Project Progress Review Meeting

INCCC- National Water Mission, MoWR,RD&GR

"IMPACT OF CLIMATE CHANGE ON WATER RESOURCES OF TAPI BASIN"

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DEPARTMENT OF CIVIL ENGINEERING

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CONTENTS OF PRESENTATION

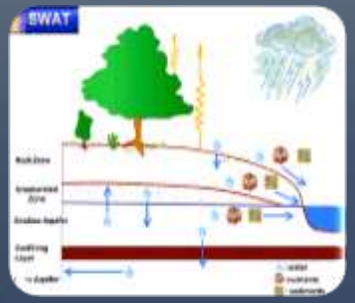
- ***Project Partnering Institutes & Project Team***
- ***Objectives of Project***
- ***Study Area & Broad Methodology***
- ***Scope of Work (Institute Wise)***
- ***Review of first R & D Session***
- ***Progress of Project Work***
- ***Expenditures Incurred***
- ***Work Plan for First half of year 2019-20***

PROJECT PARTNERING INSTITUTES & PROJECT TEAM

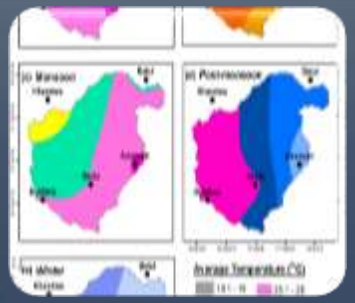
SVNIT, Surat (Leading Institute)	⑩Dr. P L Patel (PI) • Dr. P V Timbadiya (Co PI) • Mr. Shubham Jibhakate (SRF) • Mr. Lalit Kumar Gehlot (JRF)
MNIT, Jaipur (Co-coordinating Institute)	•Dr. Rohit Goyal (Co PI) • Mr. Priyamitra Munoth (SRF)
MANIT, Bhopal (Co-coordinating Institute)	• Dr. Vishnu Prasad (Co PI)

OBJECTIVES OF THE PROJECT

Collection of base line data of Tapi basin including stream gauging, rainfall, topography, soil, land use/land cover, ground water levels, reservoir and its utilities, cropping pattern of Ukai command area, past floods and tidal levels.

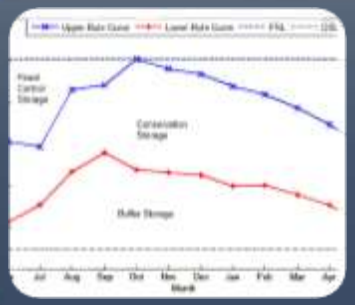


Selection of Hydrological (SWAT/MIKE SHE) and hydraulic models (MIKE FLOOD) and their calibration and validation from past observed data.



Parametric and non-parametric tests for trend detection for hydro-meteorological and hydrological variables in the basin.

OBJECTIVES OF THE PROJECT

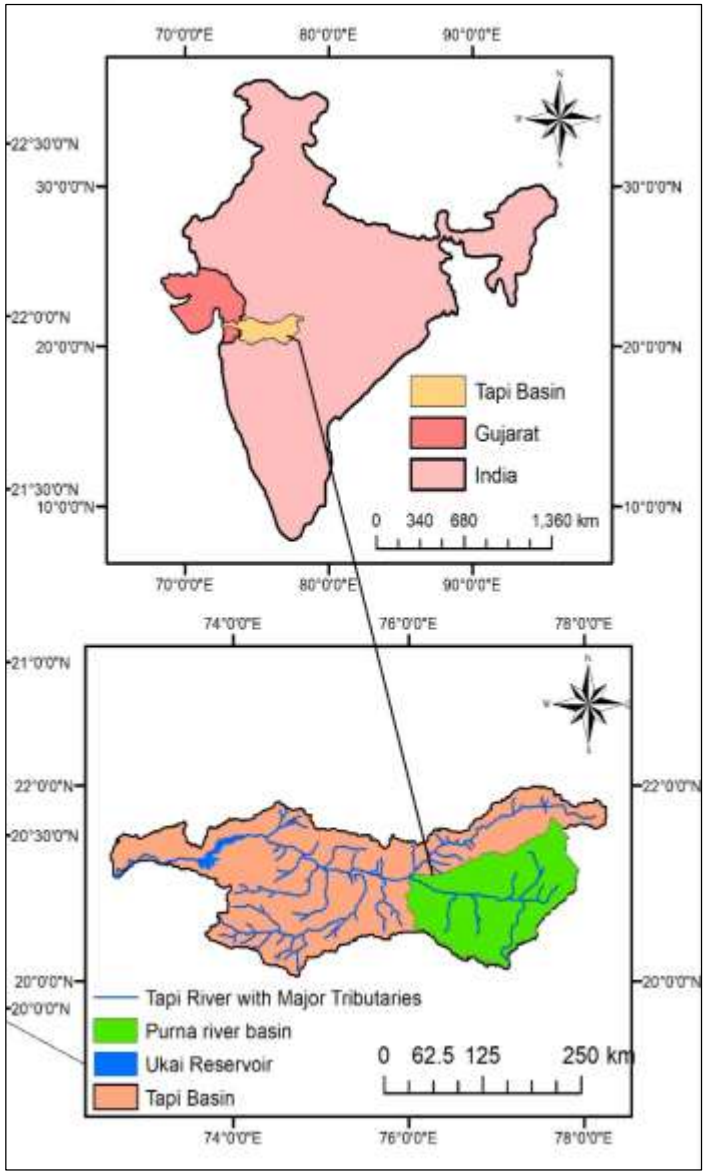


Performance evaluation of Ukai reservoir under changing climatic conditions in fulfilling its requirements of irrigation, hydropower and flood control.

Using the output from dynamic/statistical downscaling, prediction of flood situation downstream of Ukai reservoir in lower Tapi River and preparation of flood risk maps of the Surat city under changing climatic conditions.

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.

