



सरदार वल्लभभाई राष्ट्रीय प्रौद्योगिकी संस्थान, सूरत  
SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY, SURAT  
सरदार वल्लभभाई राष्ट्रीय प्रौद्योगिकी संस्था, सुरत

SVNIT

Department of Civil Engineering

No. CED/ PLP/ CC/ 1461 / 2015-16

July 20, 2015

To,

Dr. R D Singh  
Director, NIH &  
Member Secretary, INCCC  
National Institute of Hydrology  
Jalvigyan Bhawan,  
Roorkee-247 667.

Sub: - Revised project proposal for "Impact of Climate Change on Water Resources of Tapi Basin"

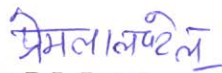
- Ref: - (a) Your letter no. NIH/CCC/2012, March 2012  
(b) MoWR letter no. 2/32/2012-NWM(S)/CC & IAD/103 dated 29.02.2012-  
Minutes of the interactive meeting  
(c) Our letter No.CED/561/2012-13, May29, 2012  
(d) Your letter through email, dated June 26, 2015

Sir,

In continuation to your letter cited at the reference (d) above on aforesaid subject, kindly find enclosed **FIVE copies** of the revised proposal for research project as per revised guidelines, under MoWR, RD&GR Govt. of India, on 'Impact of Climate Change on Water Resources of Tapi Basin' for your kind perusal and further action. The soft copy of the proposal has already been sent to your good self through the e-mail on June 20, 2015.

I would be grateful, if you kindly intimate us for taking further action from our end.

Yours faithfully

  
Dr. P L Patel  
Professor July 20, 2015

CC: (a) The Head, Department of Civil Engineering, SVNIT, Surat: For kind info please.  
(b) Dean(R&C), SVNIT, Surat: for kind information please

**PROFESSOR**  
Civil Engg. Department  
S.V. National Institute of Tech  
SURAT-395007





सरदार वल्लभभाई राष्ट्रीय प्रौद्योगिकी संस्थान, सुरत  
Sardar Vallabhbhai National Institute of Technology, Surat



**A**

**RESEARCH PROPOSAL**

**ON**

**“IMPACT OF CLIMATE CHANGE ON  
WATER RESOURCES OF TAPI BASIN”**

**SUBMITTED TO**

**INDIAN NATIONAL COMMITTEE ON CLIMATE CHANGE (INCCC),  
MINISTRY OF WATER RESOURCES,  
RIVER DEVELOPMENT & GANGA REJUVENATION  
GOVERNMENT OF INDIA**

**PRINCIPAL INVESTIGATOR**

*Dr. P.L.PATEL  
DEPARTMENT OF CIVIL ENGINEERING  
SVNIT-SURAT*

**CO-INVESTIGATORS**

*Dr. Rohit Goyal (MNIT-Jaipur)  
Dr. Vishnu Prasad (MANIT-Bhopal)  
Dr. P V Timbadiya (SVNIT-Surat)*



**DEPARTMENT OF CIVIL ENGINEERING  
(WATER RESOURCES ENGINEERING SECTION)**

**SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY, SURAT-395007**

## **Application of Research Grant**

### **1 Project Title:**

**“Impact of Climate Change on Water Resources of Tapi Basin”**

### **2 Principal Investigator:**

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## 5 Brief Bio-Data of Investigators:

Brief Biodata of Investigators is enclosed at **ANNEXURE – I**

## 6 Track Record and Workload Assessment of the PI

Enclosed at **ANNEXURE – I**

## 7 If the scheme is sanctioned, the authority in whose name the payment is to be authorized:

### Lead Institute:

i) Name of authorized person holding account with complete address:

**Director, SVNIT Surat**

ii) Organization Name as per Bank records:

**SVNIT Surat**

iii) Bank Account No: **10023050019 (current a/c)**

iv) IFSC Code : **SBIN0003320**

v) MICR Code : **395002012**

vi) Bank Name : **State Bank of India**

- vii) Bank Branch Address:  
**S. V. R. Coll of Engg. Tech. (SVRCET) Branch, SVNIT Campus,  
Ichchhanath, Dist-Surat (Gujarat) – 395007.**
- viii) Unique Agency code of the Organization and Institute: -----
- ix) Telephone & Mobile No : +91-261-2201685  
+91-99040 03857

**Partner Institute (MNIT Jaipur):**

- i) Name of authorized person holding account with complete address:  
**The Registrar, MNIT Jaipur**
- ii) Organization Name as per Bank records:  
Registrar (Sponsored Research) MNIT Jaipur
- iii) Bank Account No: 676801700388 (**current a/c**)
- iv) IFSC Code : ICIC0006768
- v) MICR Code : 302229031
- vi) Bank Name : ICICI Bank
- vii) Bank Branch Address: Jaipur MREC Branch

**Partner Institute (MANIT Bhopal):**

- i) Name of authorized person holding account with complete address:  
**The Director, MANIT Bhopal**
- ii) Organization Name as per Bank records:  
Maulana Azad National Institute of Technology, Bhopal
- iii) Bank Account No: 10021050107 (**current a/c**)
- iv) IFSC Code : SBIN0001608
- v) MICR Code : 462002014
- vi) Bank Name : State Bank of India
- vii) Bank Branch Address: MANIT, Bhopal

## **8 Category of R&D Activity (Tick those which are applicable)**

- a) Basic research
- b) Applied research** ✓
- c) Action research
- d) Education & Training
- e) Mass awareness Programme
- f) Infrastructure Development
- g) Creation of Centres of Excellence

## **9 Description of the Proposal**

According to the International Panel on Climate Change (IPCC) Scientific assessment report, global average temperature would rise between 1.4° and 5.8° by 2100 with the doubling of CO<sub>2</sub> concentration in the atmosphere. The sea level rise, change in the precipitation pattern and change in other local conditions are expected due to rise in the earth temperature. At present, the Impact of climate change on Water Resources is the most crucial research agenda worldwide (IPCC, 2007).

The Prime Minister of India unveiled the National Action Plan for climate change on 30-06-2008 wherein eight missions including the National Water Mission (NWM) were launched. One of the top agenda of the NWM has been to predict the climate change and its possible impacts on water resources of Indian basins. The Prime Minister had also shown his concern over the depleting water resources in the country and its vulnerability under the changing climatic conditions during India Water week on April 10, 2012. Under NWM, 20 river basins in the country has been identified for detailed study on effect of climate change and its possible impact on water resources of the respective basins. The information on future climate scenarios may help in adapting to the climate change and mitigation of its adverse impacts, like flood and drought etc.

Few studies have been reported in the past in our country on effect of climate change at basin levels (Gosain and Rao, 2003; Rupa Kumar et al., 2006; Hassel and Jones, 1999; IPCC, 1990; and Lal et al. 1992) particularly at very coarser grid level. Prediction of climatic variables,

under changing climatic conditions, at the basin level (fine resolutions) and their use in hydrological/hydraulic modeling is required for prediction of water availability for irrigation, domestic, industrial, power production; and flood and drought conditions at the basin levels.

The Tapi basin spreads in an area of 65145 km<sup>2</sup> which is nearly 2% of the total geographic area of the country. It originates in Multai district of Madhya Pradesh and culminates in the Arabian Sea at the Surat city. The Tapi River is a major source of irrigation and plays major role in agricultural economy of Maharashtra and Gujarat states apart from feeding several domestic water supply schemes, industries and hydropower in its catchment. Apart from aforesaid benefits, major historical floods had occurred in the past in the coastal urban flood plain of the Tapi River in the Surat city. The flood of year 2006 alone had caused a loss of Rs.21000/- Crores and the economy of the country was severely affected for several months after the flood. The rise in temperature, sea level rise and severity of the extremes (flood) in Tapi basin (Gosain and Rao, 2006; Timbadiya et al. 2012), the flood conditions in the coastal flood plain may adversely affect the Surat city in near future. Keeping in view the aggravating situation of the climate change across the globe, in general, and, for the Tapi basin, in particular, hydrological and hydraulic analyses are required to predict the water yield in the basin and status of flood and drought for different future RCP scenarios using downscaled climatic variables like precipitation, temperature (Min., Max., Average), solar radiation, wind velocity, relative humidity and sun shine hours at basin levels.

## **10 Objectives**

The objectives of proposed project, computation of reservoir sedimentation and sediment erosion modeling of catchment, can be described as below:

1. Collection of base line data of Tapi basin which would include stream gauge data, topography, soil, land use/land cover, ground water levels, reservoir and its utilities, cropping pattern of Ukai command area, past floods and tidal levels, vegetation, land management practices, sediment etc.
2. Selection of Hydrological (SWAT/MIKE SHE) and hydraulic models (MIKE FLOOD) and their calibration from past observed data.
3. Parametric and non-parametric tests for trend detection for hydro-meteorological and hydrological variables in the basin.

4. Performance evaluation of Ukai reservoir under changing climatic conditions in fulfilling its requirements of irrigation, hydropower and flood control.
5. Using the output from dynamic/statistical downscaling, prediction of flood situation downstream of Ukai dam in lower Tapi River under changing climatic conditions and preparation of flood risk maps of the Surat city under changing climatic conditions.
6. Organize Workshops during the project duration as capacity building measures and awareness for the stakeholders in the river basin and academic institutions involved in such activities.

## **11 Contribution to Water Resources Development**

The change in the climatic condition is being faced by the whole world. The average global temperature has risen by about  $0.75^{\circ}$  in the last century. Similarly, the significant sea level has taken place (12-22 cm) in the same period. The water resource has become the most fragile resource of river basin and susceptible to the ongoing climate change. The extremes (flood/drought) have become more frequent in the basin and entire humanity is likely to face the menace of the climate change in the near future. The present study would be helpful in prediction of water resources of the basin under changing climatic conditions as follows:

- a) Prediction of water yield into the reservoirs under changing climatic conditions which would help the stakeholders in the command area to be resilient in planning their cropping pattern, industrial/domestic water requirements, particularly under the drought conditions.
- b) Prediction of flood into the Ukai reservoir, routing the flood in the reservoir and hydraulic routing of the flood in the downstream channel, giving due consideration to the tidal levels, would help in flood predictions in the Surat city under different climatic scenarios. The developed flood risk maps for changing climatic conditions would help the city dwellers in managing and adopting themselves with the severe extremes in future.

## **12 Putting the Research to Use**

The proposed research project is being submitted under National Water Mission (NWM), MoWR, Govt. of India as one of the top priorities of the country. The Stakeholders, like water resources, water supply departments, Govt. of Gujarat and Maharashtra; Surat Municipal

Corporation (SMC) would be the real beneficiary of foregoing project. The findings of the research project can be put into use as under:

- a) The findings of the research project will be discussed in the research forum time to time under National Water Mission, and will be made available in the form of research project reports and publications through peer reviewed International /National Journals.
- b) The end-users will be invited in the awareness/ capacity building workshops, to be organized during the project duration, to show case the outcome of studies and motivate them to devise the adoptive measures for facing the consequences of climate change, like food/drought conditions, in near future.

The recommendations from the project would help the policy makers, both at central and state level, to initiate appropriate actions which would help the people to adopt themselves from the menace of climate change.

### **13 Present State of Art**

#### **Observed Recent Trends on Climate Change**

The earth is experiencing a rapid climate warming which may affect both the natural and human systems in near future. IPCC (2001) has indicated that the average global temperature has increased by  $0.6 \pm 0.2^\circ$  per decade since the late 19<sup>th</sup> century. The rate and duration of warming of the 20<sup>th</sup> century has been found to be larger than any other time during the last 1000 years (Sharma and Singh, 2007). The IPCC 4<sup>th</sup> assessment report (IPCC, 2007) depicts a situation characterized by snow cover reduction in northern Hemisphere and glacial retreat almost worldwide. Ranzi and Barontini (2010) presented the variation of temperature, precipitation in Adige river basin in Italy along with variation of runoff at the catchment outlet. The data analyzed by them confirmed an increase of temperature @  $1.5^\circ$  per century over the last century with acceleration in the last decade of 20<sup>th</sup> century. Recently, **Timbadiya et al. (2012 a, 2012 b) carried out the trend analysis of observed annual extremes flows at different gauging stations in the Tapi basin in India for duration 1972-2010 and reported that Annual extremes are aggravating in the basin in the recent past.**

## **Impact of Climate change on Water Resources of River Basin**

Gosain et al. (2011) presented a study on assessment of water resources in seventeen Indian basins under changing climatic conditions across the globe. They had used the weather data from PRECIS RCM for Base line (1961-1990), near term (2021-2050) and long term (2071-98) periods for A1B IPCC SRES scenario in aforesaid study. The weather output from RCM data was utilized for possible impacts on the run-off, sediment yield and actual evapo-transpiration of all the basins. **The said study indicated an increase in precipitation by 17.50% and 5.70% with reference to the base line period in the Tapi Basin during the near term and long term respectively.** The analysis related with water yield, evapo-transpiration, sediment yield, floods and drought were under taken in SWAT, a physically based hydrological model, by using the weather data from aforesaid RCM. The majority of northern river systems show an increase in evapo-transpiration during the near term scenarios while majority of southern river systems show the marginal reduction in the evapotranspiration. The Impact analysis on flood had indicated an increase in flooding from 10% to 50% over the existing magnitudes. The foregoing study was dependent on the analysis of outputs from the PRECIS RCM for present (base period) and future (near term and long term) time periods for A1B scenario. The RCM outputs related with climatic variables like precipitation, temperature, solar radiation, wind velocity and relative humidity were not validated with the actual observed data in the river basins.

Raje and Mujumdar (2011) used conditional random field (CRF) method to downscale the outputs from three GCMs under A<sub>2</sub>, A<sub>1</sub>B and B<sub>1</sub> IPCC scenarios for computations of inflow into Hirakud reservoir for time slices of year 2045-65 and 2075-95 by using actual observed data for years 1959-2005. By simulating the future stream inflow scenarios into Hirakud reservoir, they assessed the performance of the reservoir in fulfilling its requirements, viz. Hydropower, irrigation and flood control, under changing climatic scenarios.

