal, Dr. G. C. Mishra, Dr. M. L. Kansal, Dr. A. K. Keshari, Dr. K. P. Sudheer, Dr. P. Mohapatra, Dr. S. K. Mishra, Dr. M. K. Jain, Dr. C. Chatterjee, Dr. N. S. Raghuvanshi, etc. have left the Institute in the past and joined the various IITs. Scientists such as Dr. V. K. Dwivedi, Dr. R. Jha, Dr. N. Panigrahy, Dr. Arnab Bandyopadhyay and Dr. S. P. Rai have joined the NITs and other Institutes.

In due diligence to the NIH mandate, the Centres are performing well in collaboration with other organizations of the region, as warranted by the individual circumstances. However, the ARC note that regional centres are not provided with adequate supporting staff and, therefore, the precious time of the Scientists gets lost, an avoidable wastage, in undertaking routine administrative and financial matters. Staff well conversant with concerned administrative and financial matters may help avoid such situation and get a better scientific output from NIH core scientific staff. While saying so, the ARC also found that the number of Scientists in the regional centres is by and large, not adequate. Based on interaction with the type of works that are of such nature, the ARC recommend that minimum strength of Scientists at each regional centre should be anywhere between 5-8, to be achieved after a review of jobs being undertaken by individual centres.

Most of the regional centres, except Patna and Kakinada which have permanent office building and campus, have been operating from private rented buildings for last two decades. An Institute of national importance, which has to maintain a good number of research laboratories, needs to have its own campus and permanent buildings. It is unfortunate that NIH has still not been able to have its own campus for more than two decades at Belagavi regional centre, despite the fact that it was the first regional centre established in the year 1987. More efforts are needed to get own land and campus at all the regional centres. The ARC feel that if the respective State Governments are approached by the MoWR, RD & GR, positive results may be feasible in a short time.

3. Staff welfare:

The Scientific & Technical (S & T) staff of the Institute is dissatisfied with their career advancement schemes. The ARC noted that the staff plays a big role in maintaining and running advanced instruments, field and laboratory experimentations and helping the Scientists in their research work. The ARC opine that suitable cadre based promotional schemes at par with the CSIR could be extended to the S & T staff of NIH and strongly recommend quick steps in this direction.

A proposal to provide post-retirement medical treatment facilities to NIH employees is under consideration with MoWR, RD & GR. In the proposal, the cost will be partly provided from the interest earned in the consultancy account and partly by the employees. Since NIH employees are not covered by pension rules, a safety net is highly desirable and the ARC recommend that this proposal may be favourably considered at the earliest.

Appraisal on TOR-5:

The NIH was established with a vision to enable it to grow into a national apex scientific organization in all matters pertaining to hydrological inputs to the country's myriad problems of water development and management. Hydrology is gradually becoming a complex science, as the issues of water management, internationally, nationally and locally, are becoming complicated due to the distinctive nature of the development of every region for a better future of the people. The deterioration in water quality resulting from rapid industrial and population growth as also the looming change in water availability scenario due to global climate change is a daunting task that modern hydrology is faced with. Therefore, the role of NIH has become more and more significant

day by day, and will become more important in the near future. In this context, the ARC has tried to identify the areas of studies and research to be undertaken by NIH in the coming ten to fifteen years. The details have been discussed in Chapter-6.

The ARC suggest that the broad areas for future studies and research of the Institute should be in accordance with the R & D works listed in the 'National Water Mission Document' under the overall framework of the "National Water Policy" and the emerging problems in the field of water resources. Therefore, 'Integrated Water Resources Management (IWRM)' at 'River Basin level' based on multi-disciplinary approaches for scientific studies pertaining to the supplies and demands of water in the light of forecasted hydrological variability should be the main focus of the R & D activities of the Institute.

In this context, NIH is advised to emphasize its basic and applied research and studies focusing mainly towards considering 'River Basin' (or sub-basin) as the 'Hydrological Unit'. The basic research should be a supplementary part of the action research. The Institute is encouraged to continue with demand driven sponsored R & D studies on the challenging hydrological problems.

The ARC is of the considered view that NIH being the premier R & D organization needs to more intensively work with reputed international organizations to get the Institute professionally growing on advancement in hydrological research and in adaptation of emerging advanced tools and techniques. Therefore, the focus of R & D works needs to be revitalized with the changing global scenarios. The Institute needs to be provided with the requisite enabling environment.

Keeping in view the quality output expected from NIH, the Committee recommends up-gradation of all its laboratories with latest state-of-the-art instrumentation. Improving computation and modeling facilities with latest modeling software are also recommended.

NIH has limited manpower in terms of its Scientists and supporting staff. Keeping in view the past experience of over three decades, it may not be immediately possible to increase the scientific strength manifold (though highly desirable) to carry out research in the areas given in the previous section. Therefore, besides making consistent efforts to increase the scientific strength, the ARC suggested provision of 18 Research Fellowships (12 fellowships may be attached to the headquarters and remaining 6 may be distributed among Regional Centres/Centres for Flood Management Studies). The fellowships initially will be for a period of four years with a provision of extension by one year. The research fellows may also be encouraged to register for the Ph.D. degree with the IITs/Universities.

The ARC learnt that NIH has submitted a proposal for release of various posts (32 Scientists/Purchase Officer) approved in the EFC Memorandum for the period 2017-2020. After this proposal is approved, the sanctioned strength at NIH will increase and this will help in partially overcoming the shortage of Scientists in the headquarters and regional centres.

Based on the critical appraisals in different chapters, recommendations and suggestions have been made in Chapter-7 on varied aspects for the enhancement of the functioning of NIH. This will facilitate the Society and the Governing Body of NIH to

arrive at appropriate decisions for the improved functioning of this premier research institute in hydrology.

The Committee wishes to thank the President of NIH Society for giving it the opportunity to undertake the present review. It is grateful to all those who provided useful inputs to it in this important assignment. The Committee places on record its sincere thanks to Dr. Sharad Kumar Jain, Director, NIH and all his colleagues/staff in NIH, for all the support provided and for excellent logistics for Committee's works.

Contents

Chapter – 1
Introduction

1.1 Formation of ARC

In exercise of the powers vested under Rule–59 of the Memorandum of Association and Rules and Regulations, the President of the NIH Society constituted the Achievements Review Committee (ARC) to evaluate the performance of the National Institute of Hydrology, Roorkee, vide Order No. 11/7/2017-E-II dated 11th September, 2017 of the Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India with the following composition:

1. **Mr. M. Gopalakrishnan** ……. Chairman
   Former Secretary General
   International Commission on Irrigation & Drainage (ICID)

2. **Mr. A. B. Pandya** ……. Member
   Former Chairman
   Central Water Commission

3. **Dr. P. P. Mujumdar** ……. Member
   Professor
   Indian Institute of Science, Bengaluru

4. **Dr. Saleem Romani** ……. Member
   Former Chairman
   Central Ground Water Board

6 **Dr. A. K. Sikka** ……. Member
   IWMI Representative - India
   New Delhi

6. **Mr. C. P. Kumar** ….. Member-Secretary
   Scientist 'G'
   National Institute of Hydrology
   Roorkee

The terms of reference of the Committee were as follows:

(a) To review the achievements of the NIH during the period from 01.04.2010 to 31.03.2017 vis-à-vis the objectives outlined in Clause-3 of its Memorandum of Association;

(b) To review the achievements in respect of Plan schemes of NIH during 12th Five Year Plan;

(c) To consider the role of the different bodies such as Technical Advisory Committee, Coordination Committee and Working Group etc. towards fulfillment of the

objectives and suggest modifications in the working procedures of the Institute, if called for;

(d) To identify and assess the factors which facilitated or impeded the achievements of the objectives; and

(e) To advise on the areas of studies and research which may be undertaken by the Institute in coming 10 to 15 years.

The Committee was to submit its report within six months from 11thSeptember, 2017; however, given the communication time required and other requisites, the Committee could commence its works with their maiden meeting held on 23 October 2017 and could organize their first 3 sittings within 6 months. The Committee solicited an extension of time for their work after the stipulated period which could not be obtained in time with the result that their work was kept in abeyance, thereafter. In the absence of formal approval for continuance of their work, further meetings could not be organized by NIH.

Subsequently, MoWR (vide Order Number 11/7/2017-E-II dated 8th June, 2018) extended the time limit for submission of the report by another six months, retrospective though, w.e.f. 12.3.2018.

Copies of the Orders from Ministry of Water Resources, River Development and Ganga Rejuvenation are placed in Annexure – I.

1.2 Proceedings of ARC

The ARC, in its pursuit of obtaining information for objective assessment and review of achievements of NIH, visited Headquarters and one of the Regional Centres, held discussions with Director, Scientists and other staff and gathered information on the scientific activities of the Institute and solicited the views of Scientists and supporting staff for better performance and growth of the organization.

The Committee visited the physical facilities at NIH Headquarters and one of its Regional Centre located at Bhopal (Madhya Pradesh) and interacted with the scientific, technical and other staff. The Committee also met representatives of Ministry of Water Resources, RD & GR (MoWR), Central Water Commission (CWC), Indian Agricultural Research Institute (IARI), Indian Institute of Technology (IIT), Delhi and Department of Science and Technology (DST) in order to elicit their views on the functioning of NIH and to ascertain their expectations with regard to the future research areas of NIH.

The Committee also critically reviewed the scientific achievements in terms of basic and applied research and other activities undertaken by NIH during the period 2010-2017.

The Committee had detailed and extensive discussions with Director, NIH on the functioning of NIH and the operational efficiency and the implementation aspects, and autonomy of NIH as envisaged in the “Memorandum of Association (MOA) and its Rules and Regulations (RAR)”. The Committee also elicited his views and expectations on the future directions and areas of research to be undertaken by NIH. It also ascertained his views on the functioning of other Committees constituted by the Governing Body to assist the Institute in its effective performance.

Altogether five visits were undertaken by the Committee for meetings, visiting the headquarters, and one of the regional centre. Highlights for the various meetings are placed in Annexure – II. The dates of various meetings, venues and discussions are given below.

S.No.	Dates	Venue	Discussions
1.	23 October 2017	NIH, Roorkee	▪ Presentation about overview of NIH by Director (NIH) ▪ Discussion with Heads of Scientific Divisions ▪ Discussion on Terms of Reference of ARC ▪ Visit to Nuclear Hydrology Laboratory ▪ Deciding future course of action
2.	18-19 November 2017	NIH, Roorkee	▪ Dossier related to achievements of six scientific divisions during the period 2010-2017 was provided to ARC members ▪ Technical presentations by each of six scientific divisions and discussions ▪ Meeting with all Scientists of NIH, Roorkee ▪ Meeting with all Scientific and Technical Staff of NIH, Roorkee ▪ Discussion with Mr. R. D. Singh, Ex-Director, NIH
3.	31 January 2018	CWC, New Delhi	▪ Presentation by Director, NIH regarding overview of research activities during last 7 years (2010 - 2017) ▪ Interaction with Mr. N. K. Mathur (Member - D&R, CWC), Mr. Pradeep Kumar (Member - RM, CWC), Mr. S. K. Chaturvedi (Director - R&D, MoWR), Dr. Man Singh (Project Director, WTC, IARI, New Delhi), Dr. A. K. Keshari (Professor, IIT-Delhi) and Dr. Neelima Alam (Scientist E, DST) regarding – ➢ Water resources problems in India ➢ R & D challenges in water resources sector ➢ Future vision: Research needs during next 5 - 10 years ➢ How to strengthen coordination between NIH and other R&D organizations under MOWR ▪ Meeting with Mr. S. Masood Husain (Chairman and Member - WP&P, CWC)

4.	4 April 2018	NIH Regional Centre, Bhopal	▪ Dossier related to achievements of Central India Hydrology Regional Centre, NIH, Bhopal during the period 2010-2017 was provided to ARC members ▪ Overview of Regional Centre by Head of Regional Centre, technical presentations by Scientists and discussions ▪ Meeting with all Scientists and technical staff of Regional Centre ▪ Interaction with Director, WALMI, Bhopal and Dr. N. S. Raghuwanshi Director, MANIT, Bhopal
▪ The ARC work had to be kept in abeyance at this stage after April 4, 2018, since a formal approval of extension of their duration, needed NIH's initiating suitable action with MoWR which was possible on 8th June 2018. Soon after getting the formal approval for extension by a letter, NIH re-activised the ARC works but given the short duration ahead to complete the report, ARC didn't go by their earlier schedule to visit some more regional centres for appraisal. The draft report was taken up for consideration by virtual on line communications amongst members and Chairman, besides NIH.			
5.	11 July 2018	ICID, New Delhi	▪ Discussion on draft report of Achievements Review Committee
6.			▪ Final submission of the ARC Report to Hon'ble Minister for Water Resources, River Development and Ganga Rejuvenation

Chapter – 2
The National Institute of Hydrology (NIH) at a Glance

2.1 Objectives of the Institute

The main objectives (the Clause 3 of the Memorandum of Association) for which the Institute has been established include the following:

a) To undertake, aid, promote and co-ordinate systematic and scientific work in all aspects of hydrology;
b) To co-operate and collaborate with other national, foreign and international organizations in the field of hydrology;
c) To establish and maintain a research and reference library in pursuance of the objectives of the Society and equip the same with books, reviews, magazines and other relevant publications; and
d) To do all other such things as the Society may consider necessary, incidental or conducive for the attainment of the objectives for which the Institute has been established.

2.2 Governance of the Institute

The administrative functions of NIH are governed by the BYE–LAWS approved by Government of India, vide Ministry of Irrigation letter No.25(2) /80-P.III, dated 5.11.1980 and modified in No.25(2)/80-P.III, dated 31.10.1981. In the Bye-laws, it is mentioned that it should be read in conjunction with the Memorandum of Association and the Rules and Regulations (RAR) of National Institute of Hydrology and definitions therein are applicable here also. The Bye-laws contain three working rules: (i) Classification/Recruitment/and Promotion Amendment Rules 1991, (ii) Service Conditions Rules 1981, and (iii) Classification/Control and Appeal Rules 1981. The Working Rule-1 deals with classification of posts, recruitment procedure and promotion, the Working Rule-2 deals with the service matter, while the Working Rule-3 defines the authorities for governing disciplinary matters relating to personnel recruitment/ appointment, control and appeal.

NIH was established on 16 December, 1978. At that time, the control, responsibilities, and disciplinary authorities defined in the Working Rule-3, was based on the assumption that NIH will have a single unit at Roorkee. However, over the passage of time, NIH Society has approved six regional centres spread over the country at locations based on different hydrological regions. The Headquarters of NIH has complete administrative and financial control over the six regional centres.

2.2.1 NIH Society

The National Institute of Hydrology Society is the apex body of the Institute. It reviews the progress and performance of the Institute and gives such directions as it may deem fit, to the Governing Body and the Institute towards attainment of the objectives enunciated in the Memorandum of Association of the Society. The Society has 48 members out of which 10 Ministers-in-Charge of Irrigation and Water Resources from the States and

10 eminent engineers and water resources experts are nominated by the President of the Society for a 3 years term.

2.2.2 Governing Body (GB)

The Governing Body (GB), under the Chairmanship of the Secretary, Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, is the executive body of the Institute and is responsible to pursue and carry out the activities, as per objectives laid down by the Society. The Governing Body exercises all executive and financial powers of the Society.

2.2.3 Standing Committee

The Governing Body has constituted a Standing Committee under the Chairmanship of the Additional Secretary (Water Resources), Government of India, to consider the financial and administrative matters pertaining to the Institute. The Standing Committee reviews the matters referred to it by the Governing Body. Decisions of the Standing Committee are reported to the Governing Body for its approval.

2.2.4 Coordination Committee

To ensure effective coordination between the NIH and Indian Institute of Technology (IIT), Roorkee, a Coordination Committee has been constituted under the Chairmanship of Director, IIT Roorkee, Roorkee. This committee, besides ensuring effective coordination, also recommends ways for increasing interaction between the two organizations so that facilities and expertise of the organizations are optimally utilized.

2.2.5 Technical Advisory Committee (TAC)

The Technical Advisory Committee (TAC) under the Chairmanship of the Chairman, Central Water Commission, New Delhi carries out technical scrutiny of the research program of the Institute and recommends priority areas for studies and research. It also scrutinizes the technical activities proposed under the Five Years Plans and the individual schemes submitted for external assistance and expansion of the Institute.

2.2.6 Working Groups (WGs) for Headquarters

The Governing Body of the Institute has constituted a Working Group to consider and to recommend to TAC the program of studies to be taken up by various Scientific Divisions of the Institute and review the progress of work. The Working Group, under the Chairmanship of Director NIH, has members from various Central and State Government organizations, Universities and individual experts working in the field of hydrology and water resources. The Working Group meets twice in a year: during February/March to review the progress of previous year program and finalize the future program and during September/October to review the ongoing scientific program.

2.2.7 Regional Coordination Committees for Regional Centres (RCC)

Regional Coordination Committees (RCC) have been constituted to ensure effective coordination between the respective CFMS/Regional Centre and various academic and field

organizations engaged in water resources research and development in the region. RCCs advise the CFMS/Regional Centre in all technical and scientific matters and also examine the proposals for diversification of activities of the centre. Experts from field organizations and academic Institutes of the region covered by the Regional Centre are members of the Regional Coordination Committee with Director, NIH as the Chairman. The NIH Society has approved the constitution of RCC for each CFMS/Regional Centre. Normally, the RCCs meet once a year.

2.3 Scientific Divisions at Headquarters

Studies and research activities at the headquarters (Roorkee) are carried out under the following six scientific divisions.

1. Environmental Hydrology
2. Ground Water Hydrology
3. Hydrological Investigations
4. Surface Water Hydrology
5. Water Resources Systems
6. Research Management and Outreach

2.4 Regional Centres

To deal with specific hydrological problems in different regions of the country and for effective interaction with the States, the Institute has established two Centres for Flood Management Studies (CFMS) and four Regional Centres as given below:

1. Centre for Flood Management Studies, Guwahati
2. Centre for Flood Management Studies, Patna
3. Hard Rock Regional Centre, Belagavi
4. Western Himalayan Regional Centre, Jammu
5. Deltaic Regional Centre, Kakinada
6. Central India Hydrology Regional Centre, Bhopal

2.5 The Director

The Director is the ‘Principal Executive Officer’ of the Society and has been entrusted with powers and functions as detailed in Clause 31 of RAR. He is responsible for proper administration of the affairs and funds of the society of NIH. He is entrusted with all administrative and financial powers conferred on him in addition to implementing the decisions of the Governing Body of NIH.