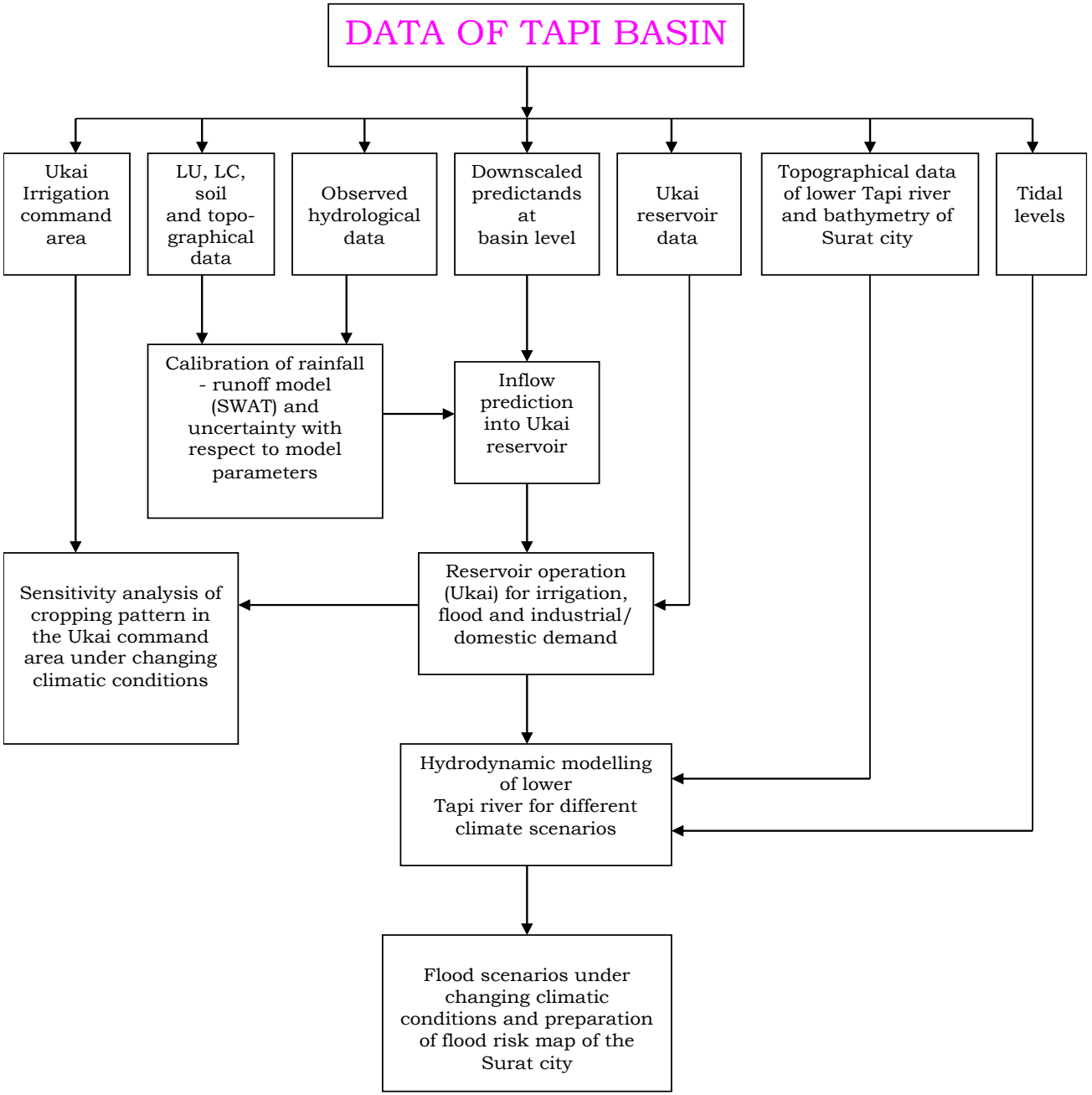
STUDY AREA



- The Tapi River is the second largest westward flowing river originating from the Indian Peninsula covering geographical area of 65,145 km^2.
- The Tapi River, with its origin at Multai (RL=752 m) 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, falls in Madhya Pradesh (9,804 km^2), Maharashtra (51,504 km^2) and Gujarat (3,838 km^2) states.

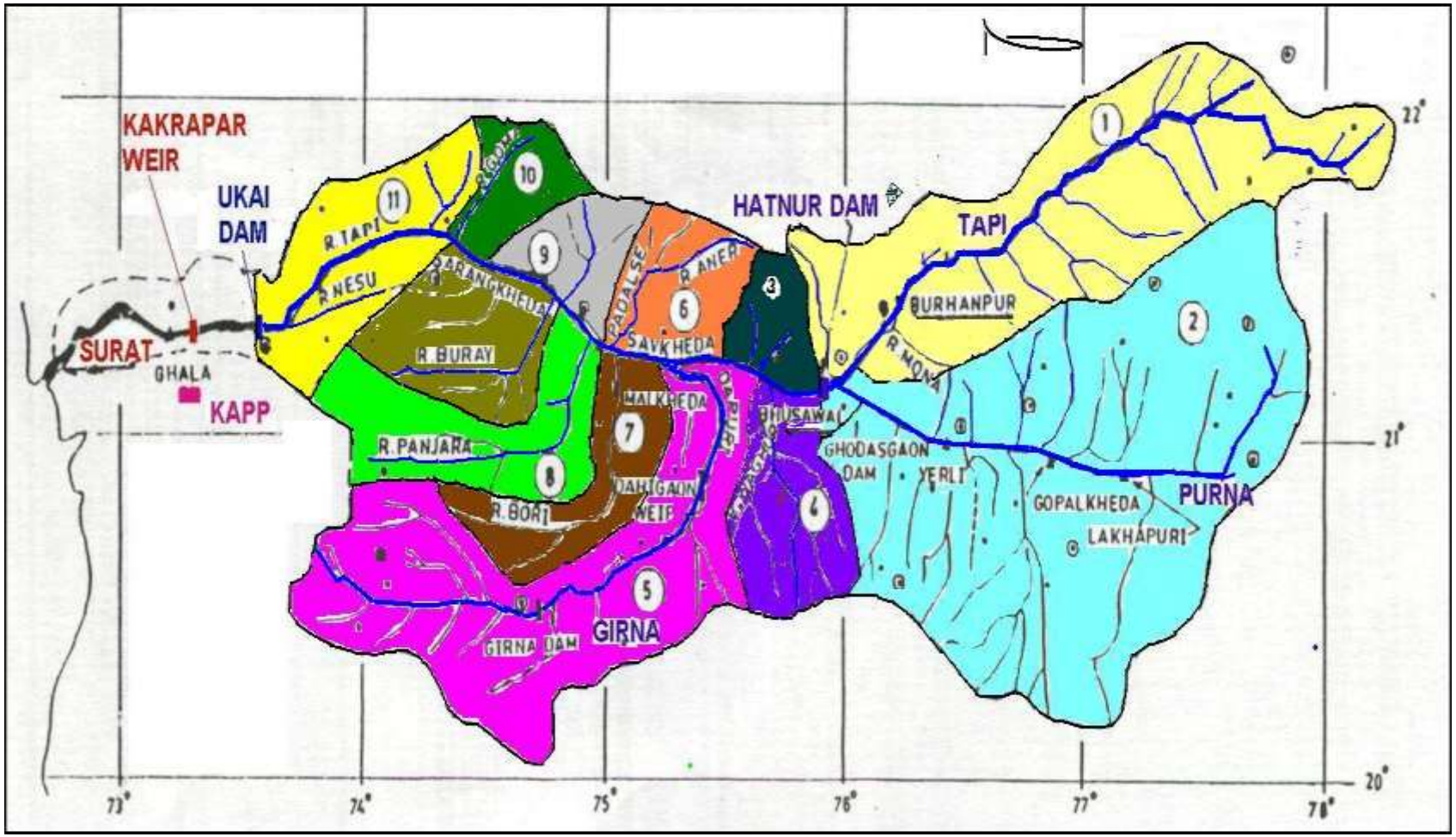
Upper Tapi Basin	• Multai to Hathnur dam • Area: 29,430 km^2
Middle Tapi Basin	• Hathnur dam to Ukai dam • Area: 31,735 km2
Lower Tapi Basin	• Ukai dam to Arabian Sea • Area: 3,980 km^2

BROAD METHODOLOGY



SCOPE OF WORK

SUB-CATCHMENT CLASSIFICATION IN TAPI BASIN



SCOPE OF WORK

SVNIT - SURAT

1. 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.

2. Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.

3. Development of rainfall-runoff and sediment yield model for Purna catchment (subcatchment-2) for present as well future scenarios.

Completed work

On Going work

SCOPE OF WORK

SVNIT - SURAT

4. • Calibration of hydraulic model (MIKE Flood) and prediction of flood situations in the downstream of Ukai reservoir under present and changing climatic situations.

5. • Sensitivity analysis of cropping pattern in Ukai command area under revised water yield in Ukai reservoir under changing climatic conditions.

6. • Assessment of reservoir (Ukai) behaviour under changing climatic conditions vis-à-vis present condition, and propose revised rule curve for its operation, if required.