Gebre (2011) studied the effect of climate change on water resources availability of Didessa catchment in Blue Nile river basin in Ethiopia. He used the downscaled results of ECHAM5M3 (GCM) through a regional circulation model (RegCM<sub>3</sub>) for A<sub>1</sub>B scenario of the said catchment. The downscaled results (precipitation, temperature, and potential evapotranspiration) were used as input to a distributed hydrological model (HBV-96) for simulating the flow in the study area

during 2031-2040 and 2091-2100. Precipitation and temperature were only downscaled parameters and the assumption of invariant climatic conditions like wind speed, solar radiation and relative humidity, in the future was made in the said analysis. A significant increase in runoff was reported in the projected time period in above study. He also recommended for using multiple GCM, in study of effect of climate change for water resources of river basin to depict the model uncertainty.

Paiva et al. (2011) studied the impact of climate change of Quarai river basin (as part of larger Uruguay and Parana La Plata basin) in South America. They used nine GCMs and six emission scenarios of greenhouse gas emissions to predict the impact of climate change on rainfall and temperature of the said basin. The uncertainty in climate change predictions was assessed by them by comparing the results obtained using different GCMs and different greenhouse gas emission scenarios. The uncertainty due to differences between GCMs greatly surpassed the differences between the greenhouse gas scenarios.

Ngugen and Nguyen (2011) proposed a methodology, called 'Scale invariance concept' to obtain cumulative probability distribution (CDF) of extreme rainfall of smaller duration (e.g., 1 hr rainfall) from statistically downscaled CDF of large duration (e.g., daily rainfall). Such study could be very useful in studying effect of climate change in the analysis of extremes (floods) at basin scales.

Ghosh et al. (2011) employed three GCMs, viz. CCSR/NIES (Centre for Climate System Research/National Institute of Environmental studies), HadCM<sub>3</sub> (Hadely Climate Model 3) and coupled global climate model 2 with two scenarios A<sub>2</sub> and B<sub>2</sub> to downscale the stream inflow, with due bias corrections, into Hirakud reservoir. The computed CDF for the downscaled stream flow had shown significant uncertainty, among the GCMs, particularly for medium flows. They had also obtained the possibilistic mean CDF for stream flow into the reservoir by giving suitable weights to each GCMs and scenario depending upon their performance in analyzing the climate condition for base line period. They assess the impact of climate change on existing policy of reservoir operation and found that hydropower production and its reliability will decrease; and vulnerability will increase as result of climate change in the future.

## CONCLUDING REMARKS

Recent studies on Tapi basin has indicated an increase in precipitation in future, both in near and long terms, with reference to base line period. The trend analysis of stream flow in the Tapi River, and inflow into Ukai reservoir has also indicated an increasing trend in near future. The downscaled climatic variables of the Tapi basin can be used as inputs to available hydrological and hydraulic models to predict availability of water resource in the Tapi basin at critical locations. Also, the predicted rainfall at the basin level can be downscaled at sub-time period (e.g. hourly) to compute event based flood hydrograph in the basin for future time projections. The predicted climatic/hydrologic variables can be useful in the assessment of reservoir performance and would help the stake holders and the policy makers to formulate appropriate adoptive measures in the river basin under the changing climatic conditions.

## References:

Ghosh S., Raje D. and Mujumdar P .P. (2011), Mahanadi Streamflow: Climate Change Impact Assessment and Adaptive Strategies, Proceeding of International symposium on water Resources Management for developing countries due to climate change, March 29, 2011, Water Resources research Centre, Kyoto University, Japan, pp.119-131.

Gosain A. K., Rao Sandhya and Arora A. (2011), Climate change Impact Assessment of Water Resources of India, Current Science, Vol.101, No.3, pp.356-371.

Intergovernmental Panel on Climate Change (2001), Climate change 2001: The scientific Basis, Intergovernmental Panel on Climate Change.

IPCC (2007), Climate Change 2007: Synthesis report, contribution of working group I, II and III to the fourth Assessment report of IPCC, IPCC, Geneva, Switzerland.

Ngugen V-T-V, Nguyen T-D (2011), On statistical modeling of extreme rainfall processes in the context of climate change, Proceeding of International symposium on water

Resources Management for developing countries due to climate change, March 29, 2011, Water Resources research Centre, Kyoto University, Japan, pp.65-74.

Paiva Radrigo C. D., Collischonn W. and ScheHini E. B. (2011), Climate change Impacts on Water Resources in the Quaraí River Basin; contributed in text book on 'Modelling the Impact of Climate Change on Water Resources, edited by Fung F., Lopez A., and New Mark, Wiley- Blackwell, pp.137-148.

Raje D. and Mujumdar P.P. (2011), Reservoir performance under uncertainty in hydrological Impacts of Climate Change, Advances in Water Resources, Science Direct,30(2010), pp.312-326.

Ranzi Roberto and Barontini S. (2010), Are there evidences of the Impact of global warming on runoff regimes in the Southern Alps? Proceeding of International workshop on 'Impact of global warming from hydrological and Hydraulic issues', March 12, 2010, DDRI, Kyoto University, Japan.

Sharma K.D. and Singh Pratap (2007), Impacts of climate change on hydrological extremes: Floods and droughts, Hydrology Journal, 30(3-4), pp.129-145.

Timbadiya P. V., Patel P. L. and Porey P. D. (2012 a), Application of innovative trend analysis methodology and distribution fitting: Study on Annual peak inflow into Ukai dam, Gujarat, India, Water and Energy International, CBIP, Vol.69, No.9, Sep.2012, pp.40-44.

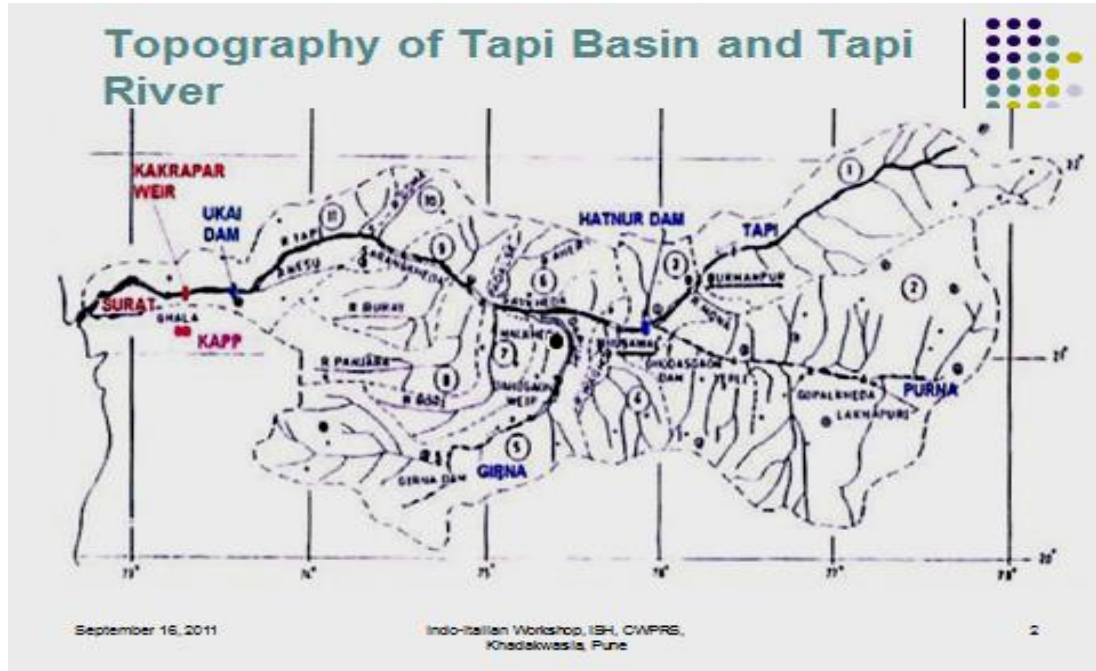
Timbadiya P. V., Mirajkar A. B. and Patel P.L. (2012 b), Recent trend analysis for annual peak flow in Tapi basin, Presented in India Water Week organized by MoWR, GOI, April 10-14, 2012 (Accepted for publication in Journal of Water and Energy International, CBIP in forthcoming issues)

## 14 Methodology

The present section describes about the study area (Tapi basin), ongoing studies related to the Tapi basin, scope of work, methodologies and the proposed Team involved in the project with the defined responsibilities:

### Study area

The Tapi River, with its origin at Multai in Madhya Pradesh, traverses around 720 km distance before meeting with the Arabian Sea just 12 km from the heart of the Surat city. The catchment of the Tapi river is elongated in shape, falling in Madhya Pradesh (9804 km<sup>2</sup>), Maharashtra (51504 km<sup>2</sup>) and Gujarat (3838 km<sup>2</sup>) states. Out of several hydraulic structures came into existence on the Tapi river, Ukai dam is one of the important multipurpose dam which was constructed for the providing irrigation in the Southern Gujarat, Controlling the flood in the Surat city and hydropower generation through releases from the dam into Kakrapar weir system. The Index map of Tapi basin, its tributaries and locations of major hydraulic structures on them including the Ukai dam is shown in Fig.1.



**Fig. 1. Geographical view of Tapi Basin**

### **Flood issues related to the Surat city in lower Tapi River**

The Surat city is just located 120 km downstream of Ukai dam and faced many major floods in the past. The details of major floods after 1950 and their corresponding levels at the Surat city are shown in Table 1.

**Table 1: Major Floods in Surat city (After 1950)**

<b>Year</b>	<b>Magnitude of Flood (lakhs cusecs)</b>	<b>Flood level (m)</b>	<b>Remarks</b>
Sep. 17, 1959	12.94	11.55	Warning level 8.50 m & Danger level 9.50 m
Aug.06, 1968	15.60	12.08	
Sep.08, 1969	8.56	9.96	
Sep. 08, 1994	5.25	10.10	
Sep.16, 1998	7.00	11.40	
Aug.06, 2006	9.09	12.40	

From Table 1, it can be seen that significant changes have taken place in the Surat city as the level which has been attained in relatively low recent flood (Flood for year 2006), was achieved at relatively higher flood earlier (Flood for Year 1969). The major reasons for reduction in the capacity of the Tapi River at the Surat city could be encroachment in the flood plain in the city due to rapid industrialisation in Hazira belt, siltation in the channel due to effect of tides and construction of river structures like major bridges etc. The flood of Year 2006 alone had caused a direct damage to Rs.21000/- Crores and major activities remained halt for more than one month after the flood. The flooding situations may worsen due to impact of climate change on precipitation of Tapi basin and sea level rise in near future.

### **Availability of Water Resources**

The unprecedented growth and industrialization of the Surat and its adjoining cities and towns, have created huge demands for domestic and industrial water requirement on the Tapi water resource. Also, many river diversion works are being coming up upstream of Ukai dam and, under such circumstances, the inflow of water into reservoir would be insignificant during non-monsoon period of the year. The availability of water and its quality in the Ukai command area may get severe blow under changing climatic scenarios due to rise in temperature, increase in frequency of food and drought and the sea level rise.

## **Ongoing studies**

Keeping in view, the severity of flood situation in the Surat city and increasing demand on the available water resources, a **Nationally Coordinated Project (NCP)**, funded from All India Council for Technical Education (AICTE), New Delhi is under implementation at SVNIT Surat..

The brief outcome of aforesaid activities is summarized as below:

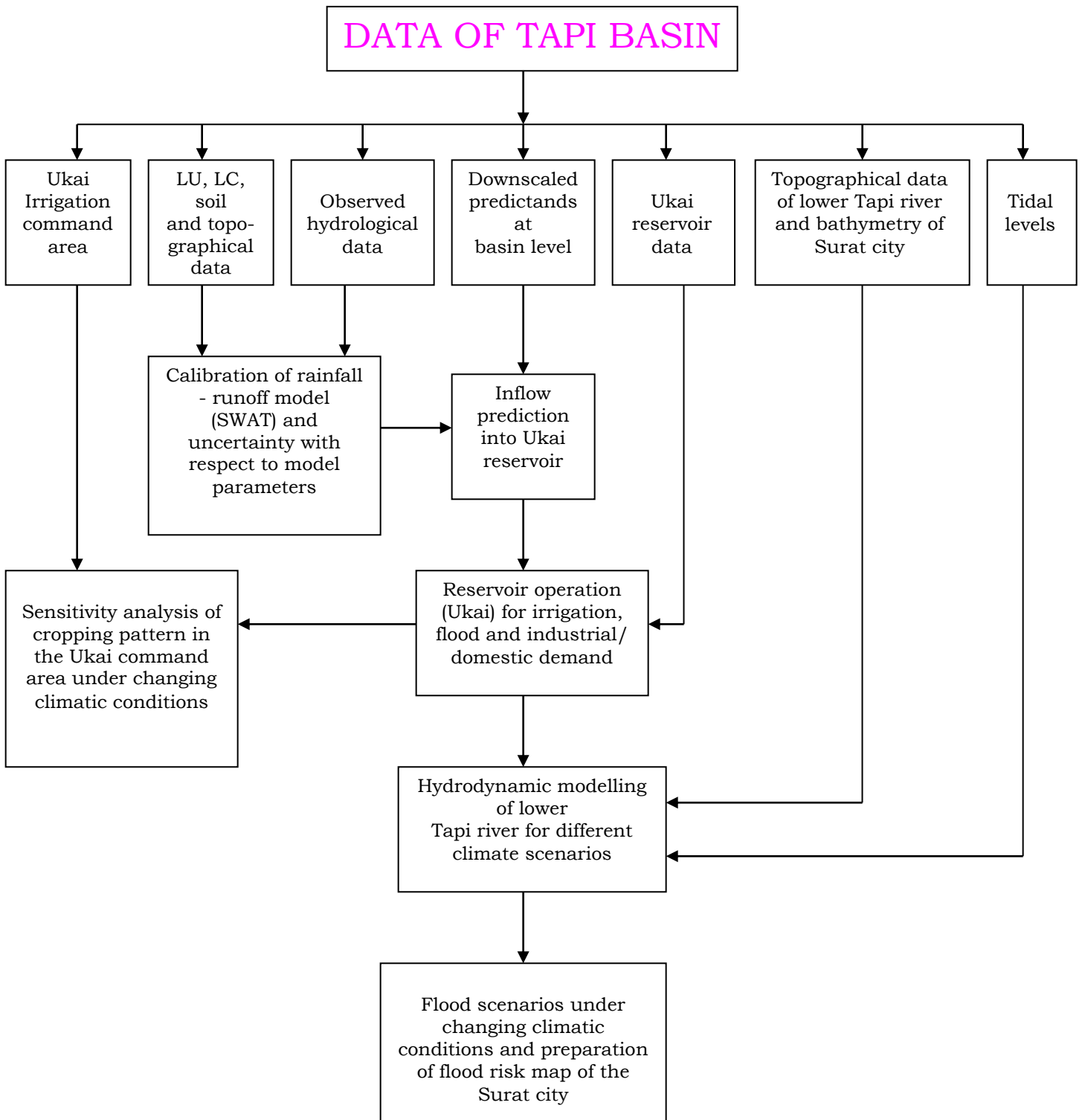
- a) The data base of Tapi basin is under process of collection from the organisations, like Central Water Commission, Gujarat Water Resources, Water Supply and Kalpsar department, Surat Municipal Corporation and Indian Meteorological, State Water Data Centre (SWDC) Gujarat.
- b) The flood prediction model at the Surat city for various releases from Ukai dam, based on one dimensional models, like HEC-RAS and MIKE 11 has already been completed. The model based on 2-D approach using MIKE Flood is under the process of completion.
- c) Studies on inflow prediction into Ukai reservoir and reservoir operation have been initiated.
- d) Studies on optimal irrigation planning in Ukai irrigation command area in under progress using multi-objective fuzzy linear programming model.
- e) A Workshop on ‘Flood forecasting and protection measures’ ‘during Aug.2010 and a National Conference on ‘Hydraulics and Water Resource’, ‘HYDRO-2011’ were organised at SVNIT and partly funded from completed NCP project.
- f) The personnel from field organisations, Like Central Water and Research Power station (CWPRS, have been enrolled for their PhD/ M Tech (Research) programmes to tackle the problem related the Tapi basin.