Chapter – 3
Review of Activities of NIH

This chapter presents the achievements of NIH during the period from 01.04.2010 to 31.03.2017 vis-à-vis the objectives outlined in Clause-3 of its Memorandum of Association and review of the achievements in respect of Plan schemes of NIH during April 2010 to March 2017 (including XIIth Plan period).

3.1 Review of the Achievements vis-à-vis the Objectives Outlined in Clause-3 of Its Memorandum of Association

The broad objectives for establishing the NIH as stated in Clause 3 of the Memorandum of Association are as follows:

a) To undertake, aid, promote and co-ordinate systematic and scientific work in all aspects of hydrology.

b) Cooperation and collaboration with other National and International Organizations in the field of Hydrology.

c) Establishment and maintenance of a research and reference library in pursuance of the objectives of the Society and equip the same with books, reviews, magazines and other relevant publications.

d) To do all other such things as the Society may consider necessary, incidental or conducive for the attainment of the objectives for which the Institute has been established.

Performance and achievements of NIH under these sub-clauses are assessed in the following sections.

3.1.1 To undertake, aid, promote and co-ordinate systematic and scientific work in all aspects of hydrology

National Institute of Hydrology strive to achieve the mandate under Clause 3 of the Memorandum of Understanding through the activities planned and executed at the headquarters at Roorkee with a national outlook and at six of its regional centres at Jammu, Patna, Bhopal, Guwahati, Kakinada and Belagavi, focusing on the issues pertaining to the regions under each centre. During the 2010-2017 period, the Institute had average scientific strength of 70 against sanctioned strength of 87.

Research management structure at headquarters

Research activities at the headquarters are structured around various divisions with a focal theme. These divisions have been re-organized time to time in response to the research needs of the country. Currently, six research divisions are in operation at the headquarters:

- Environmental Hydrology Division,
- Ground Water Hydrology Division,

- Hydrological Investigations Division,
- Surface Water Hydrology Division,
- Water Resources Systems Division,
- Research Management and Outreach Division.

The Research Management and Outreach Division (RMOD) also facilitates the outreach activities of NIH. Each of the divisions plans and executes the work under broad thematic area of the divisions. The divisions undertake work of different categories such as: (i) basic and applied R & D activities, (ii) demand-driven assignments on case-by-case basis, (iii) knowledge input to the government policies, and (iv) technology transfer through organizing training courses, seminars, public/mass awareness programs, etc. Inter-divisional activities are also promoted in the Institute. Year-wise scientific man-power of each of these divisions during the period 2010-2017 is given in Tables 3.1.

Table 3.1: Year-wise Scientists and Scientific Staff Strength in Position in Different Divisions at Headquarters during the Period 2010-2017

Division	Category	Year						
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Environmental Hydrology Division	Scientist	5	4	5	5	5	5	5
	Scientific staff	4	4	4	4	4	4	3
Ground water Hydrology Division	Scientist	7	7	7	7	8	8	7
	Scientific staff	3	3	2	2	7	8	8
Water Resources Systems Division	Scientist	9	8	12	13	11	11	11
	Scientific staff	5	5	3	3	2	2	2
Hydrological Investigation Division	Scientist	7	7	7	7	6	6	6
	Scientific staff	6	6	6	6	6	6	6
Surface Hydrology Division	Scientist	11	11	11	11	12	14	14
	Scientific staff	8	8	8	8	8	7	7
Research Management & Outreach Division	Scientist	3	3	4	4	4	3	3
	Scientific staff	4	5	5	4	3	3	2

Laboratories at Headquarters

The Institute has six laboratories attached to various scientific divisions to support the research activities.

i) **Water Quality Laboratory** attached to the Environmental Hydrology Division.
ii) **Nuclear Hydrology Laboratory** attached to the Hydrological Investigations Division.
iii) **Hydrological Instrumentation Laboratory** attached to the Hydrological Investigations Division.
iv) **Soil Water Laboratory** attached to the Ground Water Hydrology Division.
v) **Remote Sensing and GIS Laboratory** attached to the Water Resources Systems Division.

Besides the above laboratories, there are *Snow & Glacier Laboratory*, *Hydro-meteorological Observatory* and *Centre of Excellence for Advanced Groundwater Research*. The Nuclear Hydrology Laboratory is one of the best in the country with quality certification from International Atomic Energy Agency (IAEA). Other laboratories also contribute significantly to the research activities.

Performance of Six Scientific Divisions at Headquarters

The performance and achievements of various divisions at Headquarters in terms of scientific studies, publications in International and National Journals and Seminars/Conferences and the Training Courses/Workshops organized are summarized in Table 3.2.

Table 3.2: Performance of Scientific Divisions at Headquarters during 2010-2017

Division	Scientific Studies	Publications in Intl. Journals	Publications in Intl. Seminars/ Conferences	Publications in National Journals	Publications in National Seminars/ Conferences	Training courses/ Workshops Organized	Seminars/ Symposia Organized
Environmental Hydrology	21	20	37	10	31	13	Nil
Groundwater Hydrology	43	47	55	33	47	18	4
Water Resources Systems	67	66	71	57	92	57	18
Hydrological Investigations	49	68	83	32	103	28	3
Surface Water Hydrology	76	43	76	20	89	74	17
Research Management & Outreach	8	4	19	10	22	14	2
Total	**264**	**248**	**341**	**162**	**384**	**204**	**44**

Performance of Regional Centres of NIH

The year-wise scientific strengths and performances and achievements of each of the Regional Centres/CFMS are given in Tables 3.3 and 3.4 respectively.

Table 3.3: Year-wise Scientists and Scientific Staff Strength in Position in Regional Centres/CFMS during the Period 2010-2017

Regional Centre	Category	Year						
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Kakinada	Scientist	5	5	6	6	6	4	5
	Scientific staff	6	6	6	6	6	6	6
Bhopal	Scientist	3	4	4	4	4	5	5
	Scientific staff	0	0	0	0	0	0	0
Belagavi	Scientist	4	4	4	4	4	4	4
	Scientific staff	2	2	2	2	2	2	2
Jammu	Scientist	3	3	1	1	3	3	3
	Scientific staff	0	0	0	0	0	0	0
Patna	Scientist	4	4	4	4	4	4	4
	Scientific staff	1	1	1	1	1	1	1
Guwahati	Scientist	5	3	2	2	2	2	2
	Scientific staff	1	1	1	1	1	1	1

Table 3.4: Performance and Achievements of the Regional Centres/CFMS

Regional Centres	Scientific Studies	Publications in Intl. Journals	Publications in Intl. Seminars/ Conferences	Publications in National Journals	Publications in National Seminars/ Conferences	Training Courses/ Workshops Organized	Seminars/ Symposia Organized
Kakinada	30	34	31	8	51	12	1
Bhopal	14	42	26	19	19	15	Nil
Belagavi	22	20	14	8	30	20	3
Jammu	12	5	5	10	21	8	1
Patna	16	4	15	4	13	4	Nil
Guwahati	12	Nil	12	Nil	21	3	Nil
Total	**106**	**105**	**103**	**49**	**155**	**62**	**5**

Mapping of Major Activities of NIH during 2010-2017

Research projects undertaken in the Institute comes through four different channels: 1) Implementation of MoWR and Government programs, 2) Sponsored projects, 3) Consultancy projects, and 4) Internal NIH projects. The review period (2010-2017) witnessed a gradual but definitive shift in the funding source of the projects operated in the Institute from internal resources to external resources.

(1) NIH participation in implementing major MoWR, RD & GR and Government programs

i) Hydrology Project (HP) Phase – II

HP-II project was operational in the Institute until 31 May, 2014. NIH was entrusted with the responsibility as the nodal agency for the development of Decision Support System (Planning) [DSS(P)] for the Integrated Water Resources Development and Management to be implemented in six Central and nine State Agencies under the World Bank funded Hydrology Project Phase - II (HP-II). The eight Central Agencies (MOWR, NIH, CWC, CGWB, CWPRS, CPCB, IMD and BBMB) and thirteen States (Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Orissa, Tamil Nadu, Himachal Pradesh, Goa, Pondicherry and Punjab) were involved in the HP-II. As a follow up to HP-I; HP-II had activities under three major components: (i) Institutional Strengthening, (ii) Vertical Extension, and (iii) Horizontal Expansion. NIH was provided a financial allocation of Rs. 50.68 crores to achieve the tasks entrusted to it.

The International Consultant DHI of Denmark, engaged for the development of the Generic DSS (P) software, structured the software under the guidance of NIH Scientists and demonstrated its implementation for the “Upper Bhima” pilot basin in Maharashtra. Further, workshops for capacity building on developed DSS (P) were carried out in each State. The Institute also participated in the 11 Purpose Driven Studies (PDS) with the State and Central Agencies [4 Surface Water (SW), 3 Ground Water (GW) PDS of NIH and associated in 4 other PDS with the States and Central Agencies]. The Institute also conducted 60 training courses/workshops since inception of the project on the specialized topics of hydrology, data processing software SWDES & HYMOS and demand-driven trainings for the State and Central Implementing Agencies. The training and office equipment were also procured to strengthen these activities.

ii) National Hydrology Project (NHP) (World Bank funded)

MoWR, RD & GR has initiated the National Hydrology Project (NHP) as a follow-up to the earlier Hydrology Projects (HP-I and HP-II). The objectives of NHP are to improve the extent, quality and accessibility of water resources information, and to strengthen the capacity of water resources management institutions in India. NHP will improve and expand hydrology data and information systems, strengthen water resources operation and planning systems, and enhance institutional capacity for water resources management. NIH is involved in the following activities of NHP:

- Demand driven research through Purpose Driven Studies (PDS)
- Capacity building:
  - Class room training/meetings and multi-media distance learning
  - Courses on different topics of different durations
- Centre of Excellence for Hydrological Modeling (CEHM)
- DSS Planning

iii) Integrated Hydrological Studies for Upper Ganga Basin up to Rishikesh
[Task Force-II on Water, Ice and Snow including Glaciers, under National Mission on Sustainable Himalayan Ecosystem (NMSHE)]

The Department of Science & Technology (DST), GoI has been entrusted with the responsibility of coordinating NMSHE under the National Action Plan on Climate Change (NAPCC). The broad objectives of NMSHE include - understanding of the complex processes affecting the Himalayan ecosystem and evolve suitable management and policy measures for sustaining and safeguarding the Himalayan ecosystem, creating and building capacities in different domains, networking of knowledge institutions engaged in research, and development of a coherent database on Himalayan ecosystem. This project proposes to focus on the following objectives:

- Development of a project website, real-time snow cover information system, and glacial inventory and GLOF study
- Observation and modeling of various hydrological processes in a small watershed, and understanding hydrological processes using isotope techniques
- Hydrological modeling in Alaknanda and Bhagirathi basins and assessment of climate change impact
- Study of river-aquifer interactions and groundwater potential
- Environmental assessment of aquatic ecosystem
- Water census and hotspot analysis in selected villages in Upper Ganga basin

iv) Neeranchal National Watershed Project (NNWP)
[World Bank funded under PMKSY of DoLR, GoI]

The major role of NIH in the Neeranchal Project is to develop a DSS to provide the hydrology inputs for watershed management and building the capacities of the DoLR/State authorities for integration into the IWMP. The assignment also includes conducting trainings of stakeholders, awareness activities, and providing technical backup to the State level nodal agencies during handling of their Neeranchal and IWMP activities in the 9 rainfed States of Telangana, Andhra Pradesh, Madhya Pradesh, Chattisgarh, Gujarat, Rajasthan, Jharkhand, Maharashtra, and Odisha.

(2) Sponsored Projects

During the early years of the assessment period, majority of the studies were funded internally from the Plan head of expenditure. During the later years of assessment, a systematic increase in the sponsored projects has been recorded. This is also appreciated as a step in the right direction. 57 projects with total outlay of 13.45 crore were implemented or completed during the review period.

Table 3.5: Year-wise Number of Sponsored Projects undertaken during 2010-2017

Year	Sponsored Projects	Amount (Rs.) in Lakh
2010-11	1	56.8
2011-12	0	0
2012-13	5	83.49
2013-14	11	159.08
2014-15	9	55.84
2015-16	20	276.47
2016-17	11	713.82
Total	**57**	**1345.49**

(3) Consultancy Projects

Apart from active participation in the MoWR, RD & GR programs like HP-II, NHP, Neeranchal and NMSHE projects, the Institute also undertook 118 consultancy projects and generated Rs. 24.79 crore during the review period. The structure for executing the consultancy projects was put in place during the assessment period. Major sectors engaged with NIH for consultancy studies are river interlinking, basin scale water availability studies, thermal, nuclear and hydro- power sectors, dam-break and GLOF studies, railways, carrying capacity studies, petroleum pollution etc. The progress made in this direction during this short period is considered outstanding and timely.

Table 3.6: Year-wise Number of Consultancy Projects undertaken during 2010-2017

Year	Number of Consultancy Projects	Amount (Rs.) in Lakh
2010-11	12	168.93
2011-12	10	118.35
2012-13	19	377.60
2013-14	17	506.73
2014-15	14	267.23
2015-16	18	675.19
2016-17	28	365.40
Total	**118**	**2479.43**

Experimental research and field stations in the Himalayas

NIH made significant effort to generate new data and knowledge from the data sparse regions of the Himalaya by establishing field research stations during the review period. Apart from continuing monitoring of the Gangotri glacier, new stations were established in the remote locations in Ladakh, J&K and near Chamba, Uttarakhand. The committee noted this appreciable progress made by the Institute.

Capacity building

Another major activity by NIH to aid and promote hydrology research in the country is through organizing training courses. NIH organized 266 training courses during the review period averaging 38 courses per year. It includes 10 International training courses and workshops organized in India, one course in Sri Lanka and one workshop in Morocco. Table 3.7 presents the Division/RC based list of training courses organized on specific hydrological themes during the period from 2010 – 2017. Officials in the state departments, students and other professionals were benefited from these training courses. The numbers suggest that NIH is largely successful in this effort during the review period and such efforts in capacity building should continue and expand further, given the enormity of requirements to build well-trained hydrological experts all over the country in the coming years.

Table 3.7: Training Courses / Workshops Organized

Division	Training Courses/ Workshops Organized	Regional Centres	Training courses/ Workshops organized
Environmental Hydrology	13	Kakinada	12
Groundwater Hydrology	18	Bhopal	15
Water Resources Systems	57	Belagavi	20
Hydrological Investigations	28	Jammu	8
Surface Water Hydrology	74	Patna	4
Research Management & Outreach	14	Guwahati	3
Total	**204**	**Total**	**62**
Grand total		**266**	

3.1.2 Cooperation and collaboration with other National and International Organizations in the field of hydrology

NIH is mandated to promote cooperation and collaboration with National and International organizations in the field of hydrology. Apart from existing/ongoing collaborations, NIH initiated 17 national collaborations and 7 International collaborations during the review period.

i) National Collaboration

NIH collaborates with large number of Central Government organizations, R&D Institutions, Academic Institutions very regularly, namely; CWC, CGWB, CPCB, IMD, GFCC, Brahmaputra Board, NCA, BBMB, ICAR, CSMRS, CWPRS, BARC, ISRO, NRSA, CSIR Laboratories, Upper Yamuna Board, IITs, IISc Bangalore, State Universities, State

Water Resources Departments, State Ground Water Departments, NGOs, etc. During the period of ARC review, NIH further enhanced its activities by signing 17 new MoU's, as given in Table 3.8. The types of collaboration varied from data acquisition, joint collaborative studies, collaborative technical activities, exchange of information and dissemination of results, etc. and services to clients.

Table 3.8: List of Institutions with which NIH signed MoU's during 2010-2017

S. No.	Agency	Date of MoU
1	Shaheed Bhagat Singh College, Univ. Of Delhi, New Delhi	17/8/2017
2	ABES Institute of Technology, Ghaziabad, UP	21/2/2017
3	Jawaharlal Nehru University, Delhi	28/11/2016
4	National Water Mission, MoWR, RD & GR New Delhi	
5	Wadia Institute of Himalayan Geology, Dehradun	1/6/2016
6	Bundelkhand University, Jhansi	23/2/2016
7	HRRC, Belagavi& NIT Karnataka, Surathkal	Oct. 2015
8	NWDA, New Delhi	1/11/2015
9	Border Road Organisation, Leh	24/9/2015
10	CWRDM, Kozhikode, Kerala	19/3/2015
11	International Water Management Institute (IWMI)	1/6/2014
12	CGWB	10/4/2013
13	National Institute of Technology, Srinagar, Hazratbal, Kashmir	27/2/2013
14	MoWR and IIT Roorkee	15/11/2012
15	Water Institute and School of Civil Engineering of Karunya University, Coimbatore	April 2012
16	NWDA	March, 2012
17	Division of Water Sciences, University of Applied Sciences Dresden (HTWD), Germany	31/5/2011

ii) International Collaboration

International collaborations received a major thrust during the review period by way of obtaining relaxation to receive foreign funds from FCRA, once the MoU with the agency is cleared by MoWR. NIH may create institutional mechanism to make use of this facility in a coordinated way in future. Apart from existing International collaboration with UNESCO, IAEA etc., seven International MoUs were signed during the review period, as given in Table 3.9. These are significant and efforts should be made to enhance the number of such collaboration, particularly in Afro-Asia.

Table 3.9: MoU with International Agencies

S. No.	Period 2010 – 2017
1	Centre of Ecology & Hydrology, U.K.
2	World Bank
3	Carleton University, Canada
4	Swedish Meteorological & Hydrological Institute, Sweden
5	Government of Australia
6	Internal Water Management Institute, IWMI

7	University of Applied Sciences, Dresden, Germany

3.1.3 Establishment and maintenance of a research and reference library in pursuance of the objectives of the Society and equip the same with books, reviews, magazines and other relevant publications

Library plays an important role in R & D Institutions as a knowledge centre and considered as a key objective for the Institute. However, with exponential growth in the online resources, the role and structure of the institutional library needs to be revisited. The staff position of the library during the period under report is given in the Table 3.10. The year-wise additions of technical material and publications are given in the Table 3.11. The year-wise procurement of periodicals in the library of the NIH is given in the Table 3.12.