On Going work

SCOPE OF WORK

MNIT - JAIPUR

1. Development of rainfall-runoff and sediment yield model for upper Tapi basin (sub-catchments 1, 3, 4) after taking input from SVNIT for Purna catchment at the junction of Tapi River.
2. Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.
3. Performance evaluation of Hathnur reservoir under changing climatic conditions for both observed as well as future RCP scenario.
4. To assist lead Institute in collection/extraction of field data.

On Going work

SCOPE OF WORK

MANIT - BHOPAL

1. • Development of rainfall-runoff and sediment yield model for sub-catchments 5, 6, 7, 8, 9, 10, 11; and compute the inflow into Ukai reservoir after taking input from the MNIT Jaipur.

2. • Detection of trend in hydro-meteorological variables (as per TOR-2) in the sub-catchment of Tapi basin identified for the study.

3. • Performance evaluation of Girna reservoir under changing climatic conditions for both observed as well as future RCP scenarios.

4. • To assist lead Institute in collection/extraction of field data.

On Going work

REVIEW OF FIRST R & D SESSION

- Research staff were appointed w.e.f. June 28, 2018
  - Mr. Shubham M. Jibhakate, Senior Research Fellow (SRF)
  - Mr. Lalit Kumar Gehlot, Junior Research Fellow (JRF)

- The procurement of equipment (Workstation/Trimble GPS), MIKE-SHE and ArcGIS 10.6 were processed as well as the data providing agencies were approached for the collection of the relevant base line data.

- Investigation of long-term trends in the extreme rainfall (1944-2013) and temperature (1969-2012) indices as per ETCCDMI for Upper Tapi basin was completed and the key findings of the study were discussed.

- Assessment of long-term trends in the extreme rainfall (1944-2013) and temperature (1969-2012) indices, recommended by Expert Team on Climate Change Detection Monitoring Indices (ETCCDMI), for Middle and Lower Tapi basin were under progress.

- Expenditure under the project under different heads out of released fund as well as balance fund were presented.

- Work plan for the second half of year 2018-19 were discussed.

PROGRESS OF PROJECT WORK

- The relevant data is collected from data providing agencies like CWC, SWDC, Narmada Water Resources, Water Supply and Kalpsar department and IMD.

- The procurement of Equipment and Software to be complete by end of financial year 2018-19
  - **SVNIT SURAT-** Procurement of Workstation, 2 Desktop Computers, MIKE SHE software and Printer are under completion and procedure for the procurement of Arc-GIS 10.6 software, fine resolution Topographic sheets is initiated.
  - **MNIT JAIPUR-** Desktop and Printer are procured and procurements of the remaining equipment are under process.
  - **MANIT BHOPAL-** Procurement of 2 Nos. desktop computers is completed, one Laptop, software purchase are under process.

- Investigation of long-term trends in the extreme rainfall (1944-2013) and temperature (1969-2012) indices and for Upper Middle and Lower Tapi basin has been already completed.

- Assessment of trend in annual Runoff along with extreme Rainfall and stream flow indices (1973-2013) has been already completed.

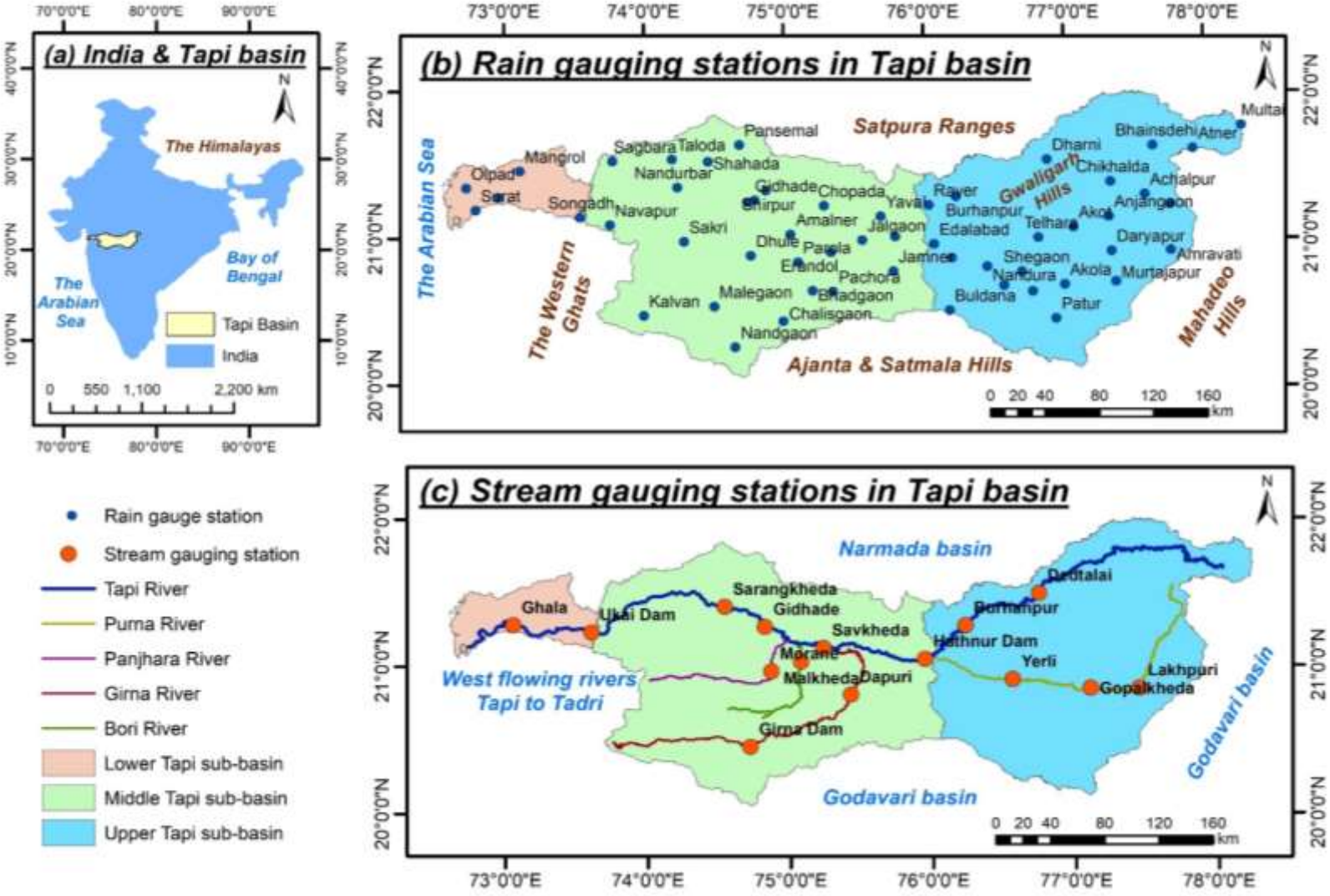
- A 2-Day training program on “Hydrological modelling using SWAT including Parametric Uncertainty and Sensitivity Analysis” was organised during February 8-9, 2019.

- A site visit along the gauging station of Lower Tapi River up-to Ukai dam is completed during the procurement of the data.