## **Scope of work and methodology**

The quantum of work involved in the proposed project “***IMPACT OF CLIMATE CHANGE ON WATER RESOURCES OF TAPI BASIN***” can be summarized as follows:

- a) Development of data base of Tapi basin related with stream gauging data, land use and land cover, topographical maps, soil map; reservoir inflow-outflow, levels, and releases pattern; cropping pattern of Ukai command area including crop calendar; bathymetry of lower Tapi river and Surat city, past flood levels in Surat city; and Tidal levels.
- b) Analysis of past data for detection of trend in hydro-meteorological and hydrological variables in Tapi basin.
- c) Calibration and validation of selected hydrological and hydraulic models from the base line data
- d) Estimation of spatial and temporal water availability in the Tapi basin by using the downscaled Predictands as inputs to the hydrological model.
- e) Using downscaled Predictands at the basin level, assess the performance of multipurpose storage reservoir (UKAI reservoir) to fulfill its intended objectives, viz. irrigation, domestic and industrial water supply; hydropower generation and flood control.

The detailed methodologies to achieve aforesaid objectives are depicted in the form of flow chart, see Fig 2.



**Fig. 2. Methodology for Hydrologic and Hydraulic Analyses under changing Climate conditions**

The following team would be involved in execution of aforesaid project:

- a) Sardar Vallabhbhai National Institute of Technology Surat (SV NIT) : **Lead Institute**
- b) Malaviya National Institute of Technology Jaipur: **Co-coordinating Institute**
- c) Maulana Azad National Institute of Technology Bhopal: **Co-coordinating Institute**

The responsibility of the Institutes, involved in the project, is described in succeeding paragraphs:

#### **SVNIT Surat**

- a) Collection/extraction of data, with the help of associate institutes, related to stream gauging, land use and land cover, topographical maps, soil map; reservoir inflow-outflow, levels, and releases pattern; cropping pattern of Ukai command area including crop calendar; bathymetry of lower Tapi river and Surat city, past flood levels in Surat city; and Tidal levels.
- b) Development of rainfall-runoff and sediment yield model for Purna catchment (subcatchment-2, see Fig.3) for present as well future scenarios.
- c) Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.
- d) Assessment of reservoir (Ukai) behavior under changing climatic conditions vis-à-vis present condition, and propose revised rule curve for its operation, if required.
- e) Sensitivity analysis of cropping pattern in Ukai command area under revised water yield in Ukai reservoir under changing climatic conditions.
- f) Calibration of hydraulic model (MIKE Flood) and prediction of flood situations in the downstream of Ukai reservoir under present and changing climatic situations.

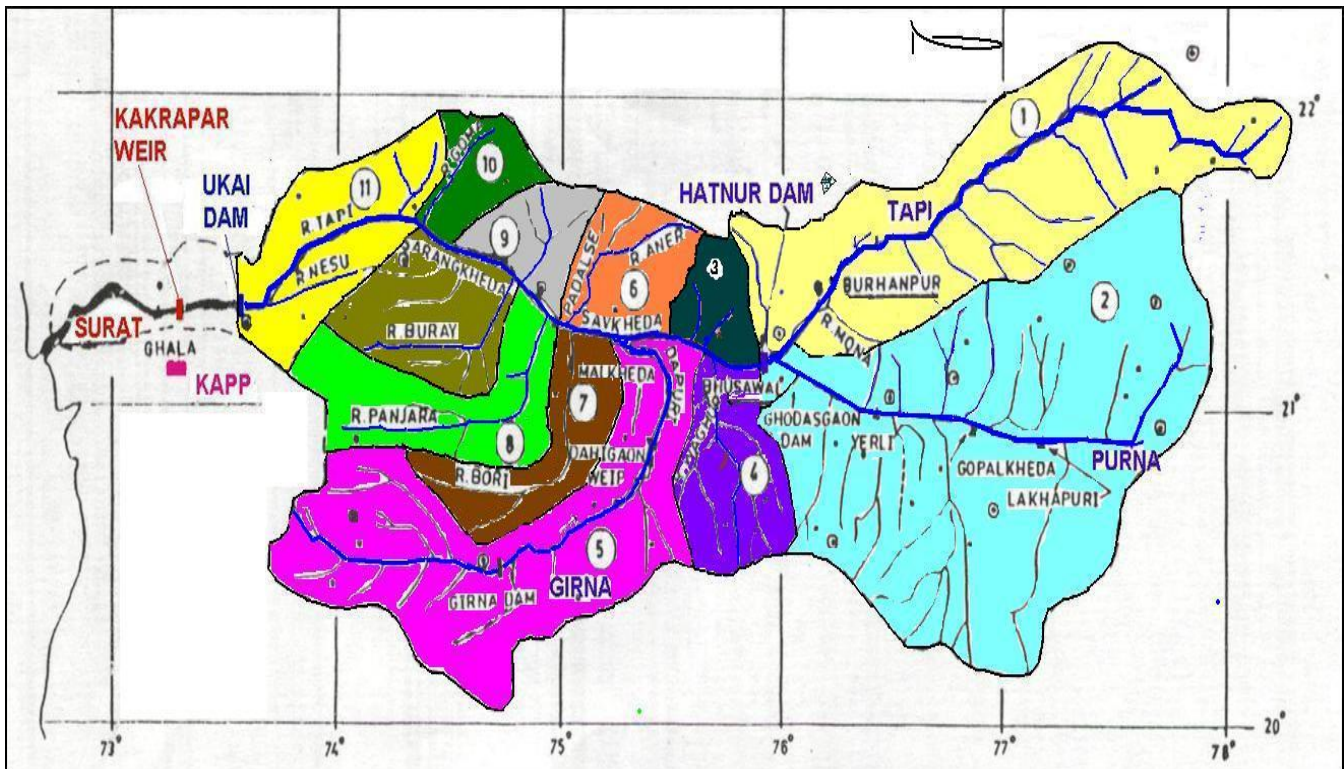
#### **MNIT Jaipur**

- a) Development of rainfall-runoff and sediment yield model for upper Tapi basin (sub-catchments 1, 3, 4, see Fig.3) after taking input from SVNIT for Purna catchment at the junction of Tapi River.

- b) Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.
- c) Performance evaluation of Hathnur reservoir under changing climatic conditions for both observed as well as future RCP scenario.
- d) To assist lead Institute in collection/extraction of field data.

**MANIT Bhopal**

- a) Development of rainfall-runoff and sediment yield model for Sub catchments 5,6,7,8,9,10,11, see Fig.4; and compute the inflow into Ukai reservoir after taking input from the MNIT Jaipur.
- b) Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.
- c) Performance evaluation of Girna reservoir under changing climatic conditions for both observed as well as future RCP scenario.
- d) To assist lead Institute in collection/extraction of field data.



**Fig.4 Description of the Catchment of Tapi Basin**

## 15.0 Cost Estimates

15.1 Total Cost of the Project including over head charges(if any) – 135.85 Lakhs

### 15.2 Subhead wise abstract

Subhead	Amount (Rs.)			
	SVNIT Surat	MNIT* Jaipur	MANIT* Bhopal	Total
Salary (2 SRF/ 1 JRF)*	35,42,400/-	12,09,600/-	11,23,200/-	58,75,200/-
Travel & Contingency	3,00,000/-	1,50,000/-	1,50,000/-	6,00,000/-
Equipment/software/data procurement**	33,10,815/-	2,01,625/-	12,91,960/-	48,04,400/-
Experimental charges	8,70,000/-	1,00,000/-	1,00,000/-	10,70,000/-
Sub Total	80,23,215/-	16,61,225/-	26,65,160/-	1,23,49,600/-
Institutional over heads (up to maximum 10 % of Total Project cost)***	8,02,322/-	1,66,122/-	2,66,516/-	12,34,960/-
Grand Total	88,25,537/-	18,27,347/-	29,31,676/-	1,35,84,560/-

\* SRF/ JRF being proposed in the project for analysis of data/images and preparing the report.

\*\* Available existing licenses (5Nos.) of ERDAS Imagine software in the Institute will be utilized for image processing.

\*\*\* Facilities of Existing Computational Hydraulics Lab will be used for the project work.

### 15.3 Justification for Institutional over head charges:

Institute will make arrangement of infrastructure like computers, internet, electricity, computational laboratory to carry out the research project.

### 15.4 Amount sought to be released at the start of the work with justification:

The amount required for procurement of Arc GIS software, Satellite Imageries, Salary of SRF for first year; Traveling expenditure for visiting IITs and NITs to have first hand information related to their facilities and literature on the theme Project should be released to start the work.

**15.5 Subhead wise Details:**

***SVNIT SURAT – Lead Institute***

Designation	Year 1			Year 2			Year 3		
	Rate/ Month (Rs.)	Months	Amount	Rate/ Month	Months	Amount	Rate/ Month	Months	amount
SRF	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-
SRF	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-
JRF	25,000/- + 5,000/-*	12	3,60,000/-	25,000/- + 5,000/-*	12	3,60,000/-	28,000/- + 5,600/-*	12	4,03,200/-
Sub Total			11,66,400			11,66,400/-			12,09,600/-
Total	Rs. 35,42,400/-								

***MNIT JAIPUR – Partner Institute***

Designation	Year 1			Year 2			Year 3		
	Rate/ Month (Rs.)	Months	Amount	Rate/ Month	Months	Amount	Rate/ Month	Months	amount
SRF	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-	28,000/- + 5,600/-*	12	4,03,200/-
Total	Rs. 12,09,600/-								

***MANIT BHOPAL – Partner Institute***

Designation	Year 1			Year 2			Year 3		
	Rate/ Month (Rs.)	Months	Amount	Rate/ Month	Months	Amount	Rate/ Month	Months	amount
JRF	25,000/- + 5,000/-*	12	3,60,000/-	25,000/- + 5,000/-*	12	3,60,000/-	28,000/- + 5,600/-*	12	4,03,200/-
Total	Rs. 11,23,200/-								

\*HRA (20% of basic at Surat) as per Annexure - IV

**Grand Total for salary including HRA Rs. 58,75,200/-**

## 15.6 Man-months utilization table

**Designation:** Senior Research Fellow (SRF-1) – Lead Institute (SVNIT Surat)  
Senior Research Fellow (SRF-1) – Partner Institute (MNIT Jaipur)

**Total man Months:** Thirty Six (36)

Activities	Months from Start →				
Literature Review (State-of-the-art) on studies related to rainfall-run off modeling including learning of standard like MIKE 11/ SWAT models; collection of relevant data from the relevant agencies.	1-6				
Trend Analysis of hydro-meteorological data, Calibration of Hydrological and sediment yield models and their validation from base line data		7-12			
Collection of downscaled Predictands from the downscaling team; and computation of run-off at the outlet of identified sub-catchment for observed and future scenarios.			13-24		
Prediction of sediment yield at the catchment outlets for observed and future scenarios; location of critical areas in the watershed and recommendation for soil conservation measures.				25-33	
Preparation and submission of report					34-36

**Designation:** Senior Research Fellow (SRF-2) – Lead Institute (SVNIT Surat)

**Total man Months:** Thirty Six (36)

Activities	Months from Start →				
Literature Review (Hydrodynamic modeling) Collection of data related to geometry of lower Tapi river including bathymetry and land use pattern of the Surat city, tidal level data, and data for various stream gauging stations from relevant funding agencies.	1-6				
Calibration of MIKE Flood, MIKE SHE models; their coupling and validation from base line data.		7-18			
Generation of flood scenarios in lower Tapi river and Surat city, preparation of flood maps and risk analysis for observed and future scenarios.			19-30		
Synthesis of the model output for observed and future scenarios; and recommendation of adaptive measures; organization of Workshop for Stakeholders and research partners.				31-33	
Preparation and submission of report					34-36

**Designation:** Junior Research Fellow (JRF-1) - Lead Institute (SVNIT Surat)

**Total man Months:** Thirty Six (36)

Activities	Months from Start →				
	1-6	7-12	13-18	19-24	25-30
Literature Review (Reservoir operation to meet the requirement of irrigation, industrial/domestic water requirement and Flood control; study of existing optimal cropping pattern models); collection of data from the user agencies related with cropping pattern of Ukai command area and Ukai Reservoir itself.	1-6				
Development of multi-objective reservoir operation model from past data for existing scenario.		7-18			
Flow simulation through the developed multi-objective model; and sensitivity analysis of cropping pattern in the command area for different future scenarios.			19-30		
Study the adequacy of available water for irrigation, domestic and Industrial water Supply and power generation during the observed and future climatic conditions; suggest suitable adoptive measures for water conservation and improving the irrigation efficiency.				31-33	
Preparation and submission of report					34-36

**Designation:** Junior Research Fellow (JRF-1) - Partner Institute (MANIT Bhopal)

**Total man Months:** Thirty Six (36)

Activities	Months from Start →				
	1-6	7-12	13-18	19-24	25-30
Literature Review (State-of-the-art) on studies related to rainfall-run off modeling including learning of standard like MIKE 11/ SWAT models; collection of relevant data from the relevant agencies.	1-6				
Trend Analysis of hydro-meteorological data, Calibration of Hydrological and sediment yield models and their validation from base line data		7-12			
Collection of downscaled Predictands from the downscaling team; and computation of run-off at the outlet of identified sub-catchment for observed and future scenarios.			13-24		
Prediction of sediment yield at the catchment outlets for observed and future scenarios; location of critical areas in the watershed and recommendation for soil conservation measures.				25-33	
Preparation and submission of report					34-36

### 15.7 Travel & Contingency Expenditure:

#### SVNIT Surat – Lead Institute

S No.	Travel Purpose	Year 1	Year 2	Year 3
1.0	Review meeting, field visits, Registration fees for International conferences	1,00,000*	1,00,000*	1,00,000*
<b>Total</b>		<b>Rs. 3,00,000/-</b>		

\*Being Lead Institute the expenditure in travel for collection of data, attending the meetings, office and other contingent expenditures are expected to be more in execution of project.