Table 3.10: Library Staff Position during 2010-2017

Staff	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Asstt. Library & Information Officer	01	01	01	01	01	01	01
Library & Information Assistant	01	01	01	01	01	01	01
Technician , Gr. III	01	01	01	01	01	-	-
Technician , Gr. II	-	-	-	-	-	01	01
MTS (Technical)	01	01	01	02	02	02	02
MTS (Ministerial)	01	01	01	01	01	01	01
Total	**05**	**05**	**05**	**06**	**06**	**06**	**06**

Table 3.11: Year-wise Addition of Various Publications in NIH's Library at Roorkee

Year	Books	Bound Periodicals	Technical Reports	Technical Papers	Total No. of Publications
Prior to Apr. 2010	11389	2925	5239	1036	20589
2010-11	102	-	36	-	138
2011-12	169	-	271	-	440
2012-13	301	-	240	-	541
2013-14	217	-	132	-	349
2014-15	146	500	153	-	799
2015-16	167	500	28	-	695
2016-17	34	-	30	-	64
Cumulative No. of Publications	**12525**	**3925**	**6129**	**1036**	**23615**

Table 3.12: Procurement of Periodicals

Year	Indian Periodicals	Foreign Periodicals				Total
		Print form	Print + Electronic	Electronic	Total Foreign Periodicals	
2010-11	28	13	12	01	26	54
2011-12	28	13	12	01	26	54

2012-13	31	06	18	03	27	58
2013-14	29	02	21	03	26	55
2014-15	34	04	20	03	27	61
2015-16	34	01	16	10	27	61
2016-17	34	04	13	10	27	61

3.1.4 To do all other such things as the Society may consider necessary, incidental or conducive for the attainment of the objectives for which the Institute has been established.

Other than the research activities, the Institute receives a number of incidental requests from the ministry from time to time. NIH strived to respond to such requests adequately, whenever such exigencies were raised during the review period.

3.2 Review of the Achievements in Respect of Plan Schemes of NIH (including XII Plan Period)

3.2.1 XII Plan Programme of the Institute

The XII Plan Programme was implemented for the period from April, 2012 to March, 2017. The component of NIH was sanctioned under **"**Research and Development Programme in Water Sector" scheme of the Ministry of Water Resources, at a total budget of Rs. 89.60 crore. The status of activities during XII Plan period is given in Annexure - III and salient achievements during XII Plan period are given in Annexure - IV.

3.2.1.1 Scientific Performance

As per the approved "Memorandum for Expenditure Finance Committee Document", the Institute had envisaged working on the following thrust areas/activities:

(i) Hydrology of Extremes,
(ii) Regional hydrology,
(iii) Environmental hydrology,
(iv) INCOH activities,
(v) Integrated Water Resources Management (IWRM),
(vi) Hydrology for Watershed Management,
(vii) R&D Under National Water Mission,
(viii) Benchmarking and technological up-gradation,
(ix) Capacity building of NIH Scientists and staff, and
(x) Technology transfer and outreach activities.

3.2.1.2 Achievements of Scientific Programme

During the period, the Institute had pursued its scientific programme through six scientific divisions at headquarters, four Regional Centres, and two Centres for Flood Management Studies (Ganga and Brahmaputra). The scientific divisions at Headquarters, Roorkee were as under.

(i) Environmental Hydrology Division,
(ii) Ground Water Hydrology Division,

(iii) Hydrological Investigations Division,
(iv) Surface Water Hydrology Division,
(v) Water Resources Systems Division, and
(vi) Research Management and Outreach Division,

The Regional Centres are as follows:

(i) Western Himalayan Regional Centre, Jammu (J & K),
(ii) Central India Hydrology Regional Centre, Bhopal (MP),
(iii) Hard Rock Regional Centre, Belagavi (Karnataka),
(iv) Deltaic Regional Centre, Kakinada (AP),
(v) Centre for Flood Management Studies (Ganga Basin), Patna (Bihar), and
(vi) Centre for Flood Management Studies (Brahmaputra Basin), Guwahati (Assam).

3.2.1.3 Highlights of the Activities carried out for Scientific Programme

During the XII Plan period, NIH contribution to the flagship programs/projects of the Ministry of WR, RD & GR was very significant. Contributing to the river interlinking project of the Ministry, NIH carried out hydrological analysis and multi-reservoir simulation of Ken-Betwa Link and simulation studies of Mahanadi-Godavari Link and Sankh-South Koel-Subarnarekha Link. Issues of Ganga basin is another key area for the Ministry and NIH launched a national mission project under NMSHE (National Mission for Sustaining Himalayan Ecosystem) to carry out integrated hydrological studies for upper Ganga basin up to Rishikesh. The Institute also carried out cumulative impact assessment of hydropower projects in upper Ganga basin and E-flow assessment for upper Ganga basin through habitat simulation modeling. NIH contributed to the efforts to ensure safe drinking water for the people by launching four schemes to demonstrate effectiveness of '*Riverbank Filtration*' for sustainable drinking water supply in different hydrogeological settings in the state of Uttar Pradesh, Bihar, Andhra Pradesh and Jharkhand during the XII Plan period.

Hydrology Project – II (HP-II) was another important activity where NIH contributed during the XII Plan period. HP-II was operational in the Institute until 31 May, 2014. NIH was entrusted with the responsibility as nodal agency for development of Decision Support System (Planning) [DSS(P)] for integrated water resources development and management projects in six central and nine state agencies. Following up on the progress made during HP-II, NIH has been entrusted with greater responsibility in "*National Hydrology Project* (NHP)", which is presently under implementation. NIH is coordinating the Purpose Driven Studies (PDS) to address specific issues of water management problems. So far, 27 PDS have been initiated by NHP Implementing Agencies which includes 15 PDS undertaken by NIH. During the XII Plan period, NIH conceptualized a major project called "*Neeranchal National Watershed Project*" with funding from World Bank under '*Pradhan Mantri Krishi Sinchayee Yojana*' (PMKSY). The work initiated under this project involves developing a Decision Support System (DSS Hydrology) for the State Level Nodal Agencies (SLNA) of 9 participating Indian states. This DSS will be used for implementation of the watershed component of PMKSY at micro-watershed levels in selected project areas. Along with this, NIH also started working on the issue of rejuvenation of village ponds. After carrying out pilot project on two ponds, the Institute is embarked on rejuvenating 22 village ponds in western Uttar Pradesh. Another focus area under this project is Integrated Water Resources Management (IWRM) planning in the drought prone Bundelkhand region. The Institute has developed IWRM plan for 4 watersheds in Tikamgarh, Chhatarpur, Jhansi and Lalitpur

districts to be used by respective DMs and line departments as inputs in the District Irrigation Plan of PMKSY.

Water availability and basin planning was another key area of NIH work during the XII Plan period. The Institute has undertaken a study on water availability and reservoir operation for Krishna basin. In this study, water availability was assessed for all major projects and important gauging sites in the Krishna basin. Multi reservoir simulation was carried out for developing procedures for operation of reservoirs so that each party state gets their share as per the tribunal award. During the period, NIH also developed hydrological indices for drought management and contributed in the preparation of Manual for Drought Management, published by the Ministry of Agriculture and Farmers Welfare in 2016. The Institute is participating in the Water Accounting+ initiative of MoWR, RD & GR and contributed to the report on World Class Protocol for Water Resources Assessment (WRA), prepared by a committee constituted by MoWR, RD & GR.

During the period of evaluation, NIH has made significant progress in generating resources through consultancy services. The Institute mobilized 24.79 crore from 118 projects. The projects covered wide array of sectors such as dam break analysis for NTPC and NHPC, emergency action plan for hydro-power projects, estimation of design flood for Chardham railway project and Border Roads Organisation, river-front development plan, impact assessment of ash disposal from STPs, area-drainage studies for thermal plants, flood safety evaluation for nuclear power plants, cumulative impact assessment of hydro-power dams in the upper Ganga basin and Glacial Lake Outburst Flood (GLOF) studies for hydro-power sector. The Institute also generated research fund to the tune of 13.45 crore from 57 sponsored research projects ranging from glacier studies in the Himalayas to forest hydrology in the Western Ghats region.

Appreciable efforts have been made by the Institute in building long-term field research stations in the Himalayas for studying the glacier and other cryospheric processes. Research stations of NIH in Indus basin at Ladakh and Gangotri glacier are amongst the most difficult areas in the Himalayan region. The Henval experimental catchment near Tehri dam is equipped with state-of-the art hydro-met instruments. The Institute also established collaboration with Centre for Ecology and Hydrology (CEH), Wallingford (UK) for this initiative. The Institute participated in EU funded "SAPH PANI" project, with 9 countries and 11 Indian partners, on the theme of "*Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India*". The Institute undertook some key works in the North-Eastern states during the XII Plan period which include groundwater quality and risk assessment of metal pollution in Kulsi river basin and arsenic contamination in groundwater of Nalbari and Barpeta districts, Assam, hydraulic modelling of Brahamputra river-front development project for Guwahati city, dam break flood wave simulation and preparation of Emergency Action Plans (EAPs): Teesta-V; Rangit; Teesta Lower dam; and Lachung dam, Sikkim and development of regional flood frequency relationships for estimation of floods of various return periods for gauged and ungauged catchments of North Brahmaputra and South Brahmaputra Subzones. The Institute also developed a software for operation analysis of multi-reservoir system called "NIH_ReSyP"

During the course of 5 year plan period, NIH conducted about 120 training courses, and trained nearly 3600 people, mainly from central and state governments. The Institute is also regularly publishing magazines "जलचेतना", and "प्रवाहिनी", along with a newsletter

"*Hydrology for People*". The magazine जलचेतना received award from the President of India for the best Hindi magazine in 2016. The Institute also contributed to the policy formulation by preparing policy documents on arsenic mitigation, and salinization of land in coastal areas, developed a plan on the use of treated wastewater from STPs in Delhi for groundwater recharge (MAR) at identified locations in NCT Delhi and prepared flood plain zoning plans for Haridwar and Uttarkashi (Uttarakhand) and participated in many other such activities towards the successful implementation of XII Plan action points. During the evaluation period, the Institute achieved a milestone by preparing itself for ISO-9001: 2015 certification and benchmarking of NIH was also undertaken during the period. Overall, the Institute has performed exceedingly well for achieving the targets set for the XII Plan period.

3.2.2 Research Studies and Publications

The research output of the Institute is published in the form of reports, scientific papers, guidelines, manuals, etc. For transfer of the development technology and techniques to the target users, the Institute organizes workshops, training courses, seminars, symposia, conferences and brain storming sessions. During the period April 2010-March 2017, the Institute pursued approximately 181 research studies (Table 3.13). Scientists of the Institute have brought out 1,284 publications (Table 3.14) in addition to the technical reports. The publications include: publication in the International Journals (351); National Journals (136); and International and National Conferences, Seminars and Symposia (797). The studies (including few additional) are listed at Annexure – V.

Table 3.13: Studies Completed during 2010-11 to 2016-17

Year	Studies completed
2010-11	24
2011-12	19
2012-13	24
2013-14	32
2014-15	24
2015-16	24
2016-17	34
Total	**181**

Table 3.14: Published Research Papers during 2010-11 to 2016-17

Year	International Journals	National Journals	International Conferences	National Conferences
2010-11	34	12	36	102
2011-12	23	11	36	107
2012-13	43	25	49	62
2013-14	55	23	90	44
2014-15	72	19	76	49
2015-16	63	13	48	100
2016-17	61	33	54	64
Total	**351**	**136**	**369**	**428**

In addition to the above scientific studies, the Institute organized 157 training courses and 65 Workshops/Conferences/Symposia/ Seminars in the country under its technology transfer and capacity building activities (Table 3.15)**.**

Table 3.15: Training Courses/Workshops and Seminars/Symposia Organized

Year	Training Courses	Workshops/ Seminars/ Symposia/Conferences
2010-11	23	10
2011-12	19	16
2012-13	18	10
2013-14	32	4
2014-15	21	5
2015-16	22	10
2016-17	22	10
Total	**157**	**65**

3.2.3 Manpower and Financial Aspects

The staff strength during the period is given in Table 3.16. It shows no increase in the manpower position. No additional posts of Scientists were sanctioned to NIH during the reported period.

Table 3.16: Year-wise Staff Strength of the Institute

Category	Year						
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Group-A	79	70	70	71	71	76	72
Group-B	67	69	66	70	69	68	67
Group-C	93	86	83	74	72	68	68
Total	**239**	**225**	**219**	**215**	**212**	**212**	**207**

Year-wise breakup of financial allocation and expenditure actually incurred is shown in Table 3.17**.**

Table 3.17: Year-wise fund allocation and expenditure incurred

Year	BE (Rs. in Crore)	RE (Rs. in Crore)	Expenditure (Rs. in Crore)
2010-11	8.95	8.23	8.46
2011-12	8.295	8.295	8.37
2012-13	14.00	10.50	10.56
2013-14	10.00	10.00	10.00
2014-15	11.00	10.00	11.40
2015-16	14.00	14.00	15.95
2016-17	16.75	12.57	12.56

3.3 Role of Regional Centres

In order to deal with specific hydrological problems in different regions of the country and for providing effective interaction with the States, the Institute has established four Regional Centres and two Centres for Flood Management Studies (CFMS). The ARC noted that the Regional Centres/CFMS have a visibility within the region. In accordance with the mandate, the Centres are performing well in collaboration with other organizations of the region.

The ARC appreciate the concerted efforts undertaken in carrying out the comprehensive drought study by the NIH-RC, Bhopal. Bundelkhand region is known to be a critically drought prone area, and the ARC feel that NIH-RC Bhopal, should take this study forward for addressing the water distress of the local population during droughts. The ARC recommend that District Drought Management Plans, including long term as well as contingency plans, for few critical drought affected districts be prepared and shared with the District Administration for its implementation. Agricultural drought should be the focus with equal consideration for drinking water and the triggering mechanism based on meteorological, soil moisture and hydrological indices be evolved and demonstrated. The ARC also suggested exploring the possibility of developing an integrated drought indicator specific to the Bundelkhand region. The ARC stressed upon the need to take up such studies on a multi-institutional platform wherein the inherent knowledge of experts from different areas can be pooled together to address the vital issue of drought management in this region. In this direction, NIH may explore possibility of developing a 'Core-Project on Drought for Bundelkhand' jointly with IWMI and ICAR.

The ARC feel that names of the regional centres may be more general (instead of identified with specific hydrological issue). Regional Centres are expected to cater all hydrological problems of the region in which they are situated. Though thrust may be given to prominent hydrological problems of the region but they must also tackle other hydrological issues also.

3.4 Observations of ARC

The Achievements Review Committee (ARC) has made an effort in assessing and appraising the performance of NIH on all the four counts of its dominant objective i.e. to undertake, to aid, to promote and to coordinate systematic and scientific work in all aspects of hydrology. While analyzing the performance in these respects, the Committee also dealt on to identify the constraints and obstacles encountered and accordingly made suggestions in the recommendations.

3.4.1 Scientific Programme Implementation

There appears to be a significant achievement in the implementation of approved scientific programmes during the 12^{th} Plan period. Table 3.13 shows that 181 studies were completed by the scientific personnel posted at the headquarters and regional centres of the Institute. In spite of the fact that there has been a marginal decline in the number of scientific personnel, this achievement is considered significant. Table 3.14 indicates that a total of 1284 research papers were published in International Journals, National Journals, International Conferences and National Conferences. In Table 3.16, it is reported that there have been on an average 72 scientific personnel in position at headquarters and the regional

centres. Thus, average publications of individual Scientists work out to be 17 published research papers during the seven years period. Based on this parameter, the level of achievement is considered quite significant. It is expected that quality of these papers would also be good since these papers have found a place in the International Journals, National Journals, International Conference proceedings and National Conference proceedings. Additionally, it is also credit worthy to the Scientists and scientific staff of the Institute to organize 157 training courses during the review period. The year-wise training courses work out to be about 22 on an average. This is also significant as it is considered to be the brain work of a total of 72 Scientists reported to be present on year-wise basis during the review period. The ARC was also appreciative that NIH has undertaken 59 sponsored projects with combined budget of Rs. 13.45 crore and 118 consultancy projects with a combined budget of Rs. 24.79 crore.

3.4.2 Scientific Manpower Strength

The ARC noted with concern that the strength of Scientists in some divisions is not commensurate with the demand in the country. Keeping in view the present scenario of increasing water resources problems being faced by the Country, it becomes obligatory for the NIH to address the situation of the strength of Scientists and to take adequate measures to deal with the situation. However, despite the depletion in strength of the Scientists in different divisions / regional centres, the ARC is of the view that the achievements and performance of scientific activities mentioned above, is commendable. It can be argued that a minimum number of Scientists are necessary to make any worthwhile R & D impact in any field/region.

The ARC noted that during the period 2010-2017, the strength of Scientists/Staff at Guwahati, Patna and Jammu centres were not commensurate with the hydrological problems of these regions. This issue can be addressed by way of better coordination with the Scientists at the headquarters. In spite of the limited scientific strength at few regional centres during 2010-17 period, the performance and achievements of all the regional centres of NIH are quite satisfactory and acceptable.

Table 3.16 brings out the year-wise strength of staff of the Institute for the period 2010-2017. Though apparently there is no decline in overall strength, but there has been a marginal decline in the scientific manpower. The ARC believe that the decline in this strength will not be a good sign for overall capability of the organization. The general rules for “deemed abolish” should not be strictly applied to such national scientific organization and there should always be a liberal view in having good number of scientific staff in such institutions.

Hydrology will gradually be faced with complex water management problems. Diversified field of hydrology experts may be required to examine and tackle such problems of resource exhaustion, quality deterioration, environmental hazards and global effect of climate change. The Institute shall therefore need a good number of Scientists of varied expertise in the field of hydrology including social sciences, economics and ecology to solve the complex water resources problems in future.

3.4.3 Role of Expertise developed at NIH in addressing the Complex Issues of Water Management in the Country

While carrying out the scientific studies and other developmental activities for XII plan and specialized projects like HP-II, Saph Pani etc., the Institute could undertake a number of specific consultancy projects where the insights developed helped in arriving at the solution of complex real life problems. In respect of water resources engineering, the hydrology plays a fundamental role in defining the basic characteristics of the project and also forms a vital role in arriving at a satisfactory solution amongst various interest groups. On the other hand, the systematic knowledge is available in relatively short supply across the country. NIH has been able to generate the knowledge in this specialized field and has become a repository of the knowledge base which is beneficial in the long run for the country and the sector as well. The knowledge management activities of NIH by way of carrying out the specialized studies and dissemination of the knowledge through published papers, training programs and specialized advice are required to be nurtured.