PROGRESS OF PROJECT WORK

TREND ANALYSIS OF HYDRO-METEOROLOGICAL VARIABLES

STUDY AREA



PROGRESS OF PROJECT WORK

TREND ANALYSIS OF METEOROLOGICAL VARIABLES

- **BASIC INDICES**
  - Total annual rainfall (PRCPTOT)
  - Number of rainy days (RD),
  - Simple daily intensity index (SDII)
- **ABSOLUTE INDICES**
  - Maximum 1-day rainfall (Rx1day)
  - Maximum 5-day rainfall (Rx5day)
- **THRESHOLD INDICES**
  - Moderate rainfall days (Rmod) – $7.5 < R < 64.5$ mm
  - Heavy rainfall days (Rheavy) – $64.5 < R < 124.5$ mm
- **PERCENTILE-BASED INDICES**
  - Very wet days (R95p)
  - Extremely wet days (R99p)
- **RELATIVE INDEX**
  - Rainfall extreme proportion (R5TOT)
- **DURATION BASED INDICES**
  - Consecutive dry days (CDD)
  - Consecutive wet days (CWD)

12 Rainfall indices

5 Temperature indices

Extreme Climate Indices recommended by ETCCDMI (2003)

- **MAXIMUM TEMPERATURE BASED**
  - Hottest day (TXx)
  - Coldest day (TXn)
- **MINIMUM TEMPERATURE BASED**
  - Warmest night (TNx)
  - Coldest night (TNn)
- **TEMPERATURE DIFFERENCE BASED**
  - Diurnal temperature range (DTR)

PROGRESS OF PROJECT WORK

KEY FINDINGS RAINFALL TRENDS

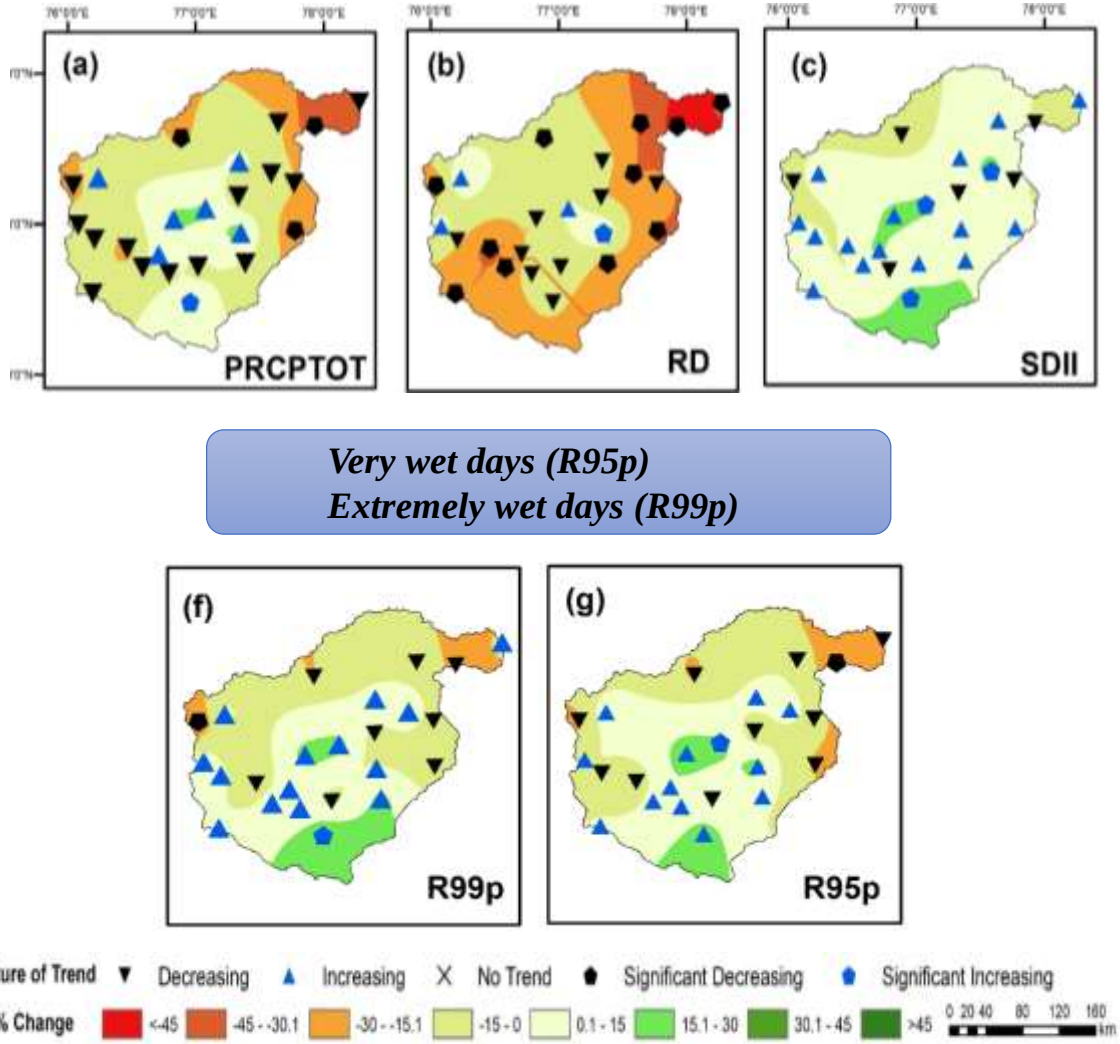
Upper Tapi Basin

- The total annual rainfall (PRCPTOT) for period 1944-2013 exhibited decreasing trends at 17 out of 24 rain gauge stations.
- The rainfall in monsoon months displayed dichotomic behaviour, wherein increasing trends in June and August months, and decreasing trends in July and September months were observed.
- The number of rainy days (RD) exhibited decreasing trend across the basin.
- The rainfall intensity (SDII) and extreme rainfall (R95p & R99p) events exhibited increasing trends across Upper Tapi Basin.

Total annual rainfall - PRCPTOT

Rainy days - RD

Rainfall intensity - SDII



Very wet days (R95p)
Extremely wet days (R99p)

PROGRESS OF PROJECT WORK

KEY FINDINGS RAINFALL TRENDS

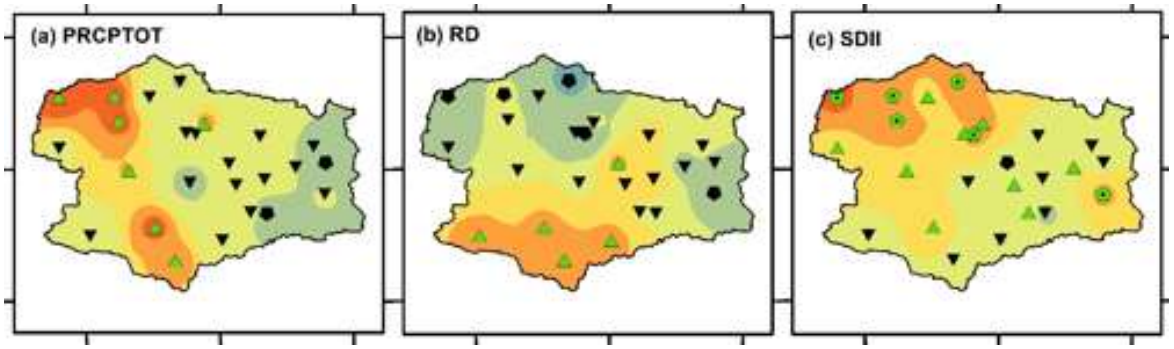
Middle Tapi Basin

- The total annual rainfall (PRCPTOT) over the basin has been reported to be decreasing at 18 of 25 stations in Middle Tapi Basin.
- The number of rainy days (RD) exhibited decreasing trend across the basin.
- The rainfall intensity (SDII) shows the increasing tends across the basin.
- The extreme rainfall events R95p (15, 5 Significant) and R99p (17, 3 Significant) exhibited decreasing trends across Middle Tapi Basin.