#### MNIT Jaipur – Partner Institute (Annexure-II)

S No.	Travel Purpose	Year 1	Year 2	Year 3
1.0	Review meeting, field visits, Registration fees for International conferences	50,000	50,000	50,000
<b>Total</b>		<b>Rs. 1,50,000/-</b>		

#### MANIT Bhopal – Partner Institute (Annexure-III)

S No.	Travel Purpose	Year 1	Year 2	Year 3
1.0	Review meeting, field visits, Registration fees for International conferences	50,000	50,000	50,000
<b>Total</b>		<b>Rs. 1,50,000/-</b>		

**Grand Total for Travel and Contingency Expenditure Rs. 6,00,000/-**

## 15.8 Equipment/ Software/ and Data:

### SVNIT Surat - Lead Institute

S NO.	Name of the equipment/software	Quantity	Estimated cost (Rs.)	Remarks
1.0	MIKE SHE	01	7,29,000/-	For modeling of the river basin downstream of Ukai Reservoir and linking the output with MIKE Flood Hydrodynamic model <b>ANNEXURE V</b>
2.0	ARC GIS	01	10,11,960/-	For modeling of flood in flood plain and the basin <b>ANNEXURE VI</b>
3.0	Rainfall data *	-	-	-
4.0	Soil data #	-	-	-
4.0	Topographical maps in digital forms	12 sheets	1,98,000/-	<b>ANNEXURE VII</b>
5.0	Procurement of satellite imageries #	-	-	-
6.0	Trimble GPS	01	6,40,000/-	<b>ANNEXURE VIII</b> (for ground truthing )
7.0	Workstation	01	6,90,850/-	<b>ANNEXURE IX</b>
8.0	Printer	02	41005/-	
	<b>TOTAL</b>		<b>33,10,815/-</b>	

\* Rainfall and other meteorological data being collected by downscaling group

# Data for Soil and Satellite Imageries (Resource Sat LISS III) of the study area are available with lead Institute from another completed/ ongoing project.

### MNIT Jaipur – Partner Institute

S NO.	Name of the equipment/software	Quantity	Estimated cost (Rs.)	Remarks
1.0	PC/laptop/workstation/software/ Printer	01	2,01,625/-	<b>Annexure – II</b>
	<b>TOTAL</b>		<b>2,01,625/-</b>	

### MANIT Bhopal – Partner Institute

S NO.	Name of the equipment/software	Quantity	Estimated cost (Rs.)	Remarks
1.0	PC/laptop/workstation/ ArcGIS software/ Printer	01	12,91,960/-	<b>Annexure – III</b>
	<b>TOTAL</b>		<b>12,91,960/-</b>	

**Grand Total for Travel and Contingency Expenditure Rs. 48,04,400/-**

## 15.9 Experimental charges:

### SVNIT Surat – Lead Institute

#### TA/DA and Honorarium to Technical Advisors

S No.	Name of Technical Advisor	No. of visits in project duration	Approx. TA/DA	Honorarium (sitting charges)	Remarks
1.0	Prof. D Nagesh Kumar IISC Bsnglore	06	1,80,000/-	15,000/-	Rs.2500/- per sitting
2.0	Dr. V Jothiprakash IIT Bombay	06	60,000/-	15,000/-	
Total	2,70,000/-				

The technical advisors will be requested to attend the progress review meet of collaborating institutes and host institute twice in a year.

#### Capacity Building workshop/training (at lead Institute)

Activity	Year 1 (Rs.)	Year 2 (Rs.)	Year 3 (Rs.)	Total (Rs.)
QUARTERLY Progress review meet at host institute and Organization of <b>Workshop at the end of the work</b> on ‘Deliberation of project outcomes and related adaptive measures with stakeholders and academic institutions involved in such studies’	1,50,000/-	1,50,000/-	3,00,000/-	6,00,000/-

#### MNIT Jaipur – Partner Institute (Annexure - III)

Activity	Year 1 (Rs.)	Year 2 (Rs.)	Year 3 (Rs.)
Consumables and other Miscellaneous expenditure	1,00,000/-		

#### MANIT Bhopal – Partner Institute (Annexure - IV)

Activity	Year 1 (Rs.)	Year 2 (Rs.)	Year 3 (Rs.)
Consumables and other Miscellaneous expenditure	1,00,000/-		

**Grand Total for experimental charges: Rs. 10,70,000/-**

## 16. Work schedule

**Probable date of commencement:** within three months after getting the Project sanction

**Duration of study:** Three years

**Stages of Work and Milestones:**

Identifiable milestones of progress	Months from start	Amount to be released
Start <b>Literature Review</b> on rainfall-runoff, sediment yield, reservoir operation under multi-objective situation, and hydrodynamic modeling; <b>collection of data</b> from relevant filed and research agencies	0	(amount of first installment) 50% of salary, TE expenditure; and 100% for procurement of data, software/hard wares
Trend analysis; Calibration of hydrological and hydraulic models; and their validation from base line data	7	
Obtaining the details of downscaled Predictands from downscaling team; prediction of inflow into reservoir; Reservoir operation including optimal irrigation planning; modeling of flood in lower Tapi river for observed period as well as future scenarios.	13	Second installment 50 % of salary is to be released
Synthesis of results from the studies related to various segments; recommendations for adoptive measures in improving the irrigation efficiency, flood forecasting and protection measures and soil conservation measures in the catchment etc.	30	
Presentation of results and preparation of report	34	
Final Submission of Report	36	

## 17. Declaration

1. I have carefully read the terms and conditions of the research grant and agree to abide by them.
2. This is to certify that I have neither submitted this proposal elsewhere for financial support nor have undertaken it at the request of any commercial agency or as a consultancy.
3. I have enclosed the following:
  - a. Complete Research Proposal (5 Copies)

Date July 20, 2015

Signature of PI

प्रेमलालपटेल

Name :

Dr. P L Patel

Place SVNIT Surat

Designation :

Professor, CED, SVNIT-Surat.

## 18. Endorsement from the Head of the Institution from Lead Institute

1. The Institute/ Organization welcomes the participation of Dr. P L Patel, Professor, Department of Civil Engineering, SVNIT Surat, as the PI and Dr. P V Timbadiya, Assistant Professor, Department of Civil Engineering, SVNIT Surat as the Co-PI for the above research scheme. In the unforeseen and legitimate event of discontinuation by the PI, the Co-PI will assume full responsibility for completion of the project. Information to this effect, endorsed by me, will promptly be sent to the INCCC.
2. The necessary equipment and institutional support as described in the proposal will be made available as and when required for the purpose of the project to ensure that the work is taken up on priority and completed on schedule.
3. In the event of foreclosure/ discontinuation/ cancellation of the scheme for any reason, the entire amount released for the scheme will be fully refunded to the INCCC along with the interest prescribed till the date of return by the institute/ organization.
4. The register of permanent and semi-permanent assets acquired out of grants from INCCC will be maintained in FORM GFR-19.
5. The organization shall ensure that financial and purchase procedures are followed as per the prescribed norms of the organization, within the allocated budget.
6. The organization shall provide timely the Statement of Expenditure and the Utilisation Certificate (UC) for the grant issued by the INCCC in the prescribed format.

7. The assets acquired out of this grant shall be transferred to the desired destination in good and working condition as and when required

Date 20/07/2015

Seal and Signature of the

Head of the Organization

Name:

Designation:

S. D. C. Committee  
20/7/15

**Professor In Charge  
(General Administration)**

**SVNS SVNIT, Surat.**

**(General Administration)  
Professor In Charge**

Place SVNIT-Surat



## ANNEXURE I

### BRIEF RESUME OF PRINCIPAL INVESTIGATOR

<b>1.0</b>	<b>Name, Designation &amp; Date of joining</b>	Dr. P L Patel, Professor of Civil Engineering Department July 03, 2007
<b>2.0</b>	<b>Age as on date</b>	49 years
<b>3.0</b>	<b>Name of the Institution</b>	S V NIT, Surat
<b>4.0</b>	<b>Department</b>	Civil Engineering
<b>5.0</b>	<b>Field of Specialization</b>	Water Resources Engineering
<b>6.0</b>	<b>Academic Qualifications</b>	B E (Civil)Hons., M E (Civil)Hons., PhD (University of Roorkee, Now IIT Roorkee)
<b>7.0</b>	<b>Technical Qualifications</b>	B E (Civil)Hons., M E (Civil)Hons., PhD (University of Roorkee, Now IIT Roorkee)
<b>8.0</b>	<b>Previous Experiences</b>	Joined Border Roads organization as Assistant Executive Engineer through Indian Engineering Services (Sep.1995-June 99).  Served Delhi College of Engineering (Now DTU) from July 99 to Jun 2007 as Reader in Department of Civil Engineering
<b>9.0</b>	<b>Awards / Prizes / Certificates etc.</b>	<ul style="list-style-type: none"><li>❖ <b>The Research project</b> ‘Erosion of non-uniform and bimodal sediments’ sponsored by <b>Department of Science and Technology (DST)</b> was rated under ‘<b>Excellent</b>’ grading during the review and final project completion presentation</li><li>❖ A guided PhD Thesis titled ‘Incipient Motion and Bed Load Transport Characteristics of Unimodal and Bimodal Sediments by (DS08 CE 106) Shaileahkumar B Patel, has been awarded <b>Professor U C Kothyari Best PhD Thesis award of Indian Society for Hydraulics for year 2012-2013</b> in HYDRO-2013 at IIT Madras.</li><li>❖ <b>The G M Nawathe Best Paper Puruskar</b> was awarded for <b>best paper</b>, ‘Sustainable Irrigation Planning using two phase Multi-Objective Fuzzy linear programming approach’ presented in HYDRO-2012 at IIT Bombay.</li></ul>

❖ **Invited for the talk** on ‘Impact of climate change on fluvial processes’ in International workshop on ‘Impacts of global warming from hydrological and hydraulic issues, March 16, 2010, Uji campus, **Kyoto University, Japan.**

❖ **The G M Nawathe Best Paper Puruskar was awarded for best paper**, ‘Incipient motion conditions of nonuniform sediments’ presented in HYDRO-2003 at CWPRS Pune.

## 10.0 Research projects completed/ongoing as Chief Coordinator

**Research projects completed: 02**

**Research projects ongoing: 01**

<b>Sr. No.</b>	<b>Name of the funding agency (AICTE/ Others)</b>	<b>Name of the Scheme</b>	<b>Programme Title</b>	<b>Year of Funding</b>	<b>Duration</b>	<b>Amount Sanctioned Amount (Rs.)</b>	<b>Status: Completed / Ongoing</b>
1.0	TEQIP-II	<b>World Bank and MHRD</b>	Centre for excellence on Water Resources and Flood Management	2013	1.5 year	5 Crore	Ongoing
2.0	DST	<b>SERC</b>	Erosion of Non uniform unimodal and bimodal sediments	2009	Three years	31.89 Lakh	Completed
3.0	AICTE	<b>NCP</b>	Development of water resources and flood management centre	2009	Three Years	35 Lakh	Completed

## 11.0 Publications

<b>International Journal :</b>	<b>13</b>
<b>National Journal :</b>	<b>16</b>
<b>International Conference :</b>	<b>30</b>
<b>National Conference:</b>	<b>42</b>
<b>Total:</b>	<b>101</b>

Sr. No.	Title of Research Paper	Author(s)	Name & Vol. of Journal with Year
<b>International Journal:</b>			
1	Fractionwise calculation of bed load transport,	Patel, P. L. and Ranga Raju, K. G.	Journal of Hydraulic Research, IAHR, Vol.34, No.3.pp 363-379
2	Critical tractive stress of nonuniform sediments	Patel, P. L. and Ranga Raju, K. G.	Journal of Hydraulic Research, IAHR, Vol. 37, No.1, pp 39-58
3	Entrainment Characteristics of Nonuniform Unimodal and Bimodal sediments	P. L. Patel, P. D. Porey, A. D. Ghare and Shaileshkumar B. Patel	Korean Society of Civil Engineering (KSCE), Springer publication, Journal of Civil Engineering, Vol. 13, No.3. Feb.2009, pp189-194.
4	Computation of Critical Tractive Stress of Scaling Sizes in Nonuniform Sediment	P. L. Patel, P. D. Porey, and Shaileshkumar B. Patel	Journal of Hydraulic Research, IAHR, Vol.48 (4), pp. 531-537, 2010.
5	Calibration of HEC-RAS model on prediction of flood for lower Tapi River	P V Timbadiya P. L. Patel, P. D. Porey	Journal of Water Resources and Protection, Scientific Research, Vol. 3, pp. 805-811, 2011,
6	Application of Innovative Trend Analysis Methodology and Distribution Fitting: Study on annual peak inflow into Ukai Dam, Gujarat, India.	P V Timbadiya P L Patel P D Porey	Water & Energy International, CBIP, Vol.69, No.9, pp.40-43, Sep.2012.
7	Threshold for initiation of motion of unimodal and bimodal sediments	S B Patel P L Patel P D Porey	International Journal of Sediment Research (IJSR), Elsevier, Vol. 28(1), pp. 24-33, March 2013
8	Development of sustainable irrigation planning with multiobjective fuzzy linear programming for Ukai - Kakrapar Irrigation Project, Gujarat, India.	A B Mirajkar P L Patel	Canadian Journal of Civil Engineering, Vol.40, No.7, pp.663-673, May 2013
9	Estimation of fractional critical Tractive stress from fractional bed load transport measurements of unimodal and bimodal sediments	S B Patel P L Patel P D Porey	Measurement, Elsevier, Vol. 47, January 2014, Pages 393-400.