3.4.4 Financial Achievement

During the period under review, the ARC observed that fund utilization by NIH has been excellent. The ARC is of the view that NIH deserves high appreciation for achieving the financial targets.

Chapter- 4
Roles of Different Advisory Mechanisms

This chapter presents the roles of different bodies such as Governing Body, Technical Advisory Committee, Working Group, etc. towards fulfillment of the objectives and suggest modifications in the working procedures of the Institute.

4.1 Functioning of Different Committees

NIH has an empowered 'Governing Body' to pursue and attain the objectives of the Society. A number of other Committees help the Governing Body in the formulation of technical program and governance of the Institute. The details about different Committees have been given in Chapter 2.

4.2 Appraisal, Observations and Analysis

The primary purpose of establishing NIH as an autonomous Society was to be able to respond quickly to hydrological problems being faced by the country. Therefore, the working arrangements in the Institute should be such that scientific temperament is maintained. The Scientists/scientific staff working in the Institute should work in an environment which is at par with the other R & D institutes in the country, indeed the world. Simultaneously, the atmosphere needs to be conducive to avoid discontentment and exodus of Scientists/staff which will not be in the interests of NIH and the Ministry of WR, RD & GR in the long run. It is in these contexts that the roles and functioning of different committees are pertinent. A brief appraisal of these aspects and the roles of various committees of NIH are as follows:

4.2.1 The Governing Body (GB) & The Standing Committee (SC)

The GB has the powers to exercise on all executive and financial matters and to pursue the policy guidelines and directions laid down by the Society. The GB had set up a Standing Committee chaired by the Additional Secretary (MoWR). However, on closer examination, the ARC find that the meetings were not being held as often as it ought to have been. Such delays had been due to, it was explained that the Additional Secretary post was lying vacant for quite some time.

The ARC believe that the present set up of decision making process, which is time consuming could be revisited. They opine that the MoWR may create an "*Autonomous*' status to NIH in a realistic manner, to cut short administrative delays by certain amendments to the present orders to the effect to expedite the decision making process. The ARC suggest that the composition of the Standing Committee may be modified as follows:

Additional Secretary, MoWR (*Alternate*: Member (D&R), CWC)	- Chairman
JS, MOWR	- Member
Director, Finance, MoWR	- Member
Representative of DST (not below the rank of JS)	- Member
Director (NIH)	- Member-Secretary

The proposed Standing Committee will do a thorough scrutiny of all matters referred to it by the Chairman, G.B. For urgent matters, Chairman (GB) may take a decision based on the advice of the Standing Committee. The ARC believe that this arrangement could obviate delays and result in quickening the decisions on matters related with NIH.

4.2.2 Technical Advisory Committee (TAC)

The TAC is the highest technical body of the NIH Society and it advises the GB in firming up the scientific program to be pursued by NIH. Recently, TAC has been expanded by including members from international organizations (UNESCO, ICRISAT and IWMI), NHPC and WAPCOS.

Presently, the meetings of TAC are normally held at New Delhi. The ARC is of the view that meetings of TAC may also be held at Roorkee for more interaction between TAC members and NIH Scientists.

4.2.3 The Working Groups (WG) & The Regional Coordination Committees (RCC)

The ARC noted that the meetings of the 'Working Groups (WGs)' for headquarters had taken place regularly i.e. twice in a year. However, in a few cases, meetings of the 'Regional Coordination Committees' (RCCs) had not been held regularly, as per ARC review.

The ARC is of the view that the membership of different RCCs be reviewed to incorporate adequate representation from the concerned departments of the Central and State governments. Also, interaction between TAC/WG members and NIH Scientists need to be further increased.

4.2.4 Indian National Committee for IHP (INC-IHP)

ARC noted that the activities of INC-IHP have increased recently and hopes that this body will be able to significantly serve hydrologic community in India.

4.2.5 NIH-IIT Roorkee Coordination Committee (CC)

The stipulated period for holding the meeting is once in six months. However, only a few meetings took place during 2010-17. However, the NIH is able to circumvent the road blocks with special efforts to liaise with IIT as it obtains.

Chapter - 5
Identification and Assessment of Factors which Facilitated or Impeded the Achievements of the Objectives

5.1 Scientists' Cadre & Pay Matrix Level

The existing structure of the scientific cadres at NIH along with the Pay Band (as per Sixth Pay Commission) and Pay Matrix Level (as per Seventh Pay Commission) is given below:

Position	Pay Band (as per Sixth Pay Commission)	Pay Matrix Level (as per Seventh Pay Commission)
Director	PB-4	14
Scientist-G	PB-4	14
Scientist-F	PB-4	13A
Scientist-E	PB-4	13
Scientist-D	PB-3	12
Scientist-C	PB-3	11
Scientist-B	PB-3	10

The highest scientific position at NIH is Scientist-G. It can be seen that the pay matrix level for both Director and Scientist-G is same.

5.1.1 Observation/Recommendation of ARC

Over the years, complexities and challenges in the hydrological and water resources sector have considerably increased the responsibilities of the Director and the senior Scientists. In a way, stature of an Institute is judged by the positional status and importance attached to the post of its Director. The existing position of the Director, NIH is equivalent to a Joint Secretary (Level 14) to the Government of India. Scientist-G of the Institute is also at the same level. In order to have proper administrative setup and functioning, the pay matrix level for Director needs to be one level higher than Scientist-G. Therefore, post of Director needs upgradation to the level of Additional Secretary (Level 15) to the Government of India or its equivalent. Director of various similar organizations are already having the pay scale of HAG (Level 15). For example, Director of Wadia Institute of Himalayan Geology (WIHG) is having the HAG pay scale. WIHG was established by Government of India as a specialized centre of excellence for advance level of research in all aspects of geology and geodynamics of the Himalayas. Similarly, Directors of CSIR (Council of Scientific and Industrial Research) labs are at HAG pay scale.

5.2 Internal Administrative Setup and Functioning

Internal administrative functioning of the Institute is facilitated through the following setups:

i. Scientific Divisions at headquarters,
ii. Regional Centres and Centres for Flood Management Studies (CFMS),
iii. Administrative section,
iv. Finance section,

v. Maintenance Division,
vi. Computer Centre,
vii. Library, and
viii. Miscellaneous units.

Each scientific division at the headquarters is headed by a Scientist-G as its Divisional Head. Each Regional Centre/CFMS is headed by a Scientist-F/G as the 'Head of the Centre'. The scientific and administrative liaison of each Regional Centre is coordinated by a Scientist-G at the headquarters. Activities under National Hydrology Project are being monitored by a Project Management Unit.

The administrative functioning of the Institute for both, the headquarters and Regional Centres/CFMS, are carried out by the administrative section which is headed by the Senior Administrative Officer. The financial activities of the Institute are carried out by the finance unit headed by the Finance Officer.

The maintenance activities (Civil & Electrical) at headquarters for the office complex and the NIH colony are carried out by the Maintenance Division; One of the Scientist-G handles the tasks of heading it, in addition to other scientific roles that (s)he performs. The Computer Centre that updates and maintains the computer facilities including e-governance mechanism and website of the Institute is coordinated by a 'group of Scientists'. In addition to these, the Institute has a number of other cells viz., Vigilance Cell; Hindi Cell; RTI Cell; Grievance Cell; Library, Documentation and Outreach Group; Vehicle Cell, etc. These cells are also as a head, managed by Scientists, as per requirements. With regard to the Regional Centres/CFMS, such activities are dealt by the Scientists of the respective centres under the direction of the Head of Regional Centre.

5.3 Financial Rules and Procedures

The Institute receives funds as Grants-in-aid (GIA) from the Ministry of Water Resources, RD & GR, under two distinct heads, viz. Plan and Non-Plan. In addition to GIA, the Institute also receives funds from other agencies for sponsored/consultancy projects. The expenditures of funds are largely governed by the Government of India general finance rules and procedures. Director, NIH is the approving authority for all financial sanctions including the matters related to the Regional Centres/CFMS. Finance Officer acts as the drawing and disbursing officer. For the Regional Centres/CFMS, Finance Officer acts as drawing officer and the Scientist located at Regional Centre, designated as Drawing and Disbursement Officer (DDO), acts as disbursement officer.

5.3.1 Recommendation of ARC

Modern methods of funds management through online transfer etc. should be promoted for smooth flow of financial resources.

5.4 Interaction between Headquarters and Regional Centres

Interactions between the headquarters and the Regional Centres/CFMS are two fold. These are: (i) scientific interaction, and (ii) interaction on administrative and financial aspects. Activities of each of the Regional Centre/CFMS are coordinated by a senior Scientist at headquarters who maintains functional liaison between the headquarters and

Regional Centre. This arrangement is ascertained to be quite successful in so far as the scientific matters interactions are concerned, but in respect of administrative and financial matters, such arrangement had resulted in procedural and functional delays. The panacea seemingly lies in effective interaction by modern communication process, more specifically brought out as one of our 'ARC recommendation' in Section 5.4.1 below.

5.4.1 Recommendation of ARC

Such delays can be minimized by leveraging on modern communication techniques like e-mails and virtual meetings.

5.5 Promotion Policy

5.5.1 Scientists

The existing promotion policy for Scientists at NIH (APS-2012) is based on the Flexible Complementary Scheme (FCS) prescribed by the Department of Personnel and Training (DoPT), Government of India with some minor modifications. There are two distinct levels of assessment for in-situ promotion under APS-2012. The first one is at internal level for screening purpose and the next level assessment is handled by an Assessment Board, having a majority of 'external' members, as nominated by NIH.

There is a minimum residency period in each grade of Scientists, as given below, before Scientists are considered for assessment:

Designation	Minimum Residency Period Linked to Performance
Scientist B	3 years
Scientist C	4 years
Scientist D	4 years
Scientist E	5 years
Scientist F	5 years
Scientist G	-

The assessment period is based on the qualifying minimum residency by 1st January or 1st July and assessment is done twice in a year. The Assessment Board recommends promotion based on the marks awarded to a Scientist for work performance (Level 1 - Internal Screening) and interview (Level 2 - Assessment Board). A Scientist is recommended for promotion on securing cumulative 75% marks in first attempt; and 65% marks in subsequent attempts. These procedures are more or less in full accordance with procedures in vogue in respect of managing Scientific Cadres in the Government or their managed Institutions.

5.5.1.1 Observation/Recommendation of ARC

The ARC noted that there is discernible frustration amongst a few of the Scientists with regard to delays in their promotions based on the existing procedures of assessment, mainly due to procedural delays in conducting the 'assessment interviews'. This needs to be addressed adequately, while following the system requirements faithfully. Such

administrative steps that can ensure the welfare and interest of eligible Scientists for promotion can be followed by an internal review at six months intervals.

5.5.2 Scientific & Technical (S & T) and Other Staff

For the Scientific & Technical (S & T) and other staff, presently two schemes are in operation: (i) Departmental Promotion Scheme (DPS), and (ii) Modified Assured Career Progression Scheme (MACPS). The DPS is vacancy based while MACPS is assured pay up-gradation to next higher grade of pay once in every 10 years with maximum of three up-gradations in the complete service period.

5.5.2.1 Observation/Recommendation of ARC

The ARC noted that the Scientific & Technical (S & T) staff of the Institute is looking for better provisions in their career advancement schemes. The staff plays a big role in the maintenance of the costly equipment and instruments, for conducting field and laboratory experiments and to assist the Scientists in their research works, etc. The ARC opine that suitable cadre based promotional schemes at par with the CSIR need to be extended to the S & T staff of NIH.

5.6 National Collaborations

Within the given framework, the ARC strongly feel that the Institute could create a sizable impact as a premier National Institute in the arena of hydrological research through working in collaboration with a number of stakeholders. These include organizations under MoWR and other related Central departments, State Government departments, R&D organizations, IITs, IISc, Universities, NGOs, etc. In the current competitive world, professional requirements demand an Institution's discernible visibility by their lead role in guiding the country on policy planning/policy evaluation. NIH has a specific role in water sector in order that the country faces ever increasing 'Water Challenges' successfully, and NIH has to strive hard to deliver the outputs in a productive and result oriented manner.

The Institute also needs to work in liaison with Industries and reputed NGOs to promote its technologies.

5.7 International Collaborations & Interactions

Interactions/collaborations with foreign and international organizations help a Premier Professional / Scientific Institution (like NIH) grow professionally.

During the period of report (2010-2017) of ARC's concern, as per ToR assigned to them, NIH has taken-up many projects with International collaboration. The ARC noticed that NIH has creditably developed some international credentials through regular scientific publications in various International journals.

The ARC was given to understand that participation of Scientists in international conferences abroad for presentation of paper, even in cases where there is no financial liability from the Institute side, one has to undergo a rigorous administrative process. Consequently, many times, delays in processing result in non-participation in the International conferences abroad. The ARC consider that opportunity delayed in one that is

forgone. Hence, it should be avoided by requisite administrative steps in processing clearance or approval in time altogether.

5.8 Additional Observations, Analysis and Suggestions

5.8.1 On one hand, NIH has grown into multiple units in comparison to what was conceived at the time of its inception; and on the other hand, the expectations of the society and hydrological fraternity in general have increased manifold. It is seen by the ARC during the present review exercise that, the service conditions have not been significantly revised or expanded as warranted from time to time. These have resulted into a good deal of dissatisfaction amongst the working cadres. There used to be a time when hydrological professionals preferred to take up a job in NIH, but now the trend is seemingly not so, as it is seen that a few of the competent Scientists, after serving 15/20 years in the Institute, had preferred to quit NIH to take up jobs in other organizations, mostly IITs/NITs. In last few years, many Scientists have left the Institute[2]. The ARC strongly opine that it is an important issue and needs to be looked into.

5.8.2 The ARC in their visit to one of the NIH regional centres interacted with the Scientists and Head of the regional centre; besides, some stakeholders of the respective region with particular interest with NIH regional centre were also contacted during the invited discussions. In respect of other regional centres also, the ARC also reviewed relevant information.

The ARC find that the Regional Centres/CFMS have a visibility within the region. In accordance with their mandate, the centres are performing well in collaboration with other organizations of the region. However, some Regional Centres/CFMS are not having adequate supporting staff. In such cases, the precious time of the Scientists is wasted in undertaking routine administrative and financial matters and affecting their positive professional contribution, otherwise. Since the numbers of Scientists in all the Regional Centres are inadequate, the ARC recommend that this be raised at each regional centre to 6 to 8.

5.8.3 Most of the Regional Centres, except Patna and Kakinada which have permanent office building and campus, have been operating from private rented buildings for long (at least two decades). This is neither desirable nor worthy for an Institute of national importance which has to maintain a good number of research laboratories. It is unfortunate that NIH has still not been able to have its own campus for more than two decades at Belagavi Regional Centre, despite the fact that it was the first regional centre established in the year 1987. Sincere efforts are needed to get own land and campus at all the Regional Centres. In this regard, Ministry of Water Resources, RD & GR may pursue the matter with respective state governments.

5.8.4 Hydrological and water resources aspects of the central region of the country were earlier being investigated by the Regional Centre located at Sagar (MP). The region is frequented by the droughts. In view of the projected climate change, relevance of

[2] A number of Scientists namely Dr. N. K. Goel, Dr. M. Perumal, Dr. G. C. Mishra, Dr. M. L. Kansal, Dr. K. P. Sudhir, Dr. P. Mahapatra, Dr. S. K. Mishra, Dr. M. K. Jain, Dr. C. Chatterjee, Dr. N. S. Raghuvanshi have left the Institute and joined various IITs. Scientists such as Dr. V. K. Dwivedi, Dr. Ramakar Jha, Dr. N. Panigrahy, Dr. Arnab Bandyopadhyay and Dr. S. P. Rai have joined NITs and other Institutes.

this centre has increased considerably. This centre was facing locational difficulties adversely affecting its performance. However, after shifting the Regional Centre from Sagar to Bhopal (named as Central India Hydrology Regional Centre), the ARC noted that the performance of the centre has improved substantially. However, the ARC find that the centre still lacks sufficient office space and other infrastructure facilities.

5.8.5 The ARC feel that NIH itself should further decentralize various administrative procedures within the Institute. Any administrative bottlenecks in carrying out sponsored research projects, consultancy projects, field visits, attending conferences, submitting research papers to conferences and journals and such other fundamental, professionally essential activities of a Scientist, must be removed. A Scientist should be made to feel good carrying out his/her research and other allied activities, being in NIH. In most IITs, CSIR laboratories and most definitely in IISc, open and encouraging ambience ensures a productive and healthy career of a researcher.

5.8.6 The ARC also noted the serious concerns of Scientists and staff members regarding non-availability of old pension scheme of Government of India to NIH and also non-availability of any post-retirement medical facilities.

Based on the above observations and appraisals, recommendations and suggestions of ARC are given in Chapter 7.

Chapter - 6
Areas of Studies and Research to be Undertaken by the Institute in Coming 10 to 15 years

6.1 Existing Framework of Scientific Activities

The existing framework of scientific activities of NIH encompasses the following:

(i) R & D activities,
(ii) Technology Transfer & Capacity Building activities, and
(iii) Consultancy and Technical Services activities.

The R & D activities are two folds i.e. (i) Basic research, and (ii) Applied research. The 'Technology Transfer and Capacity Building activities' concentrate on: (i) organizing regular professional courses to impart training to field engineers/Scientists/implementing bodies etc. on advanced tools and techniques, (ii) in-house capacity building of the Scientists and scientific staff through sponsoring in specialized workshops/academic curriculum etc., (iii) organizing Workshops/Seminars/Symposia/ Conferences, etc. and (iv) public awareness programs.

Under the 'Consultancy and Technical Services' activities, Scientists and other staff have been participating in the client based projects who can render services for a maximum of 50 man-days (about, 20% of time in a year) in a financial year and can also receive monetary benefits accordingly.

6.2 Areas of Future Studies and Research

The NIH was established with a vision to enable it to grow into a national apex scientific organization in all matters pertaining to hydrological inputs to the country's myriad problems of water development and management. Hydrology is gradually becoming a complex science, as the issues of water management, internationally, nationally and locally are becoming complicated due to development needs of every region for a better future of the people. The deterioration in water quality resulting from rapid industrial and population growth as also the looming change in water availability scenario due to global climate change is a daunting task that modern hydrology is faced with. Therefore, the role of NIH has become more significant and will become more complex in the future.