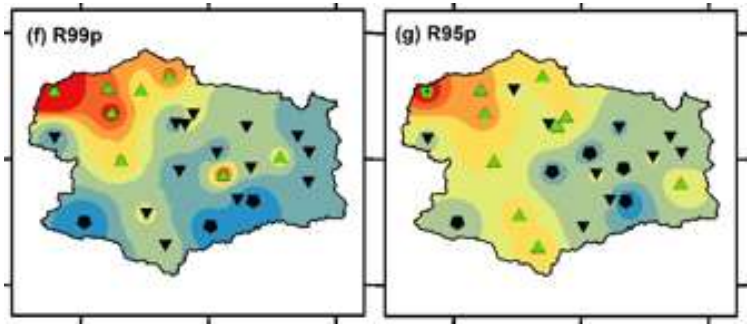
Total annual rainfall - PRCPTOT

Rainy days - RD

Rainfall intensity - SDII



Very wet days (R95p)
Extremely wet days (R99p)



PROGRESS OF PROJECT WORK

KEY FINDINGS RAINFALL TRENDS

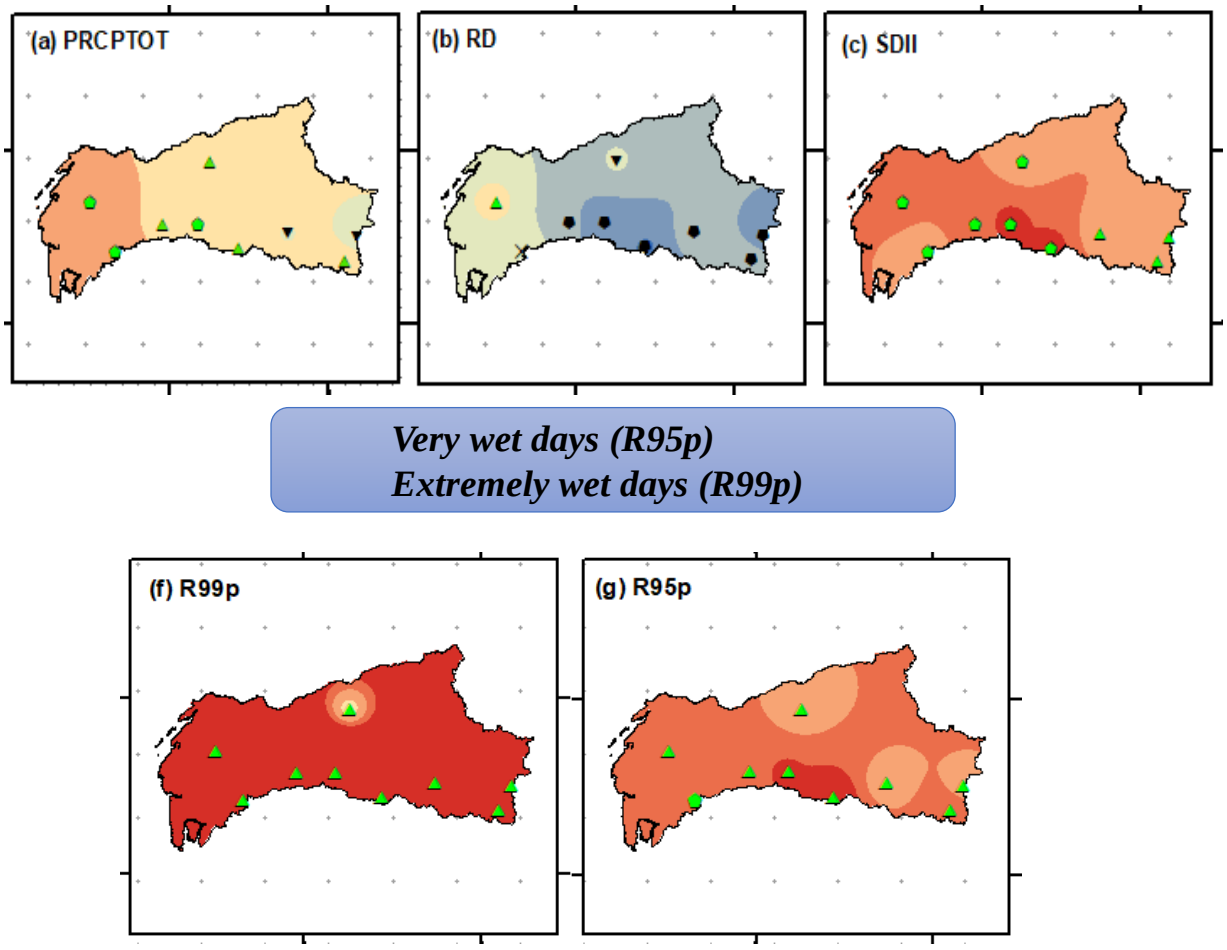
Lower Tapi Basin

- The total annual rainfall (PRCPTOT) is found to be increased at 7 out of 9 station across the Lower Tapi basin.
- The rainfall in monsoon month June, August and September are showing increasing trend whereas the July month shows the mixed trend.
- The seasonal total and monsoon rainfall exhibits increasing trend over the basin except Ukai and Kakrapar stations .
- The number of rainy days (RD) are significantly decreasing on the other hand rainfall intensity (SDII) significantly increasing.
- The extreme rainfall (R95p & R99p) events exhibited increasing trends across the basin.

Total annual rainfall - PRCPTOT

Rainy days - RD

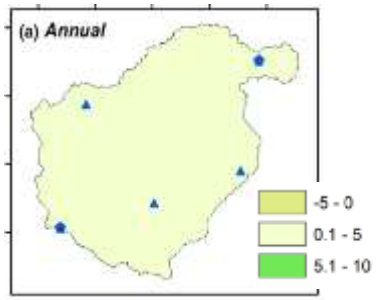
Rainfall intensity - SDII



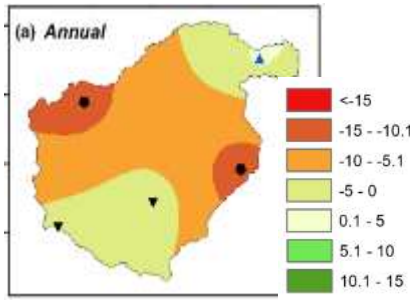
PROGRESS OF PROJECT WORK

KEY FINDINGS TEMPERATURE TRENDS

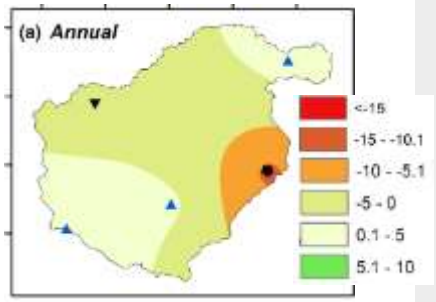
Hottest days (TXx)



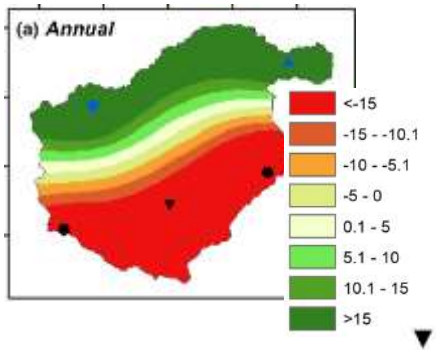
Coldest days (TXn)