10	One-dimensional hydrodynamic modelling of flooding and stage hydrographs in the lower Tapi River in India	P. V. Timbadiya P. L. Patel P. D. Porey	Current Science, Vol. 106(5), pp. 708-716, 10 March 2014
11	A 1D-2D coupled Hydrodynamic model for river flood prediction in a coastal urban flood plain	P V Timbadiya P L Patel P D Porey	Journal of Hydrologic Engineering (ASCE), Vol. 20(2), pp. 05014017-(1-18), Feb. 2015.
12	Fractional bed load transport model for unimodal and bimodal sediments	S B Patel P L Patel P D Porey	Journal of Hydro-Environment Research, Elsevier, Vol. 9, pp. 104-119, March 2015
13	Lumped conceptual hydrologic model for Purna river basin, India	V D Loliyana P L Patel	Accepted for the publication in Sadhana Journal, Springer, being published in forthcoming issues of the journal.
<b>National Journal:</b>			
14	Critical tractive stress of nonuniform and Bimodal sediments	Patel, P. L. and Pati, D. R.	Journal of Hydraulic Engineering, ISH, Taylor and Francis, Vol. 12(1). pp 39-51, 2006.
15	Bed load Transport of Bimodal Sediments	Patel, P L and Jain, Mayank	Journal of Hydraulic Engineering, ISH, Taylor and Francis, Vol. 15(1), pp.14-23, 2009.
16	Critical Tractive Stress of Representative Sizes in Nonuniform Sediments	P. L. Patel, P. D. Porey, and Shaileshkumar B. Patel	Journal of Hydraulic Engineering, ISH, Vol. 15(3), pp. 41-50, 2009.
17	Flood Forecasting in Tapi Basin: A Scope for Improvement	P V Timbadiya P. L. Patel P. D. Porey	Journal of Applied Hydrology, AHI, Vol. XXIII, No.3 & 4, 2010, pp.44-52
18	HEC-RAS based Hydrodynamic model in prediction of stages of lower Tapi River	P V Timbadiya P. L. Patel, P. D. Porey	Journal of Hydraulic Engineering, Indian Society (ISH), Vol.17, No.2, pp.110-117, 2011.
19	A Fuzzy Based Optimal Irrigation Planning for Kakrapar Right Bank Canal Command Area, Gujarat, India	A B Mirajkar P L Patel	Journal of Hydraulic Engineering, Indian Society (ISH), Vol.17 (1), No.3, pp. 110-117, January 2011.

20	Prediction of Missing rainfall data using conventional and artificial neural network.	U C Roman P L Patel P D Porey	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, Volume 18(3), pp. 224-231, September 2012.
21	Optimal Irrigation Planning of Kakrapar Right Bank Canal Using Two Phase Fuzzy Multi- objective Linear Programming Model	A B Mirajkar P L Patel	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Vol.18(3), pp. 232-240, Sep. 2012.
22	Effect of Silt Erosion on Francis Turbine: A case study of Maneri Bhali Stage-II, Uttarakhand	Mandeep Singh J Banerjee P L Patel Himanshu Tiwari	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK; Vol. 19(1), pp. 1-10, March 2013
23	Identification of Trend and Probability Distribution for Time Series of Annual Peak Flow in Tapi Basin	P V Timbadiya A B Mirajkar P L Patel P D Porey	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Vol. 19 (1), pp. 11-20, March 2013.
24	Prediction of friction factor and stage-discharge relationship in alluvial streams	B.R. Andharia, P.L. Patel, V.L. Manekar & P.D. Porey	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Vol. 19(1), pp. 49-54, March 2013.
25	Reply to the discussion on the paper: prediction of missing rainfall data using conventional and artificial neural network techniques by ISH Journal of Hydraulic Engineering, 18 (3), 224-231, Sept. 2012	U C Roman P L Patel P D Porey	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK Vol. 19(2), pp. 78-79, June 2013.
26	Reply to discussion on paper: Prediction of friction factor and stage-discharge relationship in alluvial streams in ISH journal of hydraulic engineering, 19 (1), 49-54, Feb. 2013	B.R. Andharia, P.L. Patel, V.L. Manekar & P.D. Porey	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK Vol. 20(2), pp.188-191, May 2014.
27	Development of Two-layered model for compound open-channel flow	J Sinha S K Das P L Patel B K Samtani	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Vol. 20 (3), pp 250-262, Sep. 2014.

28	Estimation of sediment yield using SWAT model for Upper Tapi basin	Prabhat Chandra P L Patel P D Porey I D Gupta	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Vol. 20 (3), pp 291-300, Sep. 2014.
29	Characterization of flow turbulence in mobile boundary channels	Sudhanshu Dixit P L Patel	ISH Journal of Hydraulic Engineering, Taylor and Francis publisher, UK, Published online, Jan 2015. <b>DOI:</b> 10.1080/09715010.2014.989549
<b>International Conference/Seminar/Symposium:</b>			
30	Semi-theoretical approach on transport of coarse sediments	Patel P L Durga Sai K.	Proceeding of an International Conference on “Hydraulic Engineering: Research and Practice (ICON-HERP-2004)” held at Department of Civil Engineering, IIT Roorkee, Oct. 26 -28, 2004,pp 164-175
31	River stage Simulation using HEC-RAS	P. V. Timbadiya P. L. Patel P. D. Porey	Proceeding of 3 <sup>rd</sup> International Congress on Computational Mechanics and Simulation-2009, at IIT- Bombay during 1-5 December, 2009.
32	Optimization of irrigation area of URBMC – A Linear Programming Approach	Nishi Bhuvandas, A.B.Mirajkar, P.V.Timbadiya, P.L.Patel	AIP conference procedeeing Volume-1324, International conference on Methods and Models in Science and Technology (ICM2ST-10) held at Chandigarh on Dec. 25-26, 2010.
33	Optimal Irrigation Planning By Stochastic Linear Programming Approach For Ukai Irrigation Project	A. B. Mirajkar P. L. Patel	Indo-Italian workshop in Hydrology, CWPRS, Pune, Maharashtra, September, 15-16, 2011.
34	Recent Trend Analysis for Annual Peak Flow in Tapi Basin	P V Timbadiya A B Mirajkar P L Patel P D Porey	International conference on “India Water Week-2012”, organized by Central Water Commission, held at New Delhi.

35	Geomorphic effectiveness of flood on lower Tapi River, India using 1D hydrodynamic model	P. V. Timbadiya P. L. Patel P. D. Porey	International Conference on Hydro-system and Engineering-2012, Orlando, USA at University of Central Florida (UOCF), Orlando, USA organized by UOCF in association with EWRI-ASCE, IAHR, IIHR etc. during November 4-7, 2012.
36	Calibration of channel and flood plain roughness using 1D/2D integrated hydrodynamic model : A study of Surat city on lower Tapi River	P. V. Timbadiya P. L. Patel P. D. Porey	International Conference on Hydro-system and Engineering-2012, Orlando, USA at University of Central Florida (UOCF), Orlando, USA organised by UOCF in association with EWRI-ASCE, IAHR, IIHR etc. during November 4-7, 2012.
37	Multi-objective fuzzy linear programming under uncertain resource parameters	A. B. Mirajkar P. L. Patel	International Conference on Hydro-system and Engineering-2012, Orlando, USA at University of Central Florida (UOCF), Orlando, USA organized by UOCF in association with EWRI-ASCE, IAHR, IIHR etc. during November 4-7, 2012.
38	Experimental study on initiation of motion and bed load transport of unimodal and bimodal sediments	S. B. Patel P. L. Patel P. D. Porey	Proceedings of the 35 <sup>th</sup> IAHR world congress 2013 at Chengdu, China during September 9-13, 2013, Vol. 5(1), paper No. A10517.
39	Analysis of trends and variability in time series of extreme daily rainfall in Tapi basin, India	Nishi Bhuvandas P. V. Timbadiya P. L. Patel P. D. Porey	Proceedings of the 35 <sup>th</sup> IAHR world congress 2013 at Chengdu, China during September 9-13, 2013, Vol. 8(3), paper No. A11949.
40	Fuzzy Programming Models for Optimal Irrigation Planning Under Uncertain Resource Conditions	Mirajkar, A. B. Patel, P. L.	Proceedings of the 18 <sup>th</sup> HYDRO – 2013 International held at IIT Madras, Chennai, during Dec. 4-6, 2013.
41	Ukai reservoir operation simulation using HEC-ResSim	Timbadiya, P. V., Mirajkar, A. B., Patel, P. L.	Proceedings of the 18 <sup>th</sup> HYDRO – 2013 International held at IIT Madras, Chennai, during Dec. 4-6, 2013.

42	Conceptual Rainfall-Runoff Model for Gopalkheda subcatchment (Maharashtra, India) using MIKE11 NAM Model	Loliyana, V. D., and Patel, P. L.	Proceedings of the 18 <sup>th</sup> HYDRO – 2013 International held at IIT Madras, Chennai, during Dec. 4-6, 2013.
43	Sediment yield modeling for upper Tapi basin	Prabhat Chandra, Patel, P. L., Porey, P. D., and Gupta, I. D.	Proceedings of the 18 <sup>th</sup> HYDRO – 2013 International held at IIT Madras, Chennai, during Dec. 4-6, 2013.
44	Mathematical modeling of aggradation in alluvial channels	Andharia, B. R., Patel, P. L., Manekar, V. L., and Porey, P. D.	Proceedings of the 18 <sup>th</sup> HYDRO – 2013 International held at IIT Madras, Chennai, during Dec. 4-6, 2013.
45	Review of Downscaling Methods in Climate Change and Their Role in Hydrological Studies	Nishi Bhuvandas, Timbadiya, P. V., Patel, P. L., and Porey, P. D.	International conference on Environmental, Ecological, Geological and Mining Engineering World Academy of Science, Engineering and Technology, held at Dubai, 2014
46	Calibration and validation of hydrologic model for Yerli sub-catchment (Maharashtra, India)	V. D. Loliyana P L Patel	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
47	Performance of multi purpose reservoir using simulation models for different scenarios	P J Sharma P L Patel V Jothiprakash	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
48	Characterization of turbulence in mobile boundary channels	Dhvani Patwa P L Patel P V Timbadiya	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
49	Development of IDF curve: A study for Dholera region of Gujarat, India	Ankit Patel P V Timbadiya P L Patel	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
50	Turbulence characteristics over a fluvial channel bed	Sudhansu Dixit P L Patel	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
51	Trend detection and forecasting of annual precipitation in Tapi basin, India using singular spectrum analysis (SSA)	Nishi Bhuvandas P V Timbadiya P L Patel P D Porey	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.

52	Experimental and numerical studies on aggradation for alluvial stream bed	Andharia, B. R., Patel, P. L., Manekar, V. L., and Porey, P. D.	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
53	Contrast in sediment yield patterns of subcatchments of upper Tapi basin	Prabhat Chandra, Patel, P. L., Porey, P. D., and Gupta, I. D.	Proceedings of the 19 <sup>th</sup> HYDRO – 2014 International held at MANIT Bhopal, during Dec. 17-19, 2014.
54	Investigation of long-term trends and temporal variability of rainfall in Surat district, Gujarat	P J Sharma V D Loliyana Resmi S R Apoorv Tripathi Garima Nagpal P V Timbadiya P L Patel	International conference on “India Water Week-2015”, organized by Central Water Commission, held at New Delhi during Jan. 13-17, 2015.
55	Flood inundation mapping of Surat city using 1D-2D coupled hydrodynamic model	P V Timbadiya P L Patel P D Porey	International conference on “India Water Week-2015”, organized by Central Water Commission, held at New Delhi during Jan. 13-17, 2015.
56	Trend analysis of climate variables and their impact on stream flow using NAM model	V. D. Loliyana P L Patel	Proceedings of the 36 <sup>th</sup> IAHR world congress 2015 at The Hague, Netherlands, during June 28-July 3, 2015.
57	Experimental investigation of turbulent bursting events in weakly mobile channel bed	Dhvani Patwa P L Patel P V Timbadiya	Proceedings of the 36 <sup>th</sup> IAHR world congress 2015 at The Hague, Netherlands, during June 28-July 3, 2015.
58	A simulation – optimization approach in development of operation policy of a multipurpose reservoir	P J Sharma P L Patel V Jothiprakash	Proceedings of the 36 <sup>th</sup> IAHR world congress 2015 at The Hague, Netherlands, during June 28-July 3, 2015.
59	Development of IDF curve under non-stationary meteorological condition	Ankit Patel P V Timbadiya P L Patel	Proceedings of the 36 <sup>th</sup> IAHR world congress 2015 at The Hague, Netherlands, during June 28-July 3, 2015.
<b>National Conference/ Symposium/ Seminar:</b>			
60	Characteristics of flow past Ski-jump bucket,	Patel, P. L., Asawa, G.L., and Ranga Raju, K.G.	NASORT in Design of Hydraulic Structures, Deptt. of Civil Engg, University of Roorkee, pp 143-151, 1994