The broad areas for future studies and research of the Institute should be in accordance with the R & D works listed in the 'National Water Mission Document' under the overall framework of the "National Water Policy". Therefore, 'Integrated Water Resources Management (IWRM)' on 'River Basin level' based on multi-disciplinary approaches for scientific studies pertaining to the supplies and demands of water in the light of forecasted hydrological variability should be the main focus of the R & D activities of the Institute.

In this context, NIH is advised to emphasize its basic and applied research and studies focusing mainly towards considering 'River Basin' (or sub-basin) as the 'Hydrological Unit'. The basic research should not be carried out in isolation but should be a

supplementary part of the action research. The Institute should also continue with demand driven sponsored R & D studies on the challenging hydrological problems.

The ARC is of the considered view that NIH being the premier R & D organization needs to more intensively work with reputed international organizations to get the Institute professionally growing on advancement in hydrological research and in adaptation of emerging advanced tools and techniques.

The focus of R & D works needs to be revitalized with the changing global scenarios. ARC noted that a recent review by DST-PAC on civil and environmental engineering had brought out a report on R & D needs in Hydrology and Water Resources. Many of the research areas identified in that report are also relevant for future NIH focus areas. The report is available at the following web link - http://www.serb.gov.in/pdfs/brainstorming-sessions/Report%20Water%20Resources%20Engineering%20Final.pdf

1. **ARC Recommend** that the Institute needs to be provided with the requisite enabling environment for future studies/research and allied activities with regard to the following: Exploring opportunities of using available indigenous low cost sensors/ advanced/high-tech instrumentation/IoT (Internet of Things) and AI (artificial intelligence) for enhancing hydrological services.
2. Integrated re-assessment of surface water, ground water and sediment yield in river basins. This shall, inter alia, include water quality aspects, rain water harvesting and groundwater recharge opportunities.
3. Eco-hydrology and dynamic review of environmental flow requirements.
4. Quantification of hydrologic alterations due to external forcings such as, climate change, land use – land cover change, sand mining, extensive/intensive irrigation and other anthropogenic interventions.
5. Hydrologic extremes: floods and droughts, including climate change impacts.
6. Re-cycling and re-use of water, use of poor quality water in agriculture with safety precaution, in-situ remediation of arsenic and other contaminants in groundwater for safe re-use.
7. Enhance the present research activities of NIH in areas such as
    i. Inland water bodies (estuaries, lakes and wetlands)
    ii. Hard rock aquifers
    iii. Arid and semi-arid regions
    iv. Forest hydrology
    v. Urban hydrology
    vi. Coastal hydrology including estuarial hydraulics and coastal aquifers
    vii. Himalayan hydrology (Third Pole).
    viii. Nuclear/Isotope hydrology
8. Applications of space technologies in hydrological studies

6.2.1 Contractual Appointments

In order to enhance the Institution's strength by means other than usual, the ARC noted that engagement of very competent hydrology experts on special terms might be helpful, in the challenging circumstances in handling water related issues that are increasing day by day.

The ARC recommend that hydrologists who are actively engaged and having professional brilliance may be employed on short contractual basis (for one or two years) with attractive package. The aim should be to attract the desired talent in some of the fields of research mentioned in the previous section 6.2.

6.2.2 Collaboration with International Organizations

The Institute has a scope to further enhance its collaboration with various international organizations and Institutes working in the area of hydrology and water resources. There can be exchange programs at various levels and all such opportunities shall be explored from time to time by liaising with Global Water Institution of reckoning.

6.3 Future Research

Given the limited manpower in terms of its Scientists and supporting staff, and granting certain bottlenecks to overcome such steps that are required to increase the scientific strength manifold for looking into new research domains given in the previous section, the ARC suggest the following additional steps.

6.3.1 Provision of Research Fellowships – 18 Nos.

To enhance the vibrancy in the Institute, it is necessary to attract young researchers. The ARC therefore recommend institution of research fellowships. As a first step, about 18 such fellowships may be awarded. Out of the proposed 18 research fellowships, 12 fellowships are proposed to be attached to the headquarters and the remaining 6 to be distributed among Regional Centres/CFMS. The fellowships initially will be for a period of four years with a provision of extension by one year. The research fellows may also be encouraged to register for the Ph.D. degree with the IITs/Universities.

Chapter - 7
Recommendations and Suggestions

7.1 Preamble

7.1.1 The ARC have expressed their views, comments and made recommendations on the various issues that have been referred to in respective chapters of the report. This chapter lists the recommendations at one place for the convenience of policy makers to take appropriate actions.

7.1.2 The ARC firmly believe that the present status of NIH needs a perceptible change. To give impetus to hydrological research and to attain a stature of a National Institute of repute in its own sphere - a 'fully autonomous' status would help. This is likely to yield their research activities at par with similar 'lead international institutions'. Since its inception, the Bye-laws of NIH have not even been revisited. If necessary, they need to be revised, as appropriate, to impart full autonomy to the Institute. Over the last three decades, the conditions and policies of the country in the water sector have undergone sea changes and the successive governments are of the view that it should emerge as the technology leader of the world. To meet the aspirations of the country and to address the multifarious hydrological problems which have repercussions in the national and international arenas, upgradation of NIH status seems all the more necessary and warranted.

Recommendations

7.2 Strength of Scientists and Service Conditions

7.2.1 The ARC noted with concern the insufficient strength of Scientists in a few scientific divisions at headquarters such as Environmental Hydrology, Hydrological Investigations and Research Management and Outreach Division (RMOD). The situation needs reversal, especially considering the present scenario of increasing environmental problems with linkage to water managerial issues, persistent almost everywhere. The ARC consider that this situation could be improved by an increase in strength of these divisions with tasks assigned to them to specific issues.

7.2.2 With regard to the strength of Scientists/staff at the regional centres, the ARC opine that staff strength is inadequate specifically at Guwahati and Jammu Centres and elsewhere to deal with the distinct hydrological problems unique to their respective regions. The strength of Scientists/staff in the regional centres needs augmentation. There should be a minimum core strength of at least five Scientists at any point of time in a Regional Centre to provide a critical mass for carrying out a meaningful research.

7.2.3 The ARC noted that there has been significant achievement in the implementation of approved scientific programmes during the review period (2010-2017) assigned to them for review. That this could be achieved despite staff strength limitation is admirable. Much more could have been achieved if the Institute were blessed with

the full approved strength of Scientists, if not the additional strength being recommended elsewhere in this report.

7.2.4 The Institute has six scientific divisions at headquarters and six regional centres. With optimum requirement of 15 Scientists in each scientific division at headquarters and 10 Scientists in each regional centre, the Institute requires a total of 150 Scientists. The ARC strongly recommend the increase in number of Scientists from the current strength of 71 to 150 Scientists. In order to address complex hydrology and water resources management problems, multi-disciplinary specializations such as social sciences, natural resources economics, and ecology has to be kept in view while furthering strength augmentation.

7.2.5 Keeping in view the past experience of over three decades, it may not be immediately possible to increase the scientific strength manifold (though highly desirable) to carry out research in the areas given in Chapter-6. Therefore, besides making consistent efforts to increase the scientific strength, the ARC suggest provision of a total of 18 Research Fellowships at any point of time (12 fellowships may be attached to the headquarters and remaining 6 may be distributed among Regional Centres/Centre for Flood Management Studies). The fellowships initially will be for a period of four years with a provision of extension by one year. The research fellows may also be encouraged to register for the Ph.D. degree with the IITs/Universities. It is also suggested to explore the possibility of attracting experts of international repute on sabbatical basis (nationally and internationally) for a fixed period of six months to a year. The sabbatical guidelines being followed in IITs/other research organizations may be examined to evolve the one for NIH[3].

7.2.6 More number of new positions should be created at the entry level (i.e., Scientist B and Scientist C) to add younger Scientists to the pool; in addition, a few positions could be filled in through lateral entry at senior levels (Scientist D, E and F) ensuring that the best talent from outside the Institute, especially in emerging areas of research is also available in NIH.

7.2.7 The ARC understand that a number of scientific posts have gone into the "deemed abolished" category as they could not be filled up in time. This has depleted the scientific strength of the Institute. Such general rules for abolition of posts should not be strictly applied to NIH and suitable action in this regard is advised[4].

7.3 Infrastructural Facilities

7.3.1 In respect of civil infrastructure development, the ARC suggest that all Regional Centres should operate from their own permanent campuses.

[3] For inviting an expert, NIH need not follow the sabbatical rules – all it has to decide is how much honorarium/salary that can be given for such an expert. The sabbatical part is applicable to the expert's institution.

[4] In this context, it will help if the powers delegated to the Secretary of seven scientific ministries vide Office Order No. 300341302/E.Coord.I/2017 dated 12th July, 2017 are also delegated to the Secretary (WR). A proposal for the same has been submitted by NIH to MoWR RD & GR in Feb., 2018.

7.3.2 Out of the six regional centres, only two at Patna and Kakinada have permanent office buildings and campuses owned by NIH and the rest are operating from private rented buildings or space provided by WALMI (Bhopal), Department of Irrigation & Flood Control, Government of Jammu and Kashmir etc. The ARC is of the firm opinion that this is undesirable for a premier research Institute of national importance. It was given to understand that a positive response from the Government of Karnataka to assist NIH in acquiring land for the Regional Centre at Belagavi has been indicated recently.

The ARC feel that other regional centres should also endeavor to acquire land by liaison with the respective State Governments and prepare plans to construct their own Institution accommodation rather than wait for actions from the Central Government. Continuation of the present state of some regional centres operating from rented premises is not advisable.

7.4 Proposed Administrative Changes

7.4.1 In order to expedite the decisions on matters concerning NIH referred to the Governing Body, the ARC suggest that the Chairman, Governing Body may constitute a Standing Committee to carry out a thorough scrutiny of all matters referred to the Chairman, Governing Body (and agenda for Governing Body meetings) for its suggestions / recommendations to enable the Governing Body to take appropriate decisions on all matters in a time bound manner. This will obviate the routine processing of proposals of NIH, and consequent delays.

7.4.2 Regarding the co-ordination with IIT-Roorkee, the ARC is of the view that NIH and IIT-Roorkee Coordination Committee should meet more frequently and make efforts to provide impetus to hydrological research and cooperation in general.

7.4.3 During the last three decades, complexities and challenges in matters related to hydrology and water resources sector have considerably increased the responsibilities of the Director and senior Scientists of NIH. It is natural to expect that with the increased responsibilities, the status of the Director of the Institute needs an upgradation to have more functional effectiveness. The ARC recommend that the position of the Director be upgraded to the level of Additional Secretary to the Government of India or an equivalent in the Government's scientific cadre.

The ARC also recommend that in order to attract best of the talents available in the country, the upgraded Director's position be filled in through a competitive process of open search allowing space for all to compete effectively. This needs appropriate rules to be formed for recruitment of the Director.

7.4.4 The ARC noted that the Regional Centres of NIH do not have adequate supporting staff; precious time of the Scientists is seen to be lost in routine administrative and financial matters. This situation needs to be remedied by appointing supporting staff at the regional centres.

7.4.5 The ARC strongly feel that NIH should be given a complete autonomous status with an almost complete revamping in its present structure of governance. It is possible to

improve the overall work ambience and enable the Institute to become internationally competitive, through such a complete autonomy.

7.4.6 The ARC also strongly recommend that the Director of NIH should have adequate discretion and flexibility in decision making, which is unavailable apparently, under the present scheme of things.

7.4.7 For taking up R & D and consultancy projects, the Institute has to form consortia with other national and international government, academic and private organizations/experts based on the expertise requirement of the projects and programs. Also, the institute has to go for biddings for small and large consultancy projects. It requires quick and time bound approvals for submitting EOI, technical and financial bids and signing of MoU etc. Hence, it is desirable to authorize Director, NIH for granting approvals for appointing Scientists (up to Scientist F level), foreign travel of Scientists (up to Scientist F level by using the funds allocated for foreign travel), signing of MoU with foreign universities/institutes, taking up international collaborative projects and programs after getting the necessary clearances from the concerned ministries.

7.5 Service Conditions and Related Matters Pertaining to Scientific, Technical and Supporting Staff

7.5.1 The ARC noted that the staff plays a significant role in the maintenance of costly equipment and for conducting field and laboratory experiments and to assist the Scientists in their research work. That in existing situation in the scheme of things, the scientific and technical staff of the Institute are not content with the career advancement schemes, should be taken note of and the situation remedied by resorting to several suggestions of the ARC in this report.

7.5.2 The ARC opine that suitable cadre based promotion scheme at par with CSIR be extended to S&T staff of NIH. There are quite a number of supporting scientific staff in NIH who are highly qualified and are engaged in genuine scientific work, at par with other Scientists. In the absence of promotion opportunities, they are stagnating. The ARC noted that many of them deserve their promotion in the scientific cadre, even at entry level as Scientist-B. The ARC noted that constraint in their getting promoted/selected at appropriate scientific level is essentially their age limitation, a condition for such entry to Scientific Cadre. The ARC is of the view that for such internal candidates, age should not be a bar, and the recruitment rules be amended accordingly.

7.5.3 In view of the expanded entity of NIH and to facilitate the functioning of the Institute as a commendable autonomous organization, there is a need to create a post of “Chief Administrative Officer” at the level of Scientist-D. The ARC suggest that this post must be an open post on deputation from other Government/Sister organizations. The deputation may be initially for a period of three years and extendable to a maximum of five years.

7.5.4 During the past thirty years, the NIH has grown in stature and size. It has added many laboratories and cells. Consequently, purchase of equipment and spares has become a time consuming job which is presently being looked after by a senior Scientist

(nominated as Procurement Officer) with support from Scientists-in-charge of laboratories, thereby consuming valuable time of the Scientists. The ARC recommend that a post of "Purchase Officer" be created and filled up as soon as possible to obviate the involvement of senior Scientists in such matters.

7.5.5 Suitable mechanism to ensure timely holding of selection and assessment interviews needs to be evolved and strictly followed. The ARC opine that because of procedural delays, promotion prospects of Scientists/staff should not be jeopardized.

7.5.6 A proposal to provide post-retirement medical treatment facilities to NIH employees is under consideration with MoWR, RD & GR. In the proposal, the cost will be partly provided from the interest earned in the consultancy account and partly by the employees. Since, NIH employees are not covered by pension rules, a safety net is highly desirable and ARC recommend that this proposal may be favourably considered at the earliest.

7.6 Strengthening of Research Efforts

7.6.1 To increase knowledge and to bring professionalism in hydrological research, more exchange programs between NIH and academic/other R & D / reputed private organizations/centres of excellence etc. may be explored and if feasible, developed.

7.6.2 New (Section 6.2) research areas have been identified and proposed for future research in the earlier chapter to enhance the visibility of NIH globally. These areas require highly competent Scientists. Short term contractual appointments with attractive package as appropriate, might enable enthusing persons having professional brilliance to take up the appointments; as and when inducted, they can provide directions to research on topics of relevance to each one of the new areas in which they have done outstanding contribution well recognized globally.

7.6.3 The ARC has suggested provision of eighteen 'Research Fellowships' at the Institute. The fellowships initially will be for a period of four years with a provision of extension by one more year.

7.6.4 Regional Centres are spread out arm of the Institute, given their focus for research in specific hydrological regions. They have a key role to play in the study of the regional hydrology and in the capacity building of the State water resources departments. These should be strengthened further through both increased manpower and infrastructure.

7.6.5 To make the Institute vibrant, it is essential that the Scientists and the scientific staff are continually trained in emerging areas of research. There can be short term (up to about one month) visits of senior Scientists and medium term (4 to 6 months) training of middle level Scientists in reputed Institutes/Universities, both in India and abroad, as per their recognized 'Excellence Identification'.

7.6.6 The ARC noted that the research scholars working in the sponsored projects could not register for Ph.D. as there is no enabling mechanism in the Institute. The ARC recommend NIH to get affiliated with a good university to remedy this problem.

7.6.7 The Institute should enhance its collaboration with various international organizations and Institutes working in the area of hydrology and water resources. The ARC suggest that international collaboration should not be limited to specific projects only. Rather, it should be a standing arrangement so that regular interaction/collaboration takes places at appropriate intervals between the Institutes of Collaboration.

7.7 Upgradation of Laboratories and Advanced Instrumentation for Field Investigations

7.7.1 The Institute is presently having five main laboratories namely; Water Quality, Nuclear Hydrology, Hydrological Instrumentation, Soil Water, and Remote Sensing and GIS. Besides the above laboratories, there are Snow & Glacier laboratory, Hydro-meteorological Observatory and Centre of Excellence for Advanced Groundwater Research. Some of these laboratories are equipped with quite a few advanced instruments. Notwithstanding, there is a perceptible need to upgrade all the laboratories with the latest 'state-of-the-art' instruments taking note of the latest trends; for example, automatic sample preparation units for various types of soil and water analyses etc. Improving computation and modeling facilities with latest modeling software is a dire necessity.

7.7.2 Presently conventional hydrological instruments are being used for collecting hydro-meteorological data by various field organizations. The ARC is of the opinion that there is a need for using 'state-of-the-art' hydrological instruments having data logger and telemetric facilities to avoid human errors and getting the hydro-meteorological data from field to a desired location. NIH has to use such an advanced instrumentation for carrying out its own field oriented studies and it should also demonstrate/educate the central and state field organizations to use such 'state-of-the-art' instruments for field data collection.

7.8 Steps to Improve Overall Excellence and Productivity

The ARC recommend the following steps.

- Autonomy to the Institute in recruitment/promotion of Scientists
- Developing high quality non-journal publications (such as manuals, technical reports, brochures, newsletters, etc.)
- Increasing collaboration both with Institutes abroad and within the country
- Developing outreach activities and field demonstrations of technological innovations in pilot projects
- Improving opportunities for professional growth and career progression
- Integrating across disciplines/divisions publishing in high impact Journals
- Assessment based promotion policy for the scientific staff, as in CSIR
- Rewards for excellence and mechanisms to penalize non-performance
- Mentoring junior Scientists by Scientists in the category of E/F/G
- Reward and recognition for good work by Scientists, scientific staff and administrative staff
- Encouragement/Remuneration for involvement in sponsored research projects
- Meeting the training needs of the Scientists and scientific staff
- Pension option made available as in Government organizations (for the employees who joined before 2004).