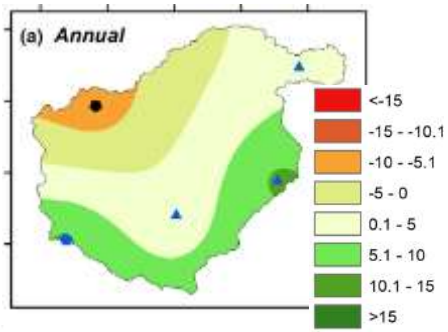
Warmest night (TNx)



Coldest Night (TNn)



Diurnal Temperature range (DTR)



▼ Decreasing
▲ Increasing
⬟ Significant Decreasing
⬟ Significant Increasing

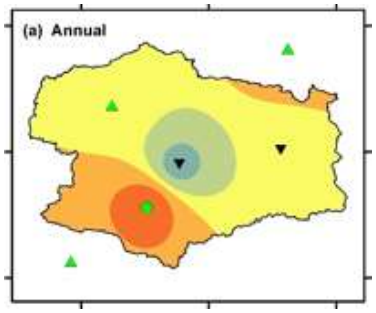
Upper Tapi Basin (1969-2012)

- The Hottest days (TXx) are Increasing annually within the basin, where as coldest day (TXn) are observed to be decreasing annually across the basin.
- The Warmest night (TNx) are decreasing in Burhanpur sub-catchment and increasing in Purna sub-catchment except Amravati region.
- The coldest nights (TNn) are increasing in Burhanpur sub-catchment where as decreasing in Purna sub-catchment.
- The Diurnal Temperature range (DTR) is increasing within entire basin except Khandwa region.

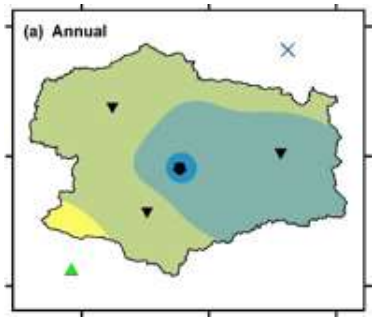
PROGRESS OF PROJECT WORK

KEY FINDINGS TEMPERATURE TRENDS

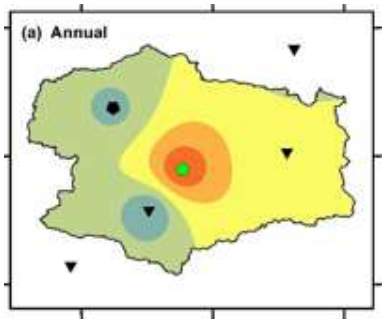
Hottest days (TXx)



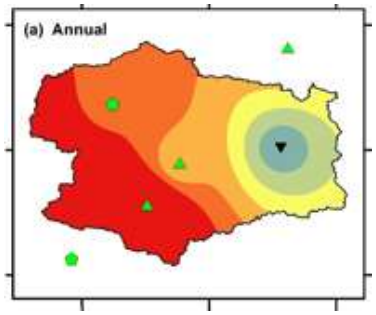
Coldest days (TXn)



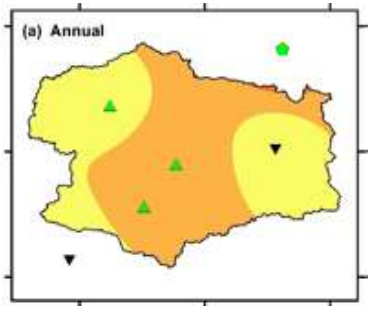
Warmest night (TNx)

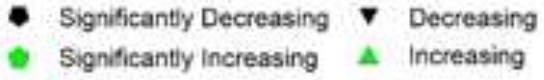


Coldest Night (TNn)



Diurnal Temperature range (DTR)





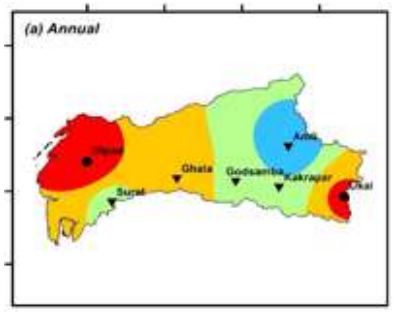
Middle Tapi Basin (1969-2005)

- The Hottest days (TXx) are Increasing annually within the basin, where are coldest day (TXn) are observed to be decreasing annually across the basin.
- The Warmest night (TNx) are decreasing annually except Dhule region through out the basin.
- The coldest nights (TNn) are annually increasing, except Jalgaon region where decreasing trend is observed within the basin.
- The Diurnal Temperature range (DTR) is increasing annually except Jalgaon and Ozar region.

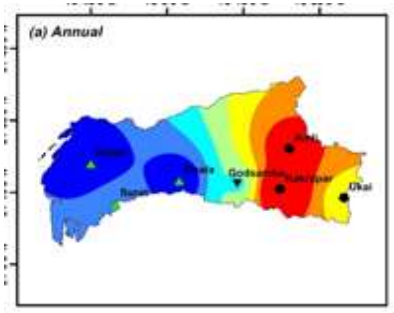
PROGRESS OF PROJECT WORK

KEY FINDINGS TEMPERATURE TRENDS

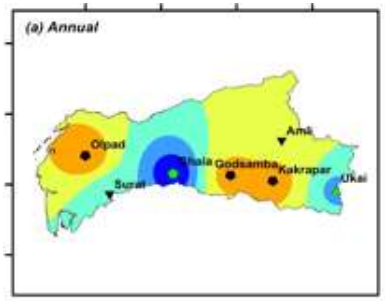
Hottest days (TXx)



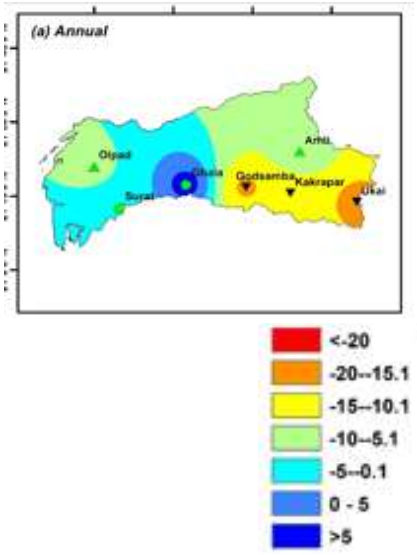
Coldest days (TXn)



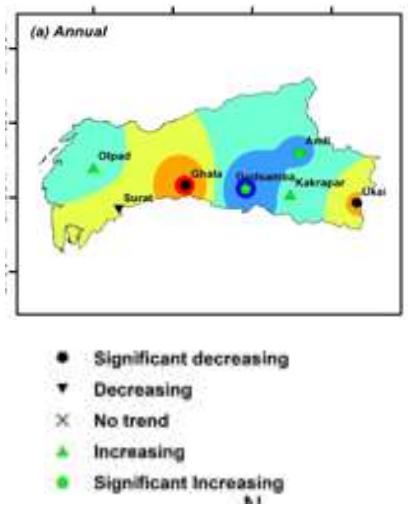
Warmest night (TNx)



Coldest Night (TNn)



Diurnal Temperature range (DTR)