61	An evaluation of fractionwise calculation of bed load	Patel, P. L., Ranga Raju, K. G	NASORT in Design of Hydraulic Structures, Deptt. of Civil Engg, University of Roorkee, pp265-272, 1994
62	Criteria for movement of nonuniform sediments-An overview	Patel P L	HYDRO 2000, Recent advances in Hydraulic and Water Resources, Deptt. of Civil Engg., Regional Engineering College, Kurukshetra, pp 216-223
63	Lift and drag model for transport of coarse sediments	Patel P. L. Ghosh, M. D.	HYDRO 2001, National conference on Hydraulics and Water Resources, CWPRS, Khadakwasla, Pune, pp 237-283
64	Model study of a ski-jump type energy dissipator	Mazumder, S. K. Patel, P. L	HYDRO 2001, National conference on Hydraulics and Water Resources, CWPRS, Khadakwasla, Pune, pp 425-432
65	Measures for silt free water in power canal	Patel, P. L.	National Workshop on 'Water Quality (Including drinking water)' Feb. 2002 held at Jawahar Lal Nehru University, New Delhi.
66	An evaluation of critical tractive stress of nonuniform sediments	Patel, P. L	National Conference on Advances in Civil Engineering, Deptt of Civil Engg., HBTI, Kanpur, pp 452-457
67	Incipient motion conditions of nonuniform sediments	Patel, P. L., Sharma A. K.	National Conference on Hydraulics and Water Resources, HYDRO 2003, December 26-27, 2003, Khadakwasla, Pune, pp 183-187
68	Sediment transport concepts in design of power canals and silt exclusion devices	Patel, P. L.	Proceeding of a National Seminar on Safety and Quality management in development of Uttranchal, organized by Institution of Engineers, June 24, pp.241-245.
69	Prediction of critical tractive stress of nonuniform and bimodal sediments	Patel, P. L.	Proceeding of a National Conference HYDRO-2005, Dec. 08-09, SIT Tumkur, pp.668-674.
70	Critical submergence of ski-jump bucket: An analytical approach,	Patel P L and Shrivastava Vishal	Proceeding of a National Conference HYDRO-2006, Dec. 08-09, SIT Tumkur.

71	Probabilistic model in prediction of nonuniform sediment bed surface under equilibrium condition	Goyal Kanhaiya and Patel P L	Proceeding of a National Conference HYDRO-2007, Dec. 21 -22, SVNIT Surat, pp 297-305.
72	Study of Mobility Index of Sarangkhedha gauging station of Tapi River	Anajwala J. Nitisha, Patel P L and Samtani B K	Proceeding of a National Conference HYDRO-2007, Dec. 21 -22, SVNIT.
72	Stream flow forecasting using Deterministic approach for Sabarmati River Basin	P.V.Timbadiya A.D.Ghare P.L.Patel P.D.Porey	Proceeding of 13 <sup>th</sup> National Seminar symposium on Hydrology with focal theme on “flow forecasting during Extremes”, 28-29, August 2008, IIT-Delhi.
73	Computation of Bed load transport of nonuniform bimodal sediments	P L Patel, P D Porey Jain Mayank	Proceeding of Indian National conference on Advances in Hydraulic engineering with special emphasis on Model- Prototype Conformity, INCAHE-2008, Nov. 6-7. 2008., pp.184-188.
74	Critical Tractive Stress of Representative Sizes in Nonuniform Sediments	P. L. Patel, P. D. Porey, and Shaileshkumar B. Patel	Proceeding of a National Conference HYDRO - 2008, MNIT, JAIPUR (INDIA), pp. 366-374. Dec. 15 -16, 2008.
75	Stream flow forecasting using ANN approach for Sabarmati River Basin	Timbadiya P V Patel P L Porey P D	Proceeding of a National Conference HYDRO-2008, Dec. 15-16, 2008 held at MNIT Jaipur, pp.254-263.
76	Flood Forecasting in Tapi Basin : A Scope for Improvement -	P.V.Timbadiya, P.L.Patel and P.D.Porey	Proceeding of National Seminar on recent advances in Hydrology for Water Resources Development and Management & xxvii Annual Convention of AHI 21st & 22nd January 2009, Baroda.
77	Need for Water Resources and Flood Management Centre in South Gujarat Region	P.L.Patel B K Samtani	Proceeding of Seminar on Water for Future- Ussues and Options organized by CWC on 4 <sup>th</sup> -5 <sup>th</sup> March-2009.
78	Simulation of Unsteady flow in Natural channel: A case study of Tapi river using MIKE-11.	P.V.Timbadiya P.L.Patel P.D.Porey	Proceeding of the Civil Engineering Conference- Innovation Without Limits (CEC-09) at NIT-Hamirpur during Septemer 18-19, 2009.

79	Simulation of flow in Tapi river between Ukai Dam and Kakrapar weir using HEC-RAS	P.V.Timbadiya Jaimin Trivedi Niket R Shah P L Patel	Proceeding of the Civil Engineering Conference- Innovation Without Limits (CEC-09) at NIT-Hamirpur during September 18-19, 2009.
80	Evaluation of Existing Methods for Computation of Critical Tractive Stress of Bimodal Sediments	P. L. Patel, P. D. Porey, and Shaileshkumar B. Patel	National Specialty Conference on River Hydraulics - 2009, held at MMU- Mullana, Haryana, Oct. 29-30, 2009.
81	Characterization and Computation of Critical Tractive Stress of Bimodal sediments	P. L. Patel, P. D. Porey, and Shaileshkumar B. Patel	Proceeding of a National Conference HYDRO - 2009, held at Khadakwasla, PUNE (INDIA), Dec. 17 -18, 2009.
82	Optimal Irrigation Planning in Fuzzy Environment: A Case Study of Kakrapar Canal Command Area, Gujarat	A. B. Mirajkar, Dr. P. L. Patel	HYDRO-2010, At Ambala (Haryana), on 16-18 December, 2010.
83	Simulation of Stages using Hydrodynamic model MIKE 11 : A case study of Lower Tapi river	P. V. Timbadiya P. L. Patel P. D. Porey	14 <sup>th</sup> National Symposium on Hydrology at MNIT- Jaipur during December- 21-22, 2010.
84	Optimal Cropping Pattern for Ukai Command Area, Gujarat.	A. B. Mirajkar, Dr. P. L. Patel	14 <sup>th</sup> National Symposium on Hydrology, at MNIT, Jaipur, on 21-22, December, 2010.
85	Optimal Cropping pattern in Command Area Kakrapar Right Bank Main Canal	Nishi Bhuvandas A. B. Mirajkar P. V. Timbadiya P. L. Patel	National Conference on Sustainable Development of Urban Infrastructure, VNIT, Nagpur, pp. 408-413, June 2010.
86	Optimal Irrigation Planning in Fuzzy Environment: A Case Study of Canal Command Area, Gujarat	A. B. Mirajkar P. L. Patel	National Conference on Environment Pollution and Management, GEC Aurangabad, MS, pg 159-166, Jan-2011.
87	HEC-RAS Model in Prediction of Levees along Lower Tapi River	Viraj D. Loliyana Dr. P. L. Patel P. V. Timbadiya M. Khan K. L. Dave	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.

88	One-Dimensional Model in Prediction of Stage-Discharge Curves in Natural Channel	P. V. Timbadiya Dr. P. L. Patel Dr. P. D. Porey	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
89	Hydrodynamic Simulation of Open Channel Flow using MIKE 11 and its Validation: A Case Study	P. V. Timbadiya Apurva M. Suthar Dr. P. L. Patel	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
90	Irrigation Operating Policies using Genetic Algorithm for Ukai Reservoir, India: A Case Study	S. S. Shiyekar Dr. P. L. Patel Dr. P. D. Porey	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
91	Chance Constraint Linear Programming Model for Optimal Cropping Pattern	A. B. Mirajkar Dr. P. L. Patel	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
92	Analysis of Sediment Yield Data in Tapi Basin	Prabhat Chandra Dr. P. L. Patel Dr. P. D. Porey Dr. I. D. Gupta	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
93	Comparative Performance of Critical Tractive Stress Predictors for Bimodal Sediments	Shailesh B. Patel Dr. P. L. Patel Dr. P. D. Porey	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
94	Estimation of Friction Factor for Alluvial Rivers	B. R. Andharia Dr. V. L. Manekar Dr. P. L. Patel Dr. P. D. Porey	Proceeding of National Conference, HYDRO-2011, At SVNIT (Surat), on 29-30 December, 2011.
95	Comparative Prediction of rating curves using 1D and 1D-2D coupled Hydrodynamic models	P. V. Timbadiya P. L. Patel P. D. Porey	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.
96	Sustainable Irrigation Planning using two phase Multi-Objective Fuzzy linear programming approach	A. B. Mirajkar P. L. Patel	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.

97	Development of two layered model for compound open channel flow	J. Sinha S.K.Das P.L.Patel B.K.Samtani	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.
98	Experimental investigation on threshold for incipient motion of graded sediments	S.B.Patel P.L.Patel P.D.Porey	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.
99	Estimation of sediment yield using SWAT model- Generation of input data for Tapi basin	Prabhat Chandra P .L.Patel P.D.Porey I.D.Gupta	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.
100	Calibration and performance of HEC-RAS based hydrodynamic model for stage prediction in lower Tapi river	V.D. Loliyana P.L.Patel	Proceeding of National Conference, HYDRO-2012, IIT-Bombay, December, 7-8, 2012.
101	Sustainable Irrigation Planning Management With Multi-Objective Fuzzy Linear Programming	A. B. Mirajkar P. L. Patel	Proceedings of SWRDAM-13 to be held at GEC Aurangabad, during Sept, 30 <sup>th</sup> –Oct 1 <sup>st</sup> 2013.

## 12.0 Consultancy Projects:

**No. of consultancy projects completed: 05**

**No. of consultancy projects ongoing: 04**

Sr. No.	Sponsoring Authority	Type of Work	Fund Sanctioned (Rs.)	Present Status
1	Central Water Commission	Morphological study on Tapi River using Remote sensing technique	72.86 Lakh	Ongoing
2	Surat Municipal Corporation	Safety assessment of Singanpore weir-cum-Causeway	15.00 Lakh	Ongoing
3	Tehri Hydro Development India Corporation Limited (THDICL) -Rishikesh Uttarakhand	CFD Simulations of Hydro Turbines including Tail Race of Koteshwar Hydro Power Project	15.00 Lakh	Ongoing
4	Design Point Consultant Pvt. Ltd. Surat	Design of storm drainage, water	29.50 Lakh	Ongoing

		supply, sewerage and waste water recycling work of TP2E of DSIR		
5	Tehri Hydro Development India Corporation Limited (THDACL) -Rishikesh Uttarakhand	Conducting CFD Simulations of River Pocket in front of Tail Race Tunnels (TR1 and TR2) of Tehri HPP	7.75 Lakh	Completed
6	Uttaranchal Jal Vidyut Nigam Limited-Dehradun	CFD Analysis of Maneri Bhali Stage II (Part I&II)	13.40 Lakh	Completed
7	SVNIT-Surat	Design of Water Distribution Network for SVNIT-Surat with revised demand	Services were provided free of cost being Institute project	Completed
8	Surat Municipal Corporation	Consultancy work on "Safety of Weir-cum-Causeway (Singanpur) due to flooding, Year 2007"	0.30 Lakh	Completed
9	Gujarat Water Resources Water Supply and Kalpsar Department	'Damaged Aqueduct at Chainage 7350 m on the Daman-Ganga Left Bank Main Canal of Daman-Ganga Project'	1.12 Lakh	Completed

13. Master Theses guided: 28 Nos.

14 PhD Theses guided: Completed 04  
Ongoing 11

**Completed Ph.D Thesis**

- i) DEVELOPMENT OF 1D-2D INTEGRATED HYDRODYNAMIC MODEL FOR RIVER FLOOD PREDICTION IN COASTAL URBAN FLOODPLAIN
- ii) INCIPIENT MOTION AND BED LOAD TRANSPORT CHARACTERISTICS OF UNIMODAL AND BIMODAL SEDIMENTS
- iii) MULTI-OBJECTIVE FUZZY OPTIMIZATION APPROACH IN INTEGRATED MANAGEMENT OF WATER RESOURCES

iv) ESTIMATION OF MISSING RAINFALL AND PREDICTION OF RUNOFF IN UPPER CATCHMENT OF TAPI BASIN

15 Member of Professional societies:

1. Fellow Institution of Civil Engineers
2. Member, International Association for Hydraulic Research(IAHR)
3. Fellow Indian Society for Hydraulics (ISH)
4. Fellow Indian Water Resources Society (IWRS)
5. Life Member, Indian Society for Technical Education (ISTE)

16. Any other activity

A member of working group of IAHR  
Working on effect of Climate change  
(Fluvial Mechanism)

## Brief Biodata of Co-Investigator

**Dr. ROHIT GOYAL**

**Designation** : **Professor in Civil Engineering, MNIT Jaipur**  
Educational Qualification : B.E. (Civil), M. E (Hydraulics and Irrigation Engg.),  
PG Diploma (Remote Sensing application in Water  
Resources Engineering), Ph.D Topic: “Seepage from  
Canals Founded on Finite Pervious Soil with  
Asymmetric Drainages”  
Area of Interest : Water resources, Remote Sensing application in  
Water Resources Engineering  
Papers Published : Journals : 20 Nos.  
Conferences : 57 Nos.  
Ph.D. thesis guided : 05  
Consultancy Project : 11 Nos.  
Research Projects : 05 Nos.  
Short Courses/ Workshop /  
Conference Attended : International: 04 Nos., National: 10 Nos.  
Courses/Workshops organized : 10 Nos.  
Best paper awards/prizes received : 01 No.  
Member of Professional societies:  
1) Indian Society for Hydraulics  
2) Indian Association of Hydrologists  
3) Indian Society for Technical Education

**Dr. VISHNU PRASAD**

***Designation*** : ***Professor in Civil Engineering, MANIT Bhopal***  
Date of Joining : 01-01-2010  
Date of Birth : 1<sup>st</sup> July, 1964  
Educational Qualification : B.E.(Civil), M. Tech.(Water Resources Engg.),  
Ph.D.(Hydro Power)  
Area of Interest : Water resources, Hydraulics and Hydraulic Machines,  
Computational Fluid Dynamics  
Experience : 26 years in teaching and research  
Papers Published : Journals : 28 Nos.  
Conferences : 60 Nos.  
M.Tech Thesis Guided : 59 Nos.  
PhD Thesis Guided : 01 No.+5 (Under progress)  
Consultancy Project : Participated in: 25 projects  
Research Projects : 2 Nos.  
Foreign Visits : UK and Thailand  
Conference Attended : International : 07 Nos., National : 16 Nos.  
Short Courses/ Workshop attended : Courses : 13 Nos.  
Workshops : 10 Nos.  
Training Courses/Workshops organised : 07 Nos.  
Member of Professional Bodies : 03 Nos.  
Best paper awards/prizes received : 02 Nos.  
Administrative responsibility : Presently Head of Civil Engg.