ANNEXURE – I

No. 11/7/2017-E-II/629
Government of India
Ministry of Water Resources, RD&GR
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Shram Shakti Bhawan, Rafi Marg,
New Delhi, the 11th September, 2017.

ORDER

Subject: Constitution of the Achievements Review Committee to assess the performance of NIH, Roorkee.

In exercise of the powers vested under Rule-59 of the Memorandum of Association and Rules and Regulations, the President of the NIH Society hereby constitutes the Achievements Review Committee with the following composition for assessment of the performance of the National Institute of Hydrology, Roorkee:-

a. Shri. M. Gopalakrishnan, Ex-Secretary General, ICID, New Delhi — Chairman

b. Shri A.B. Pandya, Ex-Chairman, Central Water Commission — Member

c. Dr. P.P. Majumdar, IISC, Bangalore — Member

d. Dr. Saleem Romani, Ex-Chairman, CGWB — Member

e. Dr. A.K. Sikka, IWMI Representative-India, IWMI — Member.

Director, NIH/Scientist F, NIH, Roorkee will act as Member-Secretary to the Committee and provide all secretariat help to the Committee.

2. The terms of reference of the Committee shall be as under:-

(a) To review the achievements of the NIH during the period from 01.04.2010 to 31.03.2017 vis-à-vis the objectives outlined in Clause – 3 of its Memorandum of Association.
(b) To review the achievements in respect of Plan schemes of NIH during 12th Five Year Plan.
(c) To consider the role of the different bodies such as Technical Advisory Committee, Coordination Committee and Working Group etc. towards fulfillment of the objectives and suggest modifications in the working procedures of the Institute, if called for.
(d) To identify and assess the factors which facilitated or impeded the achievements of the objectives; and
(e) To advise on the areas of studies and research which may be undertaken by the Institute in coming 10 to 15 years.

3. The Committee will submit its Report within six months from the date of issue of this order.

4. The Chairman and all the Member of the Achievements Review Committee will be treated as Non-official Members as per Rules and Regulation in-force. The Headquarters of the Non-official Members of the Committee for the purpose of work of the Committee will be at Roorkee and they will be entitled to TA & DA to and fro their place of residence to the place of meeting as per rules. They will be provided free boarding and lodging during their stay at Roorkee in connection with the work of the Committee. The Chairman of the Committee will be entitled to a fee of Rs 2500/- per sitting day and the members will be entitled to a fee of Rs. 2000/- per sitting day subject to an upper ceiling for payment of sitting fee for the entire tenure of the Committee at Rs. 50,000/- for Chairman and Rs. 40,000/- for Members. The Institute will bear expenditure on this account (including for TA & DA payments for which Director, NIH will act as Controlling Officer).

(S.K. KATARIA)
Under Secretary to the Govt. of India
Tel.No. 23716928

To

1. Shri M. Gopalakrishnan, Ex-Secretary General, ICID, DI/12, Janakpuri, New Delhi-110058
2. Shri A.B. Pandya, Ex-Chairman, CWC, D-2, Sahayadra Apartment, 9-A, I.P. Extension, Delhi-110092
3. Dr. P.P. Majumdar, E-32, Indian Institute of Science Campus, Bengaluru-560012
4. Dr. Saleem Romani, Ex-Chairman, CGWB, 7/2, Amaltash Complex, Sahapura, Bhopal
5. Dr. A.K. Sikka, IWMI, B-1, Tower 10, New Moti Bagh, New Delhi
6. Director, NIH, Roorkee.

File No.11/7/2017-E-II

No. 11/7/2017-E-II

Government of India

Ministry of Water Resources, RD&GR

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Shram Shakti Bhawan, Rafi Marg,

New Delhi, the 8th June, 2018.

ORDER

Subject: Constitution of the Achievements Review Committee to assess the performance of NIH, Roorkee.

The undersigned is directed to refer to this Ministry's Order of even number dated 12.9.2017 on the above subject and to convey approval of the Competent Authority for extension of the time limit for submission of the report by the Achievements Review Committee by another 6 (six) months w.e.f. 12.3.2018.

2. All the other terms and condition stipulated in the order dated 12.9.2017 remains unchanged.

(Amit Kumar Singh)

Under Secretary to the Government of India

To

1. Shri M. Gopalakrishnan, Ex-Secretary General, ICID, DI/12, Janakpuri, New Delhi-110058

2. Shri A.B. Pandya, Ex-Chairman, CWC, D-2, Sahayadra Apartment, 9-A, I.P. Extension, Delhi-110092

3. Dr. P.P. Majumdar, E-32, Indian Institute of Science Campus, Bengaluru-560012

4. Dr. Saleem Romani, Ex-Chairman, CGWB, 7/2, Amaltash Complex, Sahapura, Bhopal

5. Dr. A.K. Sikka, IWMI, B-1, Tower 10, New Moti Bagh, New Delhi

6. Director, NIH, Roorkee

ANNEXURE – II

Highlights of Meetings of Achievements Review Committee

HIGHLIGHTS OF FIRST ARC MEETING

The first ARC meeting was held on 23.10.2017 at NIH, Roorkee. The following ARC members attended the meeting.

Mr. M. Gopalakrishnan (Chairman)
Dr. P. P. Mujumdar
Dr. Saleem Romani
Dr. A. K. Sikka

Mr. A. B. Pandya had expressed his inability to attend the meeting because of pre-occupation. Director and Heads of Scientific divisions at NIH, Roorkee also participated in the meeting. Following are the brief highlights of First ARC meeting.

(1) An overview of NIH was presented by Dr. Sharad Kumar Jain, Director (NIH). Based-upon the presentation, technical discussions were held between ARC members, Director and Heads of Scientific divisions at NIH, Roorkee.

(2) Based-upon the discussions, the following meetings of ARC members were proposed to be held in future -

- Meeting with each scientific division of NIH, Roorkee
- Meeting with all Scientists of NIH, Roorkee
- Meeting with technical staff of NIH, Roorkee
- Meeting with Mr. R. D. Singh, Ex-Director, NIH
- Meeting with Director, IIT-Roorkee
- Meeting with Chairman, Governing Body of NIH and Secretary (MoWR) - at New Delhi
- Meeting with Chairman, TAC (including past CWC Chairmans) - at New Delhi
- Visit of ARC members at 2 or 3 regional centres of NIH (tentatively Belagavi, Guwahati and Jammu proposed)

(3) Terms of Reference of ARC were discussed. It was desired by ARC members that notes on studies/projects to be presented during meeting with scientific divisions may be compiled and provided to ARC members before the second meeting.

(4) Second meeting of ARC is proposed to be held at NIH, Roorkee during 14-15 November 2017 or 13-14 November 2017 depending upon the confirmation from Mr. A. B. Pandya. The following agenda items may be taken-up during the Second ARC meeting -

- Meeting with each scientific division of NIH, Roorkee
- Meeting with all Scientists of NIH, Roorkee
- Meeting with Scientific staff of NIH, Roorkee
- Meeting with Mr. R. D. Singh, Ex-Director, NIH

(5) ARC members made a visit to Nuclear Hydrology laboratory of NIH and appreciated the respective achievements of NIH.

HIGHLIGHTS OF SECOND ARC MEETING

The second ARC meeting was held during 18-19 November 2017 at NIH, Roorkee. The following ARC members attended the meeting.

Mr. M. Gopalakrishnan (Chairman)
Mr. A. B. Pandya
Dr. P. P. Mujumdar
Dr. Saleem Romani
Dr. A. K. Sikka

The following meetings were held during 18-19 November 2017.

(1) Meeting with Scientists and Scientific Staff of Surface Water Hydrology division
(2) Meeting with Scientists and Scientific Staff of Ground Water Hydrology division
(3) Meeting with Scientists and Scientific Staff of Water Resources Systems division
(4) Meeting with Scientists and Scientific Staff of Environmental Hydrology division
(5) Meeting with Scientists and Scientific Staff of Hydrological Investigations division
(6) Meeting with Scientists and Scientific Staff of Research Management and Outreach division
(7) Meeting with Mr. R. D. Singh, Ex-Director, NIH
(8) Meeting with all Scientists of NIH, Roorkee
(9) Meeting with all Scientific and Technical Staff of NIH, Roorkee

[A] A dossier related to achievements of six scientific divisions during the period 2010-2017 was provided to ARC members. During the meetings with six scientific divisions, Heads of the respective divisions made a power point presentation highlighting achievements of the division during the period 1.4.2010 to 31.3.2017. It was followed by discussions, comments and suggestions by ARC members. Many suggestions were made by ARC members on the studies presented by the divisions. Few of the salient suggestions are indicated below.

Surface Water Hydrology

- Extension of scope of Terms of Reference of consultancy projects, if considered beneficial for the study.
- Emphasis to deterministic aspects in studies pertaining to surface water hydrology.
- More emphasis on yield and consumptive usages, hydrometeorology.
- Consolidation of extensive consultancy studies for finding overall trends and policies for design and safety evaluation.
- Development of calibration guidelines of MIKE and HECRAS packages in different contexts.
- Development of 'Integrated Water Supply Index' rather than individual drought index.
- Specific studies on forestry related hydrology.
- Explore why the extreme monsoon spells occur over the country.
- Need for close interaction with IMD by surface water hydrology division.

Ground Water Hydrology

- Identification of deep confined aquifers for arsenic free groundwater.
- Management of arsenic affected water.
- Generalization of web-based conjunctive use model for applicability in canal command areas.
- Usage of urban floods for groundwater recharge.
- More emphasis on groundwater studies in hard rock areas.
- Assessing rechargibility of aquifers.
- Coordination with CGWB for arsenic and other related groundwater studies.
- Inclusion of a hydrogeologist in ground water hydrology division.

Water Resources Systems

- Enhancing efficiency of water use.
- Sharing results of hydrological studies with related tribunals.
- Linking 'Hydrology and Water Resources Information System for India' with India-WRIS.
- Study of impacts of glacier advance over a sediment bed.
- Interaction with other institutes on cryospheric studies.
- Coordination with CWC for 'Web GIS application for hydrological information'.

Environmental Hydrology

- Confirmation of water quality sampling - whether from unconfined or confined aquifers.
- Inclusion of water quality modelling studies in environmental hydrology division.
- Submission of a proposal for study on greenhouse gas emissions due to hydropower plants.
- Examination of physical reasoning of (time and space) variation in water quality parameters.
- Studies on silting and pollution transport/diffusion for surface water and groundwater.
- Regulation pertaining to fluoride removal technology developed by the Institute.
- Need for strengthening the environmental hydrology division.
- Inclusion of an ecology expert in environmental hydrology division.
- Engagement of retired and other experts on contract basis.

Hydrological Investigations

- Segregation of beneficial and non-beneficial evapotranspiration losses.
- Integration of isotope works with other divisions.
- Inclusion of aquatic biology and ecology experts in the division.
- Institutional MoU for expert manpower.
- Better spread of studies over the country.
- Involvement in IRPID (International Research Program for Irrigation and Drainage) of ICID for international collaboration.

Research Management and Outreach

- Review and revision of "Water Conservation Awareness - A Training Manual for Trainers" and inclusion of references.
- Development of NIH Hydrology Model under 'Make in India'.
- Assigning due priorities between research activities and peripheral coordination activities.

General

- Listing of technical papers pertaining to only reputed journals.
- Participation in ICID activities through Direct Membership.

[B] In the meeting of ARC with all Scientists at headquarters (Roorkee), the following issues were expressed by the Scientists.

- Increasing hydrological problems and assignments with limited manpower.
- Need for increase in scientific manpower strength and augmentation of divisions.
- Uplifting the position of Director, NIH.
- Provision of pension for NIH employees.
- Increasing the retirement age of Scientists from 60 to 62 years.
- Gradation of marking structure in APAR (Annual Performance Appraisal Report) - presently same for all grades from B to G.
- Provision of professional allowance.
- Flexibility in restricted number of permissible man-days in consultancy projects.
- Relaxation in bank guarantee / surety for availing study leave abroad.
- Allowing travel by any airlines in case of sponsored and consultancy projects.
- International cooperation for restricted areas in Himalayas.

ARC members also expressed their views/suggestions on few relevant matters.

- Implementation of earlier ARC recommendations.
- Comparison with other similar organizations to decide minimum manpower requirements at headquarters and each regional centre.
- R&D to be assigned more importance than 'earning' through projects.
- Striving hard to raise the level of NIH equivalent to the Centre for Ecology & Hydrology (CEH), UK.
- Mentoring the junior Scientists by the senior Scientists.
- Developing good work place culture and ambience.
- Working for newer hydrological areas such as urban floods, climate change, concurrent extremes etc. while continuing with the older areas.
- Development of 'sense of sharing' (expertise, knowledge, resources).
- Solving hydrological problems of the country through hard work on applied research.
- Enhancing the image of NIH instead of limiting to individual interests.

[C] In the meeting of ARC with all scientific and technical staff at headquarters (Roorkee), the following issues were expressed by the scientific and technical staff.

- Provision of pension for NIH employees.
- Re-employment of retired persons.
- More involvement of scientific staff in technical studies (besides data computerisation and GIS).
- Participation and capacity building of scientific staff in hydrological modelling.
- Training of scientific staff on specific topics.
- Promotion policy for staff members on the pattern of CSIR.
- Promotion avenues for technicians.
- Increase in retirement age of staff members.

ARC suggest to submit proposal for cadre re-structuring.

[D] ARC members also interacted with Mr. R. D. Singh, Ex-Director, NIH. He apprised ARC about the developments undertaken during the review period of ARC (2010-2017) and further suggestions.

- Average age of Scientists increasing; mentoring as well as succession line assurance may suffer leading to erosion of output.
- Lack of staff at regional centres.
- Implemented few recommendations of earlier ARC.
- Introduced Scientist 'G' post in NIH for promotion under modified FCS (Flexible Complementing Scheme for Scientists).
- Formulated rules for Consultancy Projects.
- Improved the infrastructural facilities in the Institute.
- Scope for further strengthening of the laboratories, library etc.
- Need for full-fledged Senior Administrative Officer, Finance Officer, Procurement Officer, Hindi Officer (presently looked-after by Scientists affecting their research works).
- Need for improvement in technical interaction between Scientists of the Institute.
- Need for hiring of software development group.

ARC members also expressed their views/suggestions on few relevant matters.

- Installation of advanced equipment in representative basins.
- Exploring reduction in the number of regional centres based upon non-performance due to lack of man power.
- Hiring of consultants on contractual basis to support SAO, FO etc.
- Presentation and discussion of selected studies in 'User Conference' during India Water Week.
- More interaction with academic institutes with involvement of students (such as NITs).
- Internship program in Hydrology.
- Usage of remote sensing and GIS techniques to build good macros and subroutines for development of software tools.

[E] Wrap-up Meeting

- Inclusion of multi-disciplinary experts in various fields.
- Depiction of geographical spread of studies undertaken and taking-up studies in left-out areas.

- Involvement of NIH in BRICS multilateral projects.
- Intertwining with other countries for collaboration in hydrological research.

It was decided that third meeting of ARC may be held on 27 January 2018 at Hard Rock Regional Centre, National Institute of Hydrology, Belagavi (Karnataka).

HIGHLIGHTS OF THIRD ARC MEETING

The third ARC meeting was held on 31 January 2018 at CWC, New Delhi. The following officers attended the meeting.

ARC Members:

Mr. M. Gopalakrishnan (Chairman)
Mr. A. B. Pandya
Dr. P. P. Mujumdar
Dr. Saleem Romani
Dr. A. K. Sikka

NIH Scientists:

Dr. Sharad Kumar Jain (Director)
Dr. N. C. Ghosh (Head - Ground Water Hydrology Division & Coordinator - Bhopal Regional Centre)
Dr. Rakesh Kumar (Head - Surface Water Hydrology Division & Coordinator - Patna and Guwahati Regional Centres)
Dr. C. K. Jain (Head - Environmental Hydrology Division)
Dr. Sudhir Kumar (Head - Hydrological Investigations Division)
Dr. Sanjay Kumar Jain (Head - Water Resources Systems Division)
Dr. V. C. Goyal (Head - Research Management and Outreach Division)
Dr. J. V. Tyagi (Coordinator - Kakinada and Belagavi Regional Centres)
Mr. C. P. Kumar (Scientist G)

Special Invitees:

Mr. N. K. Mathur (Member - D&R, CWC)
Mr. Pradeep Kumar (Member - RM, CWC)
Mr. S. K. Chaturvedi (Director - R&D, MoWR)
Dr. Man Singh (Project Director, WTC, IARI, New Delhi)
Dr. A. K. Keshari (Professor, IIT-Delhi)
Dr. Neelima Alam (Scientist E, DST)

Dr. S. Kerketta (Director - IA, MoEF&CC) had expressed his inability to attend the meeting in view of health problem. ARC regret that no officer from Central Ground Water Board attended the meeting.

Mr. M. Gopalakrishnan (Chairman, ARC) apprised about the constitution of ARC and its Terms of Reference. After self-introduction by the participants, the following agenda items were presented/discussed during the meeting -

(1) Brief presentation by Director, NIH regarding overview of research activities during last 7 years (2010 - 2017)
(2) Discussion on water resources problems in India
(3) R & D challenges in water resources sector
(4) Future vision: Research needs during next 5 - 10 years
(5) How to strengthen coordination between NIH and other R&D organizations under MOWR

Based-upon the deliberations, the following suggestions/comments were made by Special Invitees, ARC Members and NIH Scientists.