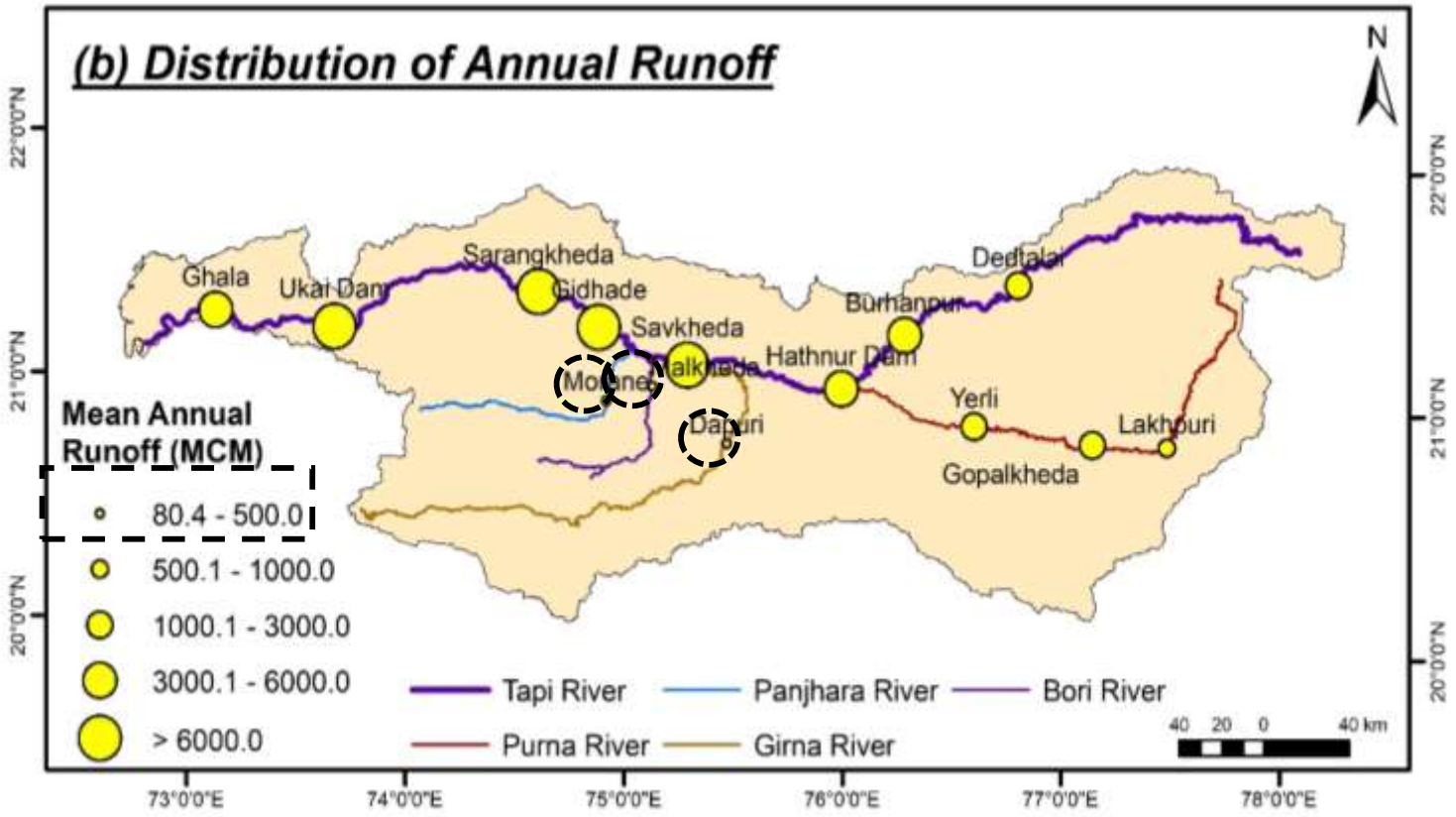


Lower Tapi Basin (2000-2016)

- The short-term trend (2000-2016) exhibits the results of decrease in annual Hottest days (TXx) similar trend in coldest days (TXn) except coastal region in the basin.
- The Warmest night (TNx) are decreasing annually except Ghala and Ukai region across the basin.
- The coldest nights (TNn) are showing overall increasing trend.
- The Diurnal Temperature range (DTR) exhibits overall increasing trend.

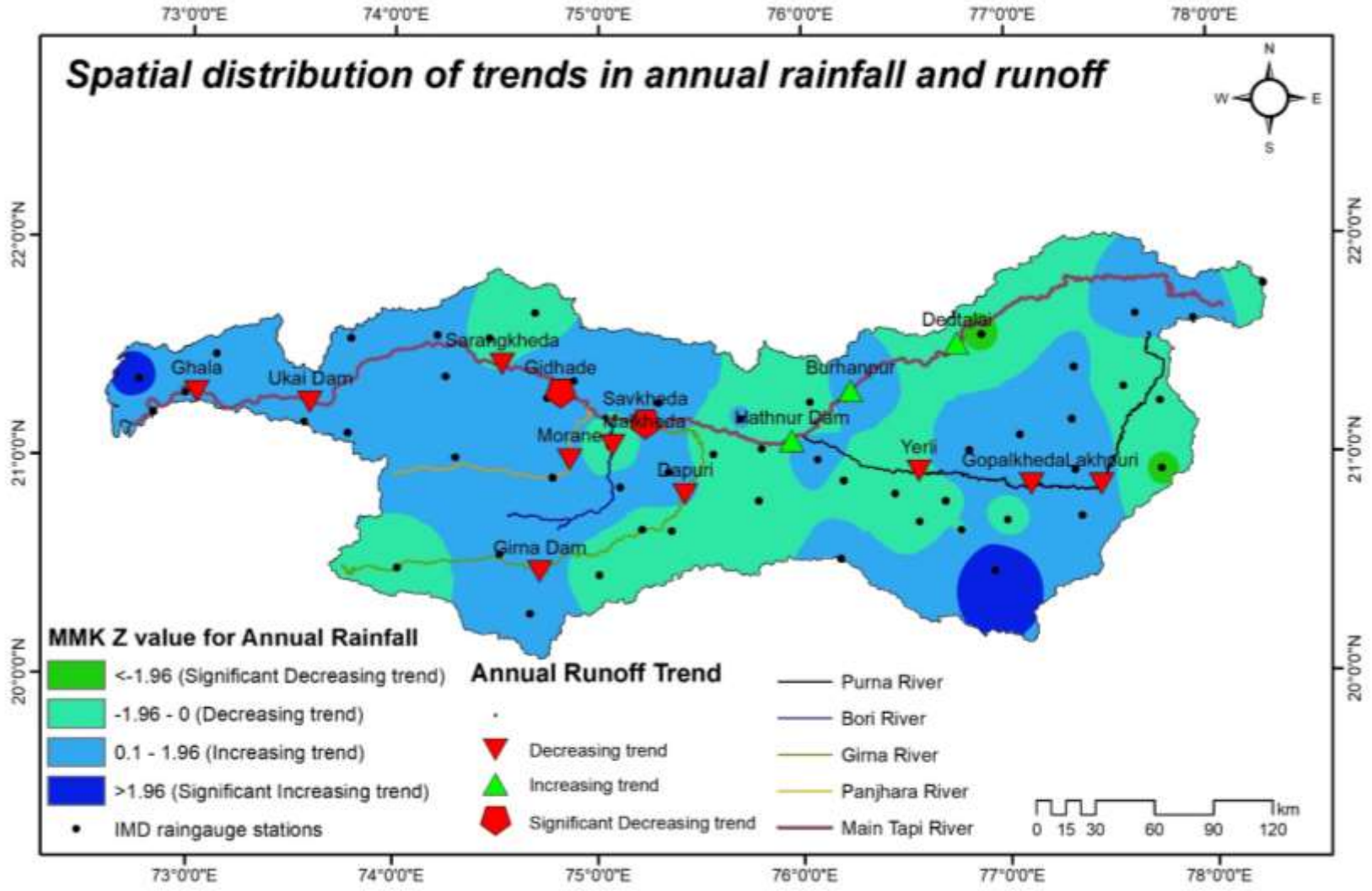
PROGRESS OF PROJECT WORK

STREAMFLOW AVAILABILITY ACROSS TAPI BASIN



PROGRESS OF PROJECT WORK

TRENDS IN ANNUAL RUNOFF (1973-2013)