**Others:** Member of Editorial Board of International Journal “HYDRO NEPAL” 6 Months training in UK on Model testing, CFD and involved in Administrative and other activities at Institute level.

**DR. P V TIMBADIYA**

<b>1.0</b>	<b>Designation &amp;</b>	<b>Assistant Professor</b>
	<b>Date of joining :</b>	<b>March 19, 2009</b>
<b>2.0</b>	<b>Age as on date</b>	34 years 8 months
<b>3.0</b>	<b>Name of the Institution</b>	S.V.National Institute of Technology-Surat
<b>4.0</b>	<b>Department</b>	Civil Engineering Department
<b>5.0</b>	<b>Field of Specialization</b>	Water Resources Engineering
<b>6.0</b>	<b>Academic Qualifications</b>	M.E. (WRE), PhD
<b>7.0</b>	<b>Awards / Prizes / ---</b>	

**8.0 Projects completed/ongoing as Principal Investigator -----**

No. of sponsored research project (ongoing/completed) 01 ongoing

No. of Consultancy Project (ongoing/completed) 04 ongoing

**9.0 Publications**

No. of Paper Published in refereed  
International and National Journals : 07

No. of paper published in International  
and National conference proceedings : 25

**10.0 Ph.D. Theses Guided: 04 ongoing**  
**Master Theses guided: 09 completed**  
**02 ongoing**

**11.0 Member of Professional societies:** 1) Indian Society for Hydraulics  
2) Indian Association of Hydrologists  
3) Association of Hydrologist of India  
4) Indian Water Resources Society  
5) Indian Society for Technical Education

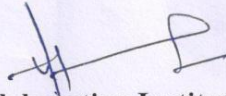
## ANNEXURE: II – Endorsement of MNIT Jaipur

### Endorsement from collaborating Institution/Agency

I have gone through the Research proposal entitled ‘**Impact of climate change on water resources of Tapi basin**’ submitted by **Dr. Rohit Goyal, Professor (Co-PI)**, Department of Civil Engineering of MNIT Jaipur with **Dr. P L Patel, Professor (PI)**, Department of Civil Engineering, SVNIT Surat for MoWR funding and noted the obligations and responsibilities indicated in our name which are as below:

- a. Proposed activities of research work: Rainfall runoff and sediment yield modeling for upper and middle Tapi basin
- b. Estimated cost for the proposed activities (Rs. 16,61,225)
- c. Share of Overhead charges and Contingency (Taken together)  
Overhead charges (@10% of estimated project cost) = Rs. 1,66,122.50  
Total cost = **Rs. 18,27,348**

I hereby affirm that my organization is committed to participate in the research scheme to the full extent with above mentioned obligations and responsibilities.



(Head of the collaborating Institution/Agency)  
Seal/Stamp

**DEAN**

Research & Consultancy  
Malaviya National Institute of Technology Jaipur  
JAIPUR-302017

Date: 14/7/2015  
Place: MNIT Jaipur

## Budget

### MNIT Jaipur Budget

Subhead Amount (Rs.)	Amount (Rs.)
Salary to SRF	12,09,600.00
Travel & Contingency Expenditure	1,50,000.00
Infrastructure / Equipment	2,01,625.00
Experimental Charges	1,00,000.00
Sub Total	16,61,225.00
Institutional over heads (10%)	1,66,122.50
<b>Grand Total</b>	<b>Rs. 18,27,348</b>

#### Salary MNIT Jaipur INR = 12,09,600

Details	Year 1	Year 2	Year 3	Total
Salary of SRF 01	3,36,000	3,36,000	3,36,000	10,08,000
HRA	67,200	67,200	67,200	2,01,600
Total	4,03,200	4,03,200	4,03,200	12,09,600

#### Travel & Contingency MNIT Jaipur INR = 1,50,000

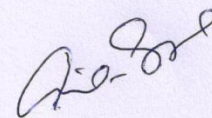
Details	Year 1	Year 2	Year 3	Total
Review meeting & Field visit	50,000	50,000	50,000	1,50,000

#### Infrastructure/ Equipment MNIT Jaipur INR = 7,55,000

Details	Cost (INR)	Year (of purchase)
PC/laptop/workstation/software/ printer	2,01,625	Year 1
Total	2,01,625	

#### Experimental Charges (MNIT Jaipur) INR = 1,00,000

Details	Cost (INR)	Year (of purchase)
Consumables and other Miscellaneous expenditure	1,00,000	Year 1 ,2, 3



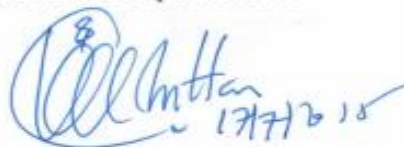
### ANNEXURE: III – Endorsement of MANIT Bhopal

#### Endorsement from collaborating Institution/Agency

I have gone through the Research proposal entitled '**Impact of Climate Change on Water Resources of Tapi Basin**' submitted by **Dr. Vishnu Prasad, Professor (Co-PI)**, Department of Civil Engineering of MANIT Bhopal with **Dr. P L Patel, Professor (PI)**, Department of Civil Engineering, SVNIT Surat for MoWR funding and noted the obligations and responsibilities indicated in our name which are as below:

- a. Proposed activities of research work: Rainfall runoff and sediment yield modeling for Middle and Lower Tapi basin and inflow prediction into Ukai reservoir
- b. Estimated cost for the proposed activities = **Rs.26,65,160.00**
- c. Share of Overhead charges and Contingency (Taken together)  
Overhead charges (@10% of estimated project cost) = **Rs.2,66,516.00**  
Total cost = **Rs.29,31,676.00**

I hereby affirm that my organization is committed to participate in the research scheme to the full extent with above mentioned obligations and responsibilities.



(Head of the collaborating Institution/Agency)

Seal/Stamp

Date:17-07-2015  
Place: MANIT Bhopal

निदेशक / Director  
मौलाना आज़ाद राष्ट्रीय प्रौद्योगिकी संस्थान  
Maulana Azad National Institute of Technology  
भोपाल-462051 (म.प्र.) भारत  
BHOPAL-462051 (M.P.) INDIA

## BUDGET

### MANIT Bhopal Budget

Subhead Amount (Rs.)	Amount (Rs.)
Salary to JRF	11,23,200.00
Travel & Contingency Expenditure	1,50,000.00
Infrastructure / Equipment	12,91,960.00
Experimental Charges	1,00,000.00
Sub Total	<b>26,65,160.00</b>
Institutional over heads (10%)	2,66,516.00
<b>Grand Total</b>	<b>29,31,676.00</b>

**Salary: MANIT, Bhopal INR = 11,23,200**

Details	Year 1	Year 2	Year 3	Total (INR)
<u>Salary of JRF 01</u>	3,00,000	3,00,000	3,36,000	<b>9,36,000</b>
HRA	60,000	60,000	67,200	<b>1,87,200</b>
Total	3,60,000	3,60,000	4,03,200	<b>11,23,200</b>

**Travel & Contingency: MANIT, Bhopal INR = 1,50,000**

Details	Year 1	Year 2	Year 3	Total(INR)
<u>Review meeting</u>	50,000	50,000	50,000	<b>1,50,000</b>

**Infrastructure/ Equipment: MANIT, Bhopal INR = 12,91,960**

Details	Cost (INR)	Year (of purchase)
Arc GIS Software	10,11,960	1 Year
Computer and printer	2,00,000	
Laptop	80,000	
Total	<b>12,91,960</b>	

**Experimental Charges: MANIT, Bhopal INR = 1,00,000**

Details	Cost (INR)	Year (of purchase)
Consumables and other Miscellaneous expenditure	1,00,000	Year 1 ,2, 3

*[Handwritten Signature]*  
17/7/15

## ANNEXURE: IV GUIDELINES FOR PAYMENT OF SALARY TO SRF/JRF

SR/S9/Z-09/2012  
Government of India  
Ministry of Science & Technology  
Department of Science & Technology

Technology Bhavan  
New Mehrauli Road  
New Delhi-110016

Dated: October 21, 2014

### OFFICE MEMORANDUM

**Subject: Revision of emoluments and guidelines on service conditions for research personnel employed in R& D programme of the Central Government Departments/Agencies**

Attention is invited to the Office Memorandum (O.M.) No. A-20020/11/97-IFD dated 31.03.2010 issued by the Department of Science and Technology, Government of India on the above subject. The matter has been further considered by the Government and the following revised emoluments have been approved. The O.M. is applicable to the research personnel working on R&D programmes funded by the Central Government Department/Agencies.

#### 1) Emoluments:

##### A. Junior Research Fellow (JRF) / Senior Research Fellow (SRF)

Sl. No.	Designation & Qualification	Revised Emoluments per month
I	<b>Junior Research Fellow (JRF)</b> Post Graduate Degree in Basic Science with NET qualification or Graduate Degree in Professional Course with NET qualification or Post Graduate Degree in Professional Course	Rs.25,000/-
II	<b>Senior Research Fellow (SRF)</b> Qualification prescribed for JRF with two years of research experience	Rs.28,000/-

The local institution shall review the performance of JRF after two years through an appropriate Review Committee constituted by the Head of the Institution. The fellow may be awarded SRF after successful assessment by the Review Committee.

##### B. Research Associate

Research associates may be fixed at a consolidated amount at one of the 3 pay levels given below depending upon the qualification and experience. The Institute/Organization

concerned may decide the level in which a particular associate should be placed based on the experience. The Essential Qualification (EQ) for RA is as follows:

Ph.D/MD/MS/MDS or equivalent degree or having 3 years of research, teaching and design and development experience after MVSc/M.Pharm/ME/M.Tech with at least one research paper in Science Citation Indexed (SCI) journal.

Sl. No.	Category	Revised Emoluments per month
I	Research Associate –I	Rs.36,000/-
II	Research Associate –II	Rs.38,000/-
III	Research Associate –III	Rs.40,000/-

## 2. Service Conditions:

(i) **DA:** JRFs, SRFs and Research Associates will not be entitled to DA.

(ii) **House Rent Allowance (HRA):** All research fellows may be provided hostel accommodation wherever available and those residing in accommodation provided by the institute will not be eligible for drawing HRA. Wherever provision of hostel accommodation is not possible, HRA may be allowed to all the above categories viz. JRF, SRF and RA as per Central Government norms applicable in the city/location where they are working. The fellowship amount may be taken as basic for calculating the HRA.

(iii) **Medical Benefits:** The research fellows and research associates (JRF/SRF/RA) will be entitled for medical allowance as applicable in the implementing institution.

(iv) **Leave and other entitlements:** The JRF/SRF are eligible only for casual leave while Research Associates are entitled to leave as per rules of the host institution. Participation of any of these categories (JRF/SRF/RA) in scientific event/workshops held in India or abroad will be treated as "on duty". The travel entitlement for JRF/SRF/RA for participation in scientific events/workshops in India will continue to be the same as earlier i.e. 2<sup>nd</sup> AC by rail. Maternity leave as per the Govt. of India instructions issued from time to time would be available to female candidates in all categories.

(v) **Bonus & Leave Travel Concession:** JRFs, SRFs and Research Associates will not be entitled to these allowances.

(vi) **Retirement Benefits:** JRFs, SRFs and Research Associates will not be entitled to these benefits.

(vii) **Publication/Patent:** The results of JRF/SRF/RA's research work may be published in standard refereed journals at the discretion of the Fellow or his/her Guide. It should be ensured by the fellow that the assistance provided by the funding agency of Government of India is acknowledged in all such publications.

(viii) **Engagement for pursuing higher degree:** Students selected as JRF/SRF may be encouraged to register for higher degrees and the tuition fees to undertake these studies may be reimbursed to the student from the contingency grant sanctioned under the project grant, if required.

**(ix) Obligation of JRF/SRF/RA:**

- a) He/She shall be governed by the disciplinary regulations of the host Institute where he/she is working.
- b) The JRF/SRF/RA must send a detailed consolidated report of the research work done during the entire period of Fellowship on completion of the tenure/resignation of the Fellowship at the earliest.

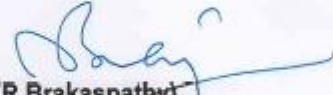
3. Central Government Departments /Agencies are requested to ensure that the above guidelines are followed in regard to the remuneration and other benefits to the research personnel engaged in R&D projects funded by them. They are also requested to circulate these orders to their attached and subordinate offices and also to the autonomous institutes funded by them.

4. Individual Departments/Institutes are not allowed to top-up the fellowship amount from their internal resources.

5. Departments/Agencies like ICMR, ICAR, DAE, DST, DBT etc. which conduct national level examinations may adopt the revised rates provided the existing rates contained in the O.M. dated 31.03.2010 have been adopted by them on the same terms & conditions. However, the revised rates are not applicable to fellows of ICAR pursuing M.Sc. and Ph.D in Agriculture and Allied Sciences.

6. **Date of Effect:** The revised emoluments will take effect from 1.10.2014. The individual departments may project the requirement of necessary funds in RE 2014-15/BE 2015-16.

7. This issues with the concurrence of the Department of Expenditure, Ministry of Finance vide their I.D. No. 184685/14 dated 15.10.2014.






**(R Brakaspathy)**  
**Scientist G / Tel No. 26961916**

To

1. All Ministries/Departments/Agencies of the Government of India
2. All Heads of DST

**ANNEXURE: V**

<p>Civil Engineering Department Sardar Vallabhbhai National Institute Of Technology (SVNIT) Ichchhanath Surat, Gujarat 395007 India</p> <p><b>DELIVERED TO</b> Civil Engineering Department Sardar Vallabhbhai National Institute Of Technology (SVNIT) Ichchhanath Surat, Gujarat 395007 India</p> <p>Attn. Dr. P. L. Patel</p>	<p align="right"><b>DUPLICATE</b></p>  <p>DHI (India) Water &amp; Environment Private Limited IIIrd Floor, NSIC - STP, Complex, NSIC Bhawan Okhla Industrial Estate New Delhi 110020 Telephone: +91 11 4703 4500 Facsimile: +91 11 4703 4501 PAN Number: AABCD4731H VAT: AABCD4731HST001 TIN No: 7800249710 Email: <a href="mailto:dhi-india@dhigroup.com">dhi-india@dhigroup.com</a> Web: <a href="http://www.dhigroup.com">www.dhigroup.com</a></p> <p>Date: 13.02.2014 Cust. No: 2011226 Order No: 6310357</p> <p>Your ref:TEQIP-II/2013/SVNITS/Direct Contract/49/3878 Dated: 20 January 2014</p>																					
<b>Invoice 63410714</b>																						
<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Product</th> <th style="text-align: left;">Key No.</th> <th style="text-align: left;">Licence</th> <th style="text-align: left;">Inst. Type</th> <th style="text-align: left;">Qty.</th> <th style="text-align: left;">Total</th> </tr> </thead> <tbody> <tr> <td>MIKE SHE - Watersher modelling software Latest version</td> <td>17743</td> <td>University</td> <td>Network</td> <td>1.00</td> <td>648,807.37</td> </tr> </tbody> </table>	Product	Key No.	Licence	Inst. Type	Qty.	Total	MIKE SHE - Watersher modelling software Latest version	17743	University	Network	1.00	648,807.37	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Total</td> <td style="width: 20%; text-align: right;">INR</td> <td style="width: 20%; text-align: right;">648,807.37</td> </tr> <tr> <td>Service Tax</td> <td style="text-align: right;">INR</td> <td style="text-align: right;">80,192.59</td> </tr> <tr> <td><b>Total</b></td> <td style="text-align: right;"><b>INR</b></td> <td style="text-align: right;"><b>728,999.96</b></td> </tr> </table>	Total	INR	648,807.37	Service Tax	INR	80,192.59	<b>Total</b>	<b>INR</b>	<b>728,999.96</b>
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<b>Total</b>	<b>INR</b>	<b>728,999.96</b>																				
<p>Terms of Payment: 30 days invoice receipt <span style="float: right;">Rounding to 729,000.00</span></p>																						
<p>Account Name: DHI (India) Water &amp; Environment Private Limited Account No. 053-176277-001 Bank: HSBC Branch: F - 43, South Extension, New Delhi IFSC Code: HSBC0110004 MICR Code: 000039000 Swift Code: HSBC INBB</p>	 <div style="text-align: right; margin-top: 10px;">               _____              Authorised Signatory         </div>																					

## ANNEXURE: VI



ESRI/SVNIT/100214/01  
10<sup>th</sup> February, 2014

### EDUCATION OFFER

S. No.	Name of GIS Software	Commercial price	Special Price for SVNIT (One Year)	Special Price for SVNIT (Three Year)
01	ArcGIS University Lab Kit	58,06,759.00	8,62,270.00	14,21,268.00
		CST @5% and Service Tax @12.36%		
			1,49,690.00	2,02,264.00
		<b>Total</b>	<b>10,11,960.00</b>	<b>16,68,000.00</b>

### UNIVERSITY LAB KIT INCLUDES FOLLOWING CORE SOFTWARE AND EXTENSIONS

#### CORE SOFTWARE

1. Arc GIS Arc Info Concurrent User
2. Arc GIS Arc Editor Concurrent User
3. Arc GIS Arc View Concurrent User

#### EXTENSIONS

1. Arc GIS 3 D Analyst
2. Arc GIS Spatial Analyst
3. Arc GIS Network Analyst
4. Arc GIS Geostatistical Analyst
5. Arc GIS Arc Scan
6. Arc GIS Arc Publisher
7. Arc GIS Arc Press
8. Arc GIS Maplex
9. Arc GIS Schematic

**ANNEXURE: VII**

**Estimate for procurement of Survey of India topographical map (digital format)**

Basin	Sub basin	Toposheet no:	Total no. of toposheet	Approx. Area in km <sup>2</sup>	Vector/ Raster	Scale	Price (rate Rs.16500/sheet)	Remark
Tapi	Lower Tapi	46G, 46C	02	3610	Vector	1:250000	33000	Multiple license
	Middle Tapi	46O,46P, 55C,55D, 46K.46L, 46H	07	31697	Vector	1:250000	115500	Multiple license
	Upper Tapi	55G, 55K, 55H,	03	26455	Vector	1:250000	49500	Multiple license
						Total	1,98,000*	
						Service Tax @12.35%	24,750/-	
						Grand Total	2,22,750/-	

\* As per details available on Survey of India website

## ANNEXURE: VIII



901-902 Gunjan Towers, Off Alembic-Gorwa Road, Subhanpura, Vadodara - 390023  
Tel : 0265-3058800, Fax : 0265-3058810 Email : vadodara@aimil.com

Sr No.	Description	Qty	Total Price
1.1	<p><b>BASE KIT</b></p> <p><b>GeoXT 2008/3000 Series</b></p> <p><u>System Specification</u></p> <ul style="list-style-type: none"> <li>§ Windows Mobile 6.1 (Classic edition)</li> <li>§ VGA display, sunlight-readable color touchscreen</li> <li>§ Integrated Bluetooth &amp; wireless LAN</li> <li>§ Ergonomic cable-free handheld</li> <li>§ Rugged and water-resistant design</li> <li>§ All-day internally rechargeable Li-ion battery</li> <li>§ Marvell 520 MHz XScale processor with 128 MB RAM</li> <li>§ 1 GB non-volatile Flash data storage</li> <li>§ Sealed SD/SDHC card slot</li> <li>§ Integrated speaker and microphone</li> </ul> <p><u>GPS Specification</u></p> <ul style="list-style-type: none"> <li>§ Integrated high-performance GPS/SBAS receiver and L1 antenna</li> <li>§ Submeter real-time or 50 cm postprocessed accuracy</li> <li>§ RTCM and CMR real-time correction support</li> <li>§ TSIP and NMEA protocol support</li> <li>§ EVEREST™ multipath rejection technology</li> </ul>	1 Set	365,000.00
1.2	<p><b>TerraSync Professional Field Software</b></p> <p>Field-proven software with powerful functionality for productive GIS data collection and maintenance</p> <p><u>Key Features</u></p> <ul style="list-style-type: none"> <li>§ Software designed for efficient field GIS data collection and maintenance</li> <li>§ Intelligent data capture based on conditional attribute collection requirements</li> <li>§ Customizable user interface data to simplify the field worker experience</li> <li>§ Seamless GNSS control in the field for high quality position data</li> <li>§ Fast, real-time map display supports multiple raster and vector background maps</li> <li>§ Graphical screens for navigation back to selected features</li> </ul>	1x	
2	<p><b>ROVER KIT</b></p> <p><b>Juno SB handheld with software – 5 unit classroom kit for</b></p>	1	275,000.00

**Corporate Office:** Naimex House, A-8, Mohan Co-operative Industrial Estate, Mathura Road, New Delhi-110044, India  
Phone: 91-11-30810200, Fax: 91-11-26950011, Email: info@aimil.com, Website: www.aimil.com  
**Branches:** Bengaluru, Bhubaneswar, Chandigarh, Chennai, Guwahati, Hyderabad, Indore, Kochi, Kolkata, Lucknow, Mumbai

Beyond Options. Solutions

	Includes		
2.1	<p><b>Juno SB handheld GPS Receiver</b></p> <p><u>System Specification</u></p> <p>Microsoft Windows Mobile 6.1 Operating System 533 MHz Samsung processor with 128 MB RAM Integrated Bluetooth v2.0 and 802.11b/g wireless LAN Integrated digital camera (color, 3 megapixel resolution) 128 MB non-volatile Flash data storage Micro SD (micro SDHC compatible) memory card slot QVGA display, sunlight-readable color touch screen Internally rechargeable and removable Li-Ion battery Integrated speaker, microphone and audio jack</p> <p><u>GPS Specification</u></p> <p>Integrated high-sensitivity GPS/SBAS receiver and antenna 1 to 3 meter accuracy after post processing NMEA and SiRF protocol support</p>	5x	
2.2	<p><b>Terrasync Professional Field Software</b></p> <p>Field-proven software with powerful functionality for productive GIS data collection and maintenance</p> <p><u>Key Features</u></p> <p>Software designed for efficient field GIS data collection and maintenance Intelligent data capture based on conditional attribute collection requirements Customizable user interface data to simplify the field worker experience Seamless GNSS control in the field for high quality position data Runs on a wide range of Trimble handheld and tablet field computers Fast, real-time map display supports multiple raster and vector background maps Graphical screens for navigation back to selected features</p>	5x	
2.3	<p><b>GPS Pathfinder Office Software</b></p> <p>Powerful and easy to use GPS data processing software for a seamless workflow between the GIS and the field</p> <p><u>GPS accuracy</u></p> <p>Improve GPS position accuracy through differential post processing, including GLONASS post processing Post process real-time differential GPS data to improve accuracy and consistency Review and edit GPS data before you transfer it to a GIS</p> <p><u>GIS compatibility</u></p> <p>Import data from popular GIS, CAD, and database formats</p>	5x	

Corporate Office: Naimex House, A-8, Mohan Co-operative Industrial Estate, Mathura Road, New Delhi-110044, India

Phone: 91-11-30810200, Fax: 91-11-26950011, Email: info@aimil.com, Website: www.aimil.com

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901-902 Gunjan Towers, Off Alembic-Gorwa Road, Subhanpura, Vadodara - 390023  
Tel : 0265-3058800, Fax : 0265-3058810 Email : vadodara@aimil.com

	Export data into a wide variety of GIS, CAD, and database formats Create data dictionaries to ensure data collected is consistent with GIS requirements		
2.4	<b>GPS correct Extension for ESRI ArcPad Field Software</b> Post-processed differential GPS for ESRI ArcPad software <u>Key features</u> Fully integrated with ESRI ArcPad software Full support for ESRI ArcPad software version 7.1 and ESRI ArcPad software version 8 or later data collection methods including offsets, traverses, and measurements from laser rangefinders <u>GPS integration and control</u> Simple GPS and real-time configuration Enhanced graphical sky plot and satellite information Detailed real-time status information Mission planning for satellite prediction in the field	5x	
2.5	<b>GPS Analyst Extension for ESRI ArcGIS Desktop Software</b> Streamlined GPS data processing inside ArcGIS Features and options <u>Work within the GIS</u> Collect, view, and edit GPS data inside ESRI ArcGIS Desktop software Improve productivity by eliminating extra file conversions and processing steps outside the GIS Quickly and easily validate position accuracy against requirements set in the feature class	5x	
	<b>TOTAL PRICE FOR THE ABOVE SET</b>	<b>1 Set</b>	<b>640,000.00</b>

Sincerely yours,  
**For AIMIL LIMITED**

**Nirav Gohil**  
**Deputy Manager**  
**Survey Division**

**Corporate Office:** Naimex House, A-8, Mohan Co-operative Industrial Estate, Mathura Road, New Delhi-110044, India  
Phone: 91-11-30810200, Fax: 91-11-26950011, Email: info@aimil.com, Website: www.aimil.com  
**Branches:** Bengaluru, Bhubaneswar, Chandigarh, Chennai, Guwahati, Hyderabad, Indore, Kochi, Kolkata, Lucknow, Mumbai

**Beyond Options. Solutions**

**ANNEXURE: IX**



#3,2<sup>nd</sup> Floor, H. Latesh Appts., Opp. Handloom House, Nanpura, Timaliawad, Surat.- 395001  
 Phone : +91 261 2462359, 2460649, Mobile : +91 9924748480 , E-mail : [info@aqutech.in](mailto:info@aqutech.in)

**QUOTATION**

To, The Director SVNIT Surat. Kind Attn : Dr P L Patel		QUOTE NO: 50				
		DATE: 14-07-2015				
		Your inquiry : Verbal				
Sr. No.	DESCRIPTION	QTY	RATE		AMOUNT	
			Rs	Ps	Rs	Ps
01	<b>DELL Workstation</b> Processor Intel Xeon E5 2670 V3 x 2 (12C HT, 30 MB Cache, 2.3 GHz Turbo) 32 GB DDR4 2133 MHz ECC Ram 2 x 1 TB 7200 rpm SATA Hard drive DVD Writer NVidia Quadro K4000 23.8" LED Keyboard and mouse Windows 8.1 Professional 3 years Warranty	01 No	6,90,850	00	6,90,850	00
02	Printer Mono Laser All in One Brand : Canon Model : MF 226DN	01 No	22,905	00	23,905	00
03	Printer Color Inkjet All in One Brand : Canon Model : Maxify MB5070	01 No	17,100	00	17,100	00
VAT TIN NO.: 24240101177 CST TIN NO.: 24740101177		<b>GRAND TOTAL</b>				

**Terms & Conditions:**

- 1 Taxes : Inclusive all
- 2 Delivery : Within One week from the date of confirmed order
- 3 Payment : Alongwith the Purchase Order in favor of "Aqutech Computer Solutions"
- 4 Warranty : One year Onsite from Aqutech and as per the individual company norms
- 5 Validity : The above quote is valid for one week

For Aqutech Computer Solutions

Pinky Shah  
 Authorised Signatory