- NIH may attempt to have the repository of exploration studies (such as glaciers) done by other organizations.
- Demarcation of flood inundation area corresponding to river levels attained.
- NIH may coordinate at a national level group to obtain disaster data/information (such as earthquake, floods) for quick assessment of the situation.
- Development of a commonly accepted protocol in case of floods and other disasters - what type of data to be immediately collected and linkages with related organizations.
- Establishment of AWS with Eddy Covariance Flux Tower and COSMOS (Cosmic-Ray Soil Moisture Observing System) in various states in the country.
- Formulation of research teams to utilize data obtained from advanced instrumentation for analysis at the basin scale.
- More representative/experimental basin studies with advanced/high-tech instrumentation.
- Upscaling of IWRM studies (done at watershed scale) to other areas.
- 'Integrated' concept of IWRM (being done at micro-basin scale) should be applied in more rational manner.
- Analysis for resolving the conflicts of upstream and downstream areas.
- Assessment of groundwater scenario is essential for any policy planning related to water resources.
- More collaboration with CGWB for groundwater studies.
- DST Technology Mission on Winning, Augmentation and Renovation (WAR) has undertaken research-led solutions, through a coordinated approach, to come out with technological options for various water challenges in different parts of the country (such as water availability, rainwater harvesting, seawater intrusion, drinking water for rural hamlets, arsenic problem, litigation etc).
- NIH should undertake hydrological solutions to water resources issues, such as estimation of hydrological parameters for climate change scenario; surface water and groundwater interaction; manage the hydrological delays and diversions etc.
- Officers from CWC opined that NIH should undertake hydrological solutions (and not the water management solutions) and to concentrate more on applied research (rather than fundamental research). However, IIT Professor stressed the importance of basic research along with applied research.
- Collaboration with other organizations for hydrological problems at the basin scale.
- Solution models at field scales. Implementation of research outputs in the field.
- How to enforce water laws in the country?
- How to increase the irrigation application efficiency? Pilot studies on irrigation efficiency.

- In-situ remediation of arsenic in groundwater.
- Effect of urban development on river morphology.
- Explore groundwater recharge through recharge wells after de-siltation of rivers.
- Action research by NIH, to be the hub of interaction between various water resources agencies.
- NIH should become a facilitator for hydrological research in India.
- Capacity building for bridging the gap.
- More manpower at Regional Centres of NIH.
- Urgent need for investment in human resources and trainers' training.
- Implementation of IoT (Internet of Things) for data communication and other hydrological services.

ARC members subsequently had a meeting with Mr. S. Masood Husain (Chairman and Member - WP&P, CWC). He stressed that CWC works should be supplemented by NIH. He also suggested revising the objectives of NIH with respect to present water resources needs.

It was decided that fourth meeting of ARC may be held during 16-17 March 2018 at Hard Rock Regional Centre, National Institute of Hydrology, Belagavi (Karnataka).

HIGHLIGHTS OF FOURTH ARC MEETING

The fourth ARC meeting was held on 4 April 2018 at Central India Hydrology Regional Centre, National Institute of Hydrology, Bhopal. The following officers attended the meeting.

ARC Members:

Mr. M. Gopalakrishnan (Chairman)
Dr. P. P. Mujumdar
Dr. Saleem Romani
Dr. A. K. Sikka

Special Invitees:

Director (WALMI, Bhopal)
Dr. N. S. Raghuwanshi (Director, MANIT-Bhopal)

NIH Scientists:

Dr. Sharad Kumar Jain (Director)
Dr. N. C. Ghosh (Coordinator - Bhopal Regional Centre)
Mr. C. P. Kumar (Scientist G)
Dr. Renoj J. Thayyen (Scientist D)
Dr. Tejram Nayak (Head - Bhopal Regional Centre)
Mr. Ravi Galkate (Scientist E)
Dr. T. Thomas (Scientist D)
Mr. R. K. Jaiswal (Scientist D)
Mrs. Shashi P. Indwar (Scientist C)

After introductory remarks by Chairman (ARC), Director (NIH) and self-introduction by Scientists and staff members of the Bhopal regional centre, the deliberations were initiated. Following are the brief highlights of fourth ARC meeting.

[A] Dr. Tejram Nayak, Head (Bhopal Regional Centre) made a power point presentation highlighting overview and achievements of the Bhopal Regional Centre during the period 1.4.2010 to 31.3.2017. Few of the salient suggestions and comments of ARC members are indicated below.

- Minimum scientific strength is required at each regional centre. Internal adjustments can be made by Director (NIH).
- More representation from Rajasthan may be included in Regional Coordination Committee (RCC) of Bhopal Regional Centre. Members not attending the RCC meetings may be replaced.
- Showcase the research done (and applicability at field level) to stakeholders.
- Tour programs of Scientists and scientific staff of the regional centre (for tours within the jurisdiction of regional centre) can be approved by Head of the regional centre.
- Avoid publishing papers in predatory journals.
- Financial power of Head of regional centre may be increased from the existing Rs. 2,000 to at least Rs. 15,000.
- ARC acknowledged the very small working space of the regional centre. It was suggested that letter may be written by MoWR to concerned state authority for pursuing the land case of regional centre.

[B] Subsequently, few technical studies were presented by Mr. R. K. Jaiswal and Dr. T. Thomas. It was followed by discussions, comments and suggestions by ARC members. Few of the salient suggestions are indicated below.

- Select high priority ERU (erosion response units) for catchment area treatment.
- Monitoring the implementation of catchment area treatment measures and validating the impacts.
- Define most critical drought prone areas. NIH, IWMI and ICAR can work together for drought management plans - contingency plans and long term management of drought. Bundelkhand region may be taken as a drought management study.
- Integration of Scientists from headquarters and regional centres on few core projects (such as droughts).
- Development of drought indices for policy makers.
- Assessment of role of Bargi reservoir in countering the problems due to climate change.
- Need for conjunctive use in Bargi canal command and Narmada basin wherever potential confined aquifers are available.
- Explore (through studies) using only groundwater in upper canal reaches.
- Understand the shallow and deep aquifers and explore possibility of using deeper aquifers.
- Study the ecological impact of tapping groundwater from deeper aquifers.
- Utility of inter-basin water transfer for augmenting the water supply for welfare of farmers.
- Study the water quality aspect of various colonies in Bhopal affected by gas tragedy.

- Synergizing the efforts of various related organizations.
- Memorandum of Understanding (MoU) between NIH-Bhopal and WALMI to take-up joint programs.
- Collaboration between Bhopal Regional Centre of NIH and Maulana Azad National Institute of Technology, Bhopal such as collaborative guidance to research scholars and M.Tech. students and joint research programs specifically with respect to drought management studies.

[C] During interaction with ARC members, the following issues were expressed by the Scientists of Bhopal Regional Centre.

- Lack of infrastructure facilities such as very limited office space.
- Lack of sufficient supporting staff.
- Lack of subscribed journals and licensed software.
- Need of international trainings for the Scientists for updation of knowledge.
- Need for strengthening of laboratories.
- Need for strengthening of library with more reports, books and journals.
- Non-availability of vehicle for field visits.

ARC members also expressed their views/suggestions on few relevant matters.

- High level meetings with policy makers to implement the research results.
- NIH can become Institutional Member of ICID to access the journals.
- Also pursue with Ministry of Human Resource Development (MHRD) to access the journals.
- Collaboration with MANIT-Bhopal for the journals.
- Vehicles can be hired for field visits.
- Identify advanced topics and arrange trainings through faculty from academic and research institutes.

[D] During the concluding session of the meeting, various other issues were also discussed with ARC members. Following are the issues raised and suggestions/comments of ARC members.

- Set high goals and prepare vision and mission document.
- Assess the performance of regional centres.
- Post of Director (NIH) may be upgraded. And there can be a Joint Director (for regional centres).
- Posts of SAO and FO may be upgraded to attract suitable persons.
- Requirement of Documentation Officer and Procurement Officer was also raised. It was suggested to hire consultants, wherever feasible.
- Recommendation to make NIH at par with institutes such as those associated with Ministry of Earth Sciences.
- Efforts to reduce the number of committees/meetings.
- Provision of utilizing the Professional Development Fund (created from sponsored projects) to present the papers abroad.
- The issue of post-retirement medical facilities (from the interest of R&D support fund) was also raised and discussed.

The meeting ended with a vote of thanks to the Chair.

HIGHLIGHTS OF FIFTH ARC MEETING

The fifth ARC meeting was held on 11 July 2018 at International Commission on Irrigation & Drainage (ICID), New Delhi. The following officers attended the meeting.

ARC Members:

Mr. A. B. Pandya
Dr. P. P. Mujumdar
Dr. A. K. Sikka

NIH Scientists:

Dr. N. C. Ghosh (Scientist G)
Mr. C. P. Kumar (Scientist G)
Dr. Renoj J. Thayyen (Scientist D)

[A] Draft chapters of ARC report were provided to ARC members (soft copy sent to them earlier). ARC members examined various chapters and made the following suggestions.

- Relevant Office Orders from MoWR (regarding ARC) may be appended as Annexure-I of ARC report.
- Highlights of all ARC meetings may be appended as Annexure-II of ARC report.
- Chapters 3 and 4 of the draft report may be merged and re-titled as "Review of Activities of NIH".
- Section on "Observations and Suggestions of ARC" may be put at the end of relevant chapters.
- Chapter 5 may be retitled as "Roles of Different Advisory Mechanisms".
- ARC proposed the following suggested composition for Standing Committee of Governing Body.

Additional Secretary, MoWR (Alternate: Member (D&R), CWC)	- Chairman
JS, MOWR	- Member
Director, Finance, MoWR	- Member
Representative of DST (not below the rank of JS)	- Member
Director (NIH)	- Member-Secretary

- NIH can make above modifications in the draft report for further finalization by ARC members.

[B] Following suggestions were also made by ARC members.

- In TAC meetings, MoWR/CWC/CGWB may suggest what strategic solutions/studies are required to be carried out by NIH.
- In Working Group meetings, few practicing engineers from states may be invited and their travel expenditure can be borne by NIH.
- NIH should have FCRA registration to receive funding from abroad.

- Smoother mechanism should be established to receive funds from international projects.
- Minimum strength of Scientists at each regional centre should ideally be 8 but at least 5 at all times.
- Provision of sabbatical to NIH for a period of 6 months to one year for specific projects.
- Need-based supplementation of manpower (Research Fellowship) under the head of Operational/Personal costs.

[C] During the concluding session of the meeting, few other issues were also discussed with ARC members.

- The issue of post-retirement medical facilities.
- Upgradation of the post of Director (NIH) to the Level 15 (as per Seventh Pay Commission).

The meeting ended with a vote of thanks to the Chair.

ANNEXURE - III

Status of Activities during 12th Plan Period

S N	Item	Status & justification for activities not completed
i.	**Research Studies & Activities in the field of Hydrology**	
1.	**Hydrology of Extremes** • Flood management • Urban flooding • Drought mitigation and management • Glacier lakes outburst flood • Early warning systems	Undertaken
2.	**Environmental Hydrology** • Pollution from point and non-point sources • Water quality and health • Environmental flow in rivers • River bank filtration studies • Water treatment/remediation technologies	Undertaken
3.	**Regional Hydrology**	Undertaken
4.	**Integrated Water Resources Management (IWRM)** • Hydrology for sustainability of water sources • Integrated operation of reservoirs • Groundwater management • Conjunctive use of surface and ground water • Pilot basin studies • DSS (Planning) activities • Hydrological studies in Brahmaputra basin	Undertaken
5.	**Hydrology for Watershed Management** • Forest hydrology • Hydrology for springs management • Hydrology of lakes and other water bodies • Water management in mined areas • Water management in salinity-affected areas • Water management in coastal and hard rock aquifers • Impact assessment studies	Undertaken
6.	**R&D Under National Water Mission** • Development / implementation of modern technology for measurement of various data • Research and studies on all aspects related to impact of climate change on hydrologic cycle and water resources, including quality aspects • Projection of the impact of climate change on water resources • Dynamics of deeper aquifers • Centre for Climate Change Studies • Centre for Snow & Glacier Studies	Undertaken Undertaken Undertaken Could not be established due to non-availability of additional

		manpower
7.	**Benchmarking and technological up-gradation**	A proposal of restructuring of NIH under consideration of MoWR, RD & GR
8.	**Capacity building of NIH Scientists and staff**	Done
9.	**Technology Transfer and Outreach Activities** • Training workshops • Seminars/symposia • User interaction workshops • Science-policy interface • IPR issues in hydrology and water resources • PPP linkages	Undertaken 1 patent application filed Not yet established
ii. Procurement of equipment /software for strengthening of capabilities and facilities in NIH (Estimated Provision: Rs. 23.15 crore)		
	▪ S&T equipment/products (e.g. lab & field equipment, satellite data products, IT equipment including computers, Laptops/ notebooks, servers, printers, & general as well as Hydrological applications software) for labs and Pilot Basin Studies ▪ Office equipment (e.g. photocopier, fax, scanner, UPS, binder, vacuum cleaners) ▪ Auxiliary equipment (e.g. communication facility, generators, ACs, Audio Visual equipment, water purifiers, deep freezers, heaters, security systems, biometric attendance system, green energy facility, horticulture equipment) ▪ Technical upgradation and benchmarking of laboratories ▪ Upgradation of NIH Library and Documentation facilities ▪ 'Water-on-wheel' exhibition van	Procured Procured Procured Done Partially done Van could not be procured due to ban imposed by GoI
iii. Upgradation / creation of basic infrastructure (Estimated Provision: Rs. 20.50 crore)		
	• Renovation of existing buildings, labs, additional rooms, etc. • Infrastructure & staff welfare facilities at HQs (e.g. Centres for Climate Change Studies, Snow & Glacier Studies, Hydrological Instrumentation Facility, Water Activity Centre, Software Development Centre, Technology Transfer & Outreach Unit, seminar/conference facilities, tube well, modernization of canteen, rainwater harvesting facility) • Infrastructure & staff welfare facilities at staff colony (e.g. emergency medical aid unit, day care centre for employees' kids, garages, tube wells, HT substation) • Purchase of land & construction of office buildings at RC-Belgaum, RC-Bhopal and CFMS (Guwahati) • Lease/hiring of office buildings at RC-Jammu, RC-Belagavi, RC-Bhopal and CFMS (Guwahati) • Lease/hiring of Liaison & Co-ordination unit at Delhi • Renovation of office buildings at RC-Kakinada and	Undertaken Only modernization of canteen and rainwater harvesting facility established Day care centre, tube wells, and HT substation could not be established Purchase of land in progress for RC-Bhopal. Completed Completed Not completed

	CFMS (Patna) • Furniture, fixtures, furnishings at HQ/RC/CFMS • Replacement of old vehicles at HQs & RC/CFMS	Completed Replacement of vehicles not approved by MoWR, RD & GR
iv. Establishment (Estimated Provision: Rs. 27.30 crore)		
	• Salary of i. Continuing Plan posts (Rs. 11.67crore) ii. Additional posts of Scientists (Rs. 11.52crore) • Domestic, foreign travel, including hiring of vehicles (Rs. 4.11crore)	Additional posts of Scientists not released
v. Operative Cost (Estimated Provision: Rs. 18.65 crore)		
	Wages (Rs. 11.57crore) I. On contract i. Research Chairs ii. Institute Research Interns iii. Visiting Scientists (upto 4 months/year) iv. Emeritus Scientists v. Administrative staff (consultant, retainership basis, etc.) II. Hiring of Professional Services for software development, IPR, IEC, management/technology commercialization, e-Governance, documentation/ communication, capacity building & training, instrumentation, advanced modeling applications III. Outsourcing for housekeeping, security, vigilance, office & field assistance	 These contractual scientific positions could not be filled due to budget cut Completed as per requirement Completed as per requirement
	Other Recurring Items (Rs. 7.08 crore) i. O&M costs of equipment, vehicle, furniture, etc. ii. Organisation of Training Workshops/seminar/ symposia iii. Printing & stationery iv. Rents, rates and taxes v. Fee to attorneys, auditors, etc. vi. Postage, communications & others	Completed as per requirement

ANNEXURE-IV

Salient Achievements during 12th Plan Period

I. Contribution to MoWR, RD & GR Programmes

1. Inter-linking of Rivers

a. Hydrological Study of Ken-Betwa Link
b. Simulation Study of Mahanadi-Godavari Link
c. Study of Sankh- South Koel- Subarnarekha Link

In the above studies, NIH has done hydrological analysis and multi reservoir simulation.

2. Studies in Ganga Basin

a. Under a DST funded project "National Mission for Sustaining Himalayan Ecosystem (NMSHE)", NIH is executing various studies covering the theme of "Integrated Hydrological Studies for Upper Ganga Basin up to Rishikesh".
b. Cumulative Impact Assessment of Hydropower Projects in Upper Ganga Basin
   Under this project, the cumulative impact of hydropower projects in Upper Ganga Basin on various components of environment is being studied.
c. E-Flow assessment for Upper Ganga basin through habitat simulation modeling
   A methodology that involves simulation of aquatic habitats is being applied for assessment of environmental flows.
d. Four schemes to demonstrate effectiveness of 'Riverbank Filtration' for sustainable drinking water supply in different hydrogeological settings are being developed. After investigations, these schemes will be handed over to state 'Jal Sansthans':
   i. Uttar Pradesh (Mathura and Agra along Yamuna river)
   ii. Bihar (Arrah site in Bhojpur area along Ganga river)
   iii. Andhra Pradesh (Visakhapatnam area)
   iv. Jharkhand (Sahebganj along Ganga river)

3. National Hydrology Project

NIH is coordinating purpose driven studies (PDS) to address specific issues of water management problems. So far, twenty-seven PDS have been initiated with states on various issues pertaining to lakes, reservoir operation and sedimentation, water quality, springs, characterization of deep aquifers, groundwater dynamics, arsenic affected aquifers etc. Also, a number of training and capacity building programs have been organized.

As part of Hydrological Modelling efforts, three studies have been initiated (i) Integrated assessment of the impacts of climate change on the hydrology of Narmada basin through hydrological modelling approaches, (ii) Integrated management of water resources for quantity and quality in Upper Yamuna Basin upto Delhi, and (iii) Development and testing of a large-scale conceptual hydrological model (jointly with IIT Kharagpur).