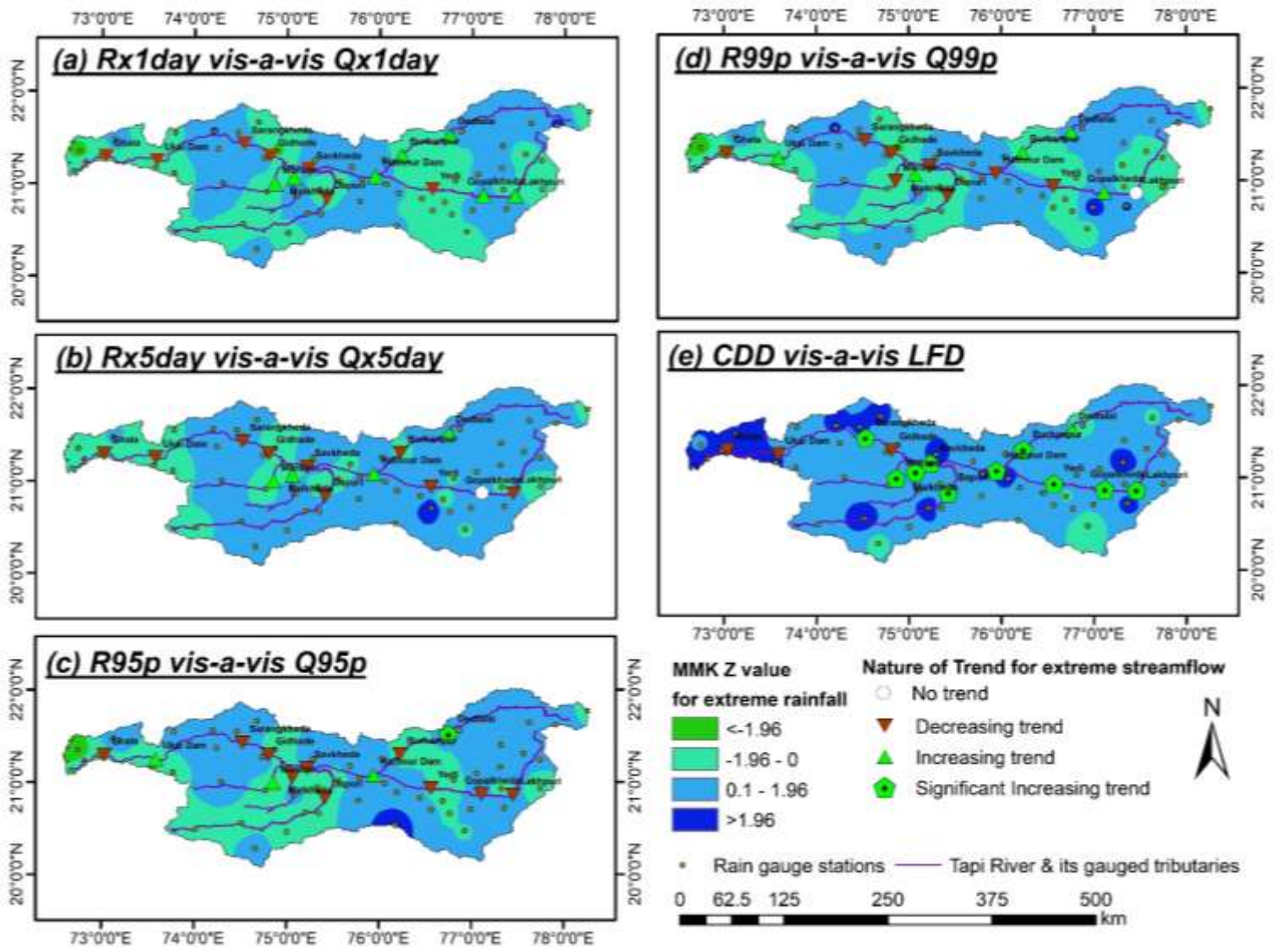
PROGRESS OF PROJECT WORK

EXTREME STREAMFLOW INDICES

Indicator	Indicator Name	Indicator Type	Indicator Definition	Unit
		Extreme streamflow indices		
Qx1day	Maximum 1-day flow	Absolute	Annual maximum 1-day streamflow	m^3/s
Qx5day	Maximum 5-day flow	Absolute	Annual maximum consecutive 5-day streamflow	m^3/s
Q99p	Very high flow days	Percentile-based	Annual total streamflow from days > 99^{th} percentile	m^3/s
Q95p	High flow days	Percentile-based	Annual total streamflow from days > 95^{th} percentile	m^3/s
LFD	Low flow days	Frequency-based	Maximum number of consecutive days when streamflow < 10^{th} percentile	days

PROGRESS OF PROJECT WORK

TRENDS IN EXTREME RAINFALL & STREAMFLOW INDICES (1973-2013)



PROGRESS OF PROJECT WORK

KEY CONCLUSIONS

- The annual runoff has been found to decrease at all the stream gauging stations except Dedatalai, Burhanpur and Hathnur dam, with significant decrease in Middle Tapi basin.
- The extreme streamflow indices (Qx1day and Qx5day) indicated decreasing trend at all stations, except Dedtalai, Hathnur dam, Malkheda and Morane stations.
- The percentile-based streamflow indices, viz., Q95p and Q99p, exhibit decreasing trends across most stations, except for Ukai dam and Dedtalai stations.
- The low flow days (LFD) were also found to be significantly increasing at all the stations except Gidhade, Ukai dam and Ghala stations.

EXPENDITURES FOR FY 2018-19

SVNIT, SURAT

Sr. No.	Head of Expenditure	Fund Sanctioned (Rs.)	Fund Released (Rs.)	Fund Spent (Rs.)	Balance (Rs.)
1	Salary	3542400	1062720	348549	714171
2	Travel Expenditure	233000	69900	57375	12525
3	Infrastructure/ Equipment	3310815	3310815	2032361*	1278454
4	Experimental Charges	870000	261000	175322	85678
5	Sub Total	7956215	4704435	2613607	2090828
6	Contingencies	67000	0	20946	-20946
7	Total	8023215	4704435	2634553	2069882
8	Institute Overhead	802322	0		0
9	Grand Total	8825537	4704435	2634553	2069882

* *Procurement of Workstation, MIKE-SHE, ARCGIS 10.6, Desktop Computers and Printer will be completed in current financial year.*

WORK PLAN FOR FIRST HALF OF YEAR 2019-20

SVNIT-Surat

- *Development of Hydrologic Model using SWAT for Purna sub-catchment (2) and Calibration & Validation using historical data.*
- *Development of Hydrologic Model using MIKE-SHE for Lower Tapi Basin and Calibration & Validation using historical data.*

MNIT-Jaipur

- *Development of Hydrologic Model using SWAT for sub-catchment 1,3 & 4; Calibration & Validation using historical data.*

MANIT-Bhopal

- *Development of rainfall-runoff and sediment yield model for sub-catchments 5, 6, 7, 8, 9, 10, 11.*
- *Compute the inflow into Ukai reservoir after taking input from the MNIT Jaipur.*

Thank You


SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY
SURAT


MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR


MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY - BHOPAL