HYDROLOGICAL ASSESSMENT OF CLIMATE CHANGE IMPACTS ON SUSTAINABLE AGRICULTURE – A CASE STUDY OF KRISHNA BASIN

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INTRODUCTION