4. Pradhan Mantri Krishi Sinchayee Yojana

a. Watershed Development: Neeranchal National Watershed Project

Developing a Decision Support System (DSS-Hydrology), to be used by the State Level Nodal Agencies (SLNA) of 9 participating Indian States for implementation of the Watershed Component of PMKSY at micro-watershed levels in selected project areas, both for watershed development planning and impact assessment

b. Rejuvenation of village ponds in Uttarakhand and Uttar Pradesh

Rejuvenated a village pond in Haridwar district (Uttarakhand) and undertaking rejuvenation of 22 village ponds in identified villages of Western UP using Natural Treatment Systems

c. Integrated Water Resources Management (IWRM) planning in Bundelkhand

Developed IWRM Plan for 4 watersheds in Tikamgarh, Chhatarpur, Jhansi and Lalitpur districts of Bundelkhand region, to be used by the respective DMs and line departments as inputs in the District Irrigation Plan-PMKSY

5. Water Availability and Basin Planning

a. Contributed to the Report on World Class Protocol for Water Resources Assessment (WRA), prepared by a committee constituted by MoWR, RD & GR
b. Water Availability and Reservoir Operation for Krishna Basin
   In this study, water availability was assessed at all major projects and important gauging sites in the Krishna basin. Multi reservoir simulation was carried out for developing procedures for operation of reservoirs so that each party state gets their share as per the tribunal award.
c. Participating in the Water Accounting+ initiative of MOWR: Using advanced techniques for water accounting and computing various indices
d. Developed hydrological indices for drought management and contributed in the preparation of Manual for Drought Management, published by the Ministry of Agriculture and Farmers Welfare (2016)

II. Contribution to the Key Infrastructure Sectors

a. Completed carrying capacity studies for two projects
b. Estimated GLOF design flood for eight projects
c. Cumulative Impact assessment-Upper Ganga basin
d. Conducted flood safety evaluation of Nuclear Power Plants at Gorakhpur (Haryana), Chutka (MP), Banswada (Rajasthan), Kaiga (Karnataka) and Narora (UP)
e. Conducted area-drainage studies for 8 thermal power plants
f. Assessed impact of ash disposal from STPPs (Ramgundam)
g. Prepared riverfront development plan for Vadodara city
h. Estimated railway bridge/design flood for Chardham Connectivity
i. Prepared Emergency Action Plan for ten hydro-power projects

j. Completed dam break analysis studies of 10 dams for NTPC & NHPC

III. Studies for NE Region

a. Hydraulic modeling of Brahamputra riverfront development project for Guwahati city
b. Dam break flood wave simulation and preparation of Emergency Action Plans (EAPs): Teesta-V; Rangit; Teesta Lower dam; and Lachung dam, Sikkim
c. Developed regional flood frequency relationships for estimation of floods of various return periods for gauged and ungauged catchments of North Brahmaputra and South Brahmaputra Subzones
d. Ground Water Quality and Risk Assessment of Metal Pollution in Kulsi River Basin
e. Arsenic Contamination in Ground Water of Nalbari and Barpeta Districts, Assam

IV. Software Development

1. **NIH_ReSyP (NIH_Reservoir Systems Package)**
   Operation analysis of multi-reservoir system

2. **NIH_SNOWMOD (Model for Snow-melt Modeling)**
   Model for simulation of snow-melt runoff from snow/glacier areas

3. **WEGREM**
   Web-enabled groundwater recharge estimation model

V. Research Stations in the Himalayas

1. Conducting experimental research in Indus basin at Ladakh and Shyok (for BRO), and at Gangotri Glacier
2. Established an experimental catchment on Henval river near Tehri Dam for detailed study of hydrological processes. Besides hydromet instruments, in collaboration with Centre for Ecology and Hydrology (CEH), Wallingford (UK), a COsmic-ray based Soil MOisture Sensor (COSMOS) is also installed at this site for in-situ measurement of soil moisture
3. Collaborated with Carleton University, Canada for Permafrost research in the Himalayas

VI. Fostering International Collaboration and Outreach

1. Successfully participated in EU funded “SAPH PANI” Project, with 9 countries and 11 Indian partners, on the theme of “Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India”
2. Established research collaboration with CEH (UK) in the fields of COSMOS-India national soil moisture monitoring system, Ecological flows assessment, Indian Hydrological Outlook system at national scale, Rejuvenation of village ponds, NIH-

CEH Modeling Centre, Water resources modelling and assessment under climate and land use change (Narmada basin)
3. Hosting Secretariat of Indian National Committee on International Hydrological Programme of UNESCO (INC-IHP)
4. Submitted proposal for establishment of a UNESCO Category-II Regional Centre on "Water and Environment for South Asia"

VII. Inputs In Policy Making

1. Prepared Policy Documents on Arsenic Mitigation, and Salinization of Land in Coastal Areas
2. Developed a plan on the use of treated wastewater from STPs in Delhi for groundwater recharge (MAR) at identified locations in NCT Delhi
3. Flood Plain Zoning Plans for Haridwar and Uttarkashi (Uttarakhand)
4. Tackling Water Logging Problems in Canal Commands – Saryu Nahar Pariyojna
5. Monitoring of potential hazards of Industrial Development in Singrauli Area
6. Contributed in the preparation and review of Standards by Bureau of Indian Standards: NIH has prepared an International standard on "Measurement of liquid flow in open channels- Stage-Fall-Discharge relationship (ISO 9123)", and contributed in the finalization of a standard on "Guidelines for measurement and control of sediments in natural lakes".

VIII. Capacity Building and Outreach Activities

1. Conducted about 120 training courses, and trained nearly 3600 people, mainly from Central and State Governments
2. Prepared a short film on "Water Conservation"
3. Publishing magazines "**जल चेतना**", "**प्रवाहिनी**", and a newsletter "Hydrology for People"
4. Prepared a TOT Manual on "Water Conservation Awareness"

IX. Consultancy Projects for Private & Public Sectors, Central and State Organizations

NIH undertakes consultancy works pertaining mainly to the projects in the water resources sector. In addition, the investigations carried out for the different private, public sector, central and state organizations (WAPCOS, UP State Water & Sanitation Organization, Maharashtra Pollution Control Board, NTPC, NHPC, ONGC etc.) have contributed to arrive at a safe and economical solution for the problems.

NIH has rendered its consultancy services to other sectors also particularly to the organizations such as, NPCIL, NHAI, Coal and Copper mines, etc. for works related to the fly ash characterization, foundation competency of the thermal and nuclear power stations and open dump coal mines, respectively. At times, the consultancy works provide a basis for the research work at NIH. Quite often the consultancy work is not a routine exercise and involves an element of research. Sometimes, for better insight into the problem, extra analyses i.e., what is not asked for by the client, is done. Many times, data pertaining to several consultancy works is collated and upon analyzing the same, the research work is produced.

X. Training and Dissemination of Knowledge

Through organization of the Training Courses and otherwise, NIH shares knowledge with the wider section of practicing engineers from India and also those from other countries such as countries in Africa, and Sri Lanka. Many Indian students benefit from NIH expertise in their research work. NIH officers guide B. Tech., M. Tech. and Ph.D. scholars from institutions, including IITs. NIH Scientists are frequently invited as external examiner for viva voce of B. Tech., M. Tech. and Ph.D. candidates. They are also on the Editorial Boards and Reviewer Panels of reputed journals.

XI. Other Important Works

NIH also contributes its bit to the following:

- Activities of Bureau of Indian Standards.
- Training of in-service professionals.
- Representing India's interests (at national and international levels)
- Leader of Pollution investing Team
- As Neutral expert in case of a dispute

XII. Awards received by NIH

- Rajbhasha Kirti Puruskar awarded by Hon’ble President of India for publishing the Hindi Magzine “Jal Chetna” on the occasion of Hindi Divas Samaroh held on 14th September 2016.
- NIH Scientists have received awards by different national/international journals and in seminar/symposia.

XIII. Bench Marking of NIH

The Benchmarking of NIH was undertaken and the report is under consideration at MoWR, RD & GR.

ANNEXURE - V

Research Studies Conducted during 2010-11 to 2016-17

1. Modelling of Pesticide Transport in Ground Water – A Case Study of Metropolitan City Vadodara (2007 - 2010)
2. Impact of Climate Change on Dynamic Groundwater System in a Drought Prone Area (2009 - 2012)
3. Impact of Kumbha Mela 2010 on Water Quality of Surface Water and Ground Water Resources in and around Haridwar City (2010-11)
4. Spatial Variability of Ground Water Quality in Jammu, Kathua and Udhampur Districts, J&K (India) (2011-12) (2010 - 2012)
5. Quantification of Impact of Rainwater Harvesting on Groundwater Availability in Aravalli Hills (2010 - 2012)
6. Study of Variability of Snow and Glacier Contribution in Melt Water of Gangotri Glacier at Goumukh using Isotopic Techniques (2010 - 2013)
7. Identification of Recharge Zones of Some Selected Springs of Uttarakhand (2010 - 2012)
8. Assessment of Water Quality of Hindon River Basin (2011 - 2014)
9. Managed Aquifer Recharge (MAR) and Aquifer Storage Recovery (ASR) (2011 - 2015)
10. Ground Water Quality Mapping and Surveillance for Safe Water Supply in District Haridwar (Bahadrabad Block) (2012 - 2013)
11. Hydrological Instrumentation and Data Monitoring Planning for Integrated Water Resources Management (IWRM) of the Bina River Pilot Basin (2012 - 2013)
12. Status Report on Ionic Enrichment Dynamics of Glacial Sediment and Meltwater of Gangotri Glacier (2013 - 2014)
13. Water Quality Modelling Using Soft Computing Techniques(2013 - 2014)
14. Development of Low Cost Media for Fluoride Removal from Drinking Water of Fluoride Affected Areas (2013 - 2014)
15. Estimation of Specific Yield and Storage Coefficient of Aquifers (2013 - 2015)
16. Estimation of Radon Concentration in Waters and Identification of Paleo-groundwater in Part of Punjab located in Satluj River Basin using Isotopes (2013 - 2015)
17. Isotope Studies for the Identification of Different Aquifer Groups and their Dynamics in Upper Yamuna River Plains (2013 - 2016)
18. Water Quality Modelling using Soft Computing Techniques(2014 - 2016)
19. Sub-marine Groundwater Discharge and Intrusion in Coastal Aquifers of East Coast, India (2014 - 2016)
20. Status Report on Phytoremediation of Wastewater(2015 - 2016)
21. Web Enabled Groundwater Recharge Estimation Model (WE-GREM) (2015 - 2016)
22. Isotopic investigation of Benchmark Himalayan Glaciers (2015 - 2016)
23. Alternate Water Supply Management Strategies in Arsenic Affected/Vulnerable Areas: Mapping of Arsenic affected Zones/Regions in Eastern U.P. (2015 - 2017)
24. Lake-Groundwater Interaction Studies for Sukhna Lake, Chandigarh (2015 - 2018)
25. Interaction between Groundwater and Seawater along the Northern Part of East Coast of India (2015 - 2018)
26. Baseline Hydro-geological Data Collection and Analysis of Mewat district, Haryana (2016 - 2017)
27. Isotopic Investigations in Parts of Upper Yamuna River Basin (2016 - 2018)
28. Radiocarbon Dating of Deeper Groundwater of Indo-Gangetic Basin (2016 - 2019)
29. Status Report on Rewalsar Lake (H.P.) (2015 - 2016)
30. Assessment of Dissolved Radon Concentration for Groundwater Investigations in Haridwar District(2015 - 2015)
31. Water Quality, Hydrogeology and Isotopic Investigations in SW Punjab (2012 - 2015)
32. Water Availability Studies of Sukhna Lake, Chandigarh (2013 - 2015)

33. Assessment of Sensitivity of Open Water Evaporation to Increase in Temperature for Different Climatic Regions of India (2012 - 2014)
34. Hydrological Assessment for Artificial Recharge and Water Management in Ghar area, Saharanpur District, UP (2011 - 2013)
35. Assessment of Radon Concentration in Waters and Identification of Paleo-Groundwater in Punjab State (2011 - 2013)
36. Spatial Variability of Ground Water Quality in Jammu, Kathua and Udhampur Districts (Jammu & Kashmir) (2010 - 2012)
37. Recession Flow Analysis for Evaluation of Spring Flow in Himalayan Region, India (2011 - 2014)
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39. Assessment of Water Quality in Hindon River Basin (2012 - 2014)
40. Customization of WEAP Model for Application in Ur River Watershed in Tikamgarh district of Bundelkhand Region (2014 - 2016)
41. WEAP Model Setup for Four Sub-basins under Pilot Basin Studies (PBS) Programme (2015 - 2017)
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43. Development of Drought Vulnerability Indices for Mitigation and Preparedness (2007 - 2010)
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45. Snowmelt Runoff Modelling using Fuzzy Logic (2009 - 2011)
46. GIS based Dams and Drought Information System (2009 - 2011)
47. Snow melt Runoff Modelling in Sutlej Basin (2009 - 2012)
48. Data Book (2001-2013) Hydro-Meteorological Observatory, NIH, Roorkee (2009 - 2013)
49. Computationally Simple Functions for Approximating Normal and Log-Normal Distributions (2010 - 2011)
50. A Simple IUH Model for Runoff Modelling(2010 - 2011)
51. Prediction of Dispersion Coefficient of Streams using Kriging Technique (2010 - 2011)
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67. Development of Analytical Solutions for Sequent Depths in Rectangular Channels (2013 - 2014)
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69. Application of DSS (P) for Integrated Water Resources Development and Management (2013 - 2015)
70. Evaluation and Modeling of Hydrological Support Systems for Watersheds of Garhwal, Uttarakhand Hills (2013 - 2016)
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78. Study of Regional Drought Characteristics and Long Term Changes in Supplemental Irrigation Water Requirement in Seonath Basin in Chhattisgarh (2015 - 2017)
79. Assessment of Effects of Sedimentation on the Capacity/Life of Bhakra reservoir (Gobind Sagar) on River Satluj and Pong Reservoir on River Beas (2009 - 2014)
80. Integrated Approach for Snowmelt Runoff Studies and Effect of Anthropogenic Activities in Beas Basin (2009 - 2014)
81. Development of a Flood Forecasting Model for the Chenab Basin (2007 - 2011)
82. NIH_ReSyP – Reservoir Systems Package (Version 1) (2010 - 2012)
83. Mathematical Representation of Elevation-Area-Capacity Curves for Indian Reservoirs (2010 - 2012)
84. Application of a Distributed Hydrological Model for River Basin Planning and Management (2010 - 2014)
85. GIS Based Dams and Drought Information System (2010 - 2011)
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90. Hydrological Evaluation of Leh Flash Flood 05-Aug-10 (2010 - 2011)
91. Isotopic Characteristics of Cryospheric Waters of Jammu & Kashmir, India (2010 - 2013)
92. Cryospheric System Studies and Runoff Modeling of Ganglass Catchment, Leh, Ladakh Range (2010 - 2014)
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98. Shifting Characteristics of Kosi River (2008 - 2011)
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100. Rainfall Runoff Modeling of Bagmati Basin (2011 - 2014)
101. Analysis of Temporal Variability of Climatological Parameters in Patna (2011 - 2014)
102. Pilot Basin Studies (PBS) for Mahi River Basin in Ghaghra-Gandak Composite Basin (2012 - 2017)

103. Development of Flood Forecasting System based on Rainfall Information obtained from Satellite Data (2012 - 2016)
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110. Study on Pre and Post project Scenarios and IWRM under Pushkar Canal Command Area in Andhra Pradesh (2011)
111. Present Status of Salinity Ingress in the Coastal Andhra Pradesh, Tamilnadu and Prediction of Impact due to the Sea Level Rise in Varying Climatic Conditions (2009 - 2011)
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127. Hydrological Evaluation of Leh Flash Flood August 5, 2010 (2010 - 2011)
128. Trend Analysis of Hydrological Variables in Western Himalayan Region - Phase I (Jammu & Kashmir) (2010 - 2011)
129. Status Report on "PBS: Integrated Water Resources Management (IWRM) Study in Tawi River Basin, JK" (2012 - 2013)
130. Status Report on Environmental Flow Assessment (EFA) inthe Context of Western Himalayan Region (2012 - 2013)
131. Impact of Landuse Changes on the Flow Regime and Sustenance of Environmental Flows of Tawi River at Jammu (2011 - 2016)

132. Climate Change Effects on Hydrology of the Tawi Basin in Western Himalaya (2012 - 2016)
133. Estimation of Sediment Yield and Identification of Areas Vulnerable to Soil Erosion and Deposition in a Western Himalayan Catchment (2015 - 2017)
134. Modelling Non-point Source Pollution (2008 - 2011)
135. Plan for Upgrading Water Quality Monitoring Network for Meghalaya (2010 - 2011)
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137. Assessment of Water Quality in Meghalaya (2011 - 2012)
138. Status Report on Flood Inundation and Flood Hazard Mapping with Special Reference to Brahmaputra in North East India (2011 - 2012)
139. Pilot Basin Study: Assessment of Ground Water Quality in Kulsi River Basin (Assam/Meghalaya) (2012 - 2013)
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156. Integrated Assessment of Drought Vulnerability for Water Resources Management in Bina Basin (2014 - 2016)
157. Development of DSS for Bina River Basin in Bundelkhand Region in M.P. Using WEAP Model (2015 - 2017)
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164. Sediment Transport Characteristics of Rivers of Karnataka (2011 - 2013)
165. Review Of Existing Empirical Formulae Used in Water Resources Planning and Design (2011 - 2014)
166. Integrated Water Resources Management (IWRM) on a Pilot Basin – Zuari River Basin, Goa (2013 - 2016)
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169. Water Quality Assessment using Remote Sensing Technique – A Case Study (2012 - 2014)
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171. Impact of Land Use and Land Cover Changes on Hydrological Parameters of Malaprabha Sub-basin (2011 - 2014)
172. Spring-flow Studies in Parts of Sindhudrug district and Ghataprabha Sub-basin (2013 - 2015)
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176. Groundwater Fluctuations and Conductivity Monitoring in Punjab (2016 - 2017)
177. Web Enabled Conjunctive Use Model for Management of Surface and Ground Water using concept of MAR and ASR (2016 - 2017)
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180. Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State (2014 - 2017)
181. Effect of Climate Change on Evaporation at Point Scale (2014 - 2018)
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183. Study on Effect of Climate Change on Sediment Yield to Pong reservoir (2015 - 2018)
184. Snowmelt Runoff Modelling and Study of the Impact of Climate Change in Sharda River Basin (2015 - 2018)
185. Snow Cover Variability in the Upper Yamnotri Basin (2016 - 2018)
186. NIH_Basin – A WINDOWS Based Model for Water Resources Assessment in a River (2013 - Ongoing)
187. Development of Ganga Information Portal (2015 - 2018)
188. Decision Support System for Water resources Planning in Upper Bhima Basin, Maharashtra (2014 - Ongoing)
189. Catchment Scale Evaluation of Cold-Arid Cryospheric System Hydrology, Ganglass Catchment, Ladakh (2015 - Ongoing)
190. Runoff Modelling of Shyok River, Karakorum Range (2015 - Ongoing)
191. Study of Hydrological Changes in Selected Watersheds in View of Climate Change in India (2015 - 2018)
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196. Application of USLE Model for Estimation of Soil Loss in Kulsi River Basin using Remote Sensing and Geographic Information System (2015 - Ongoing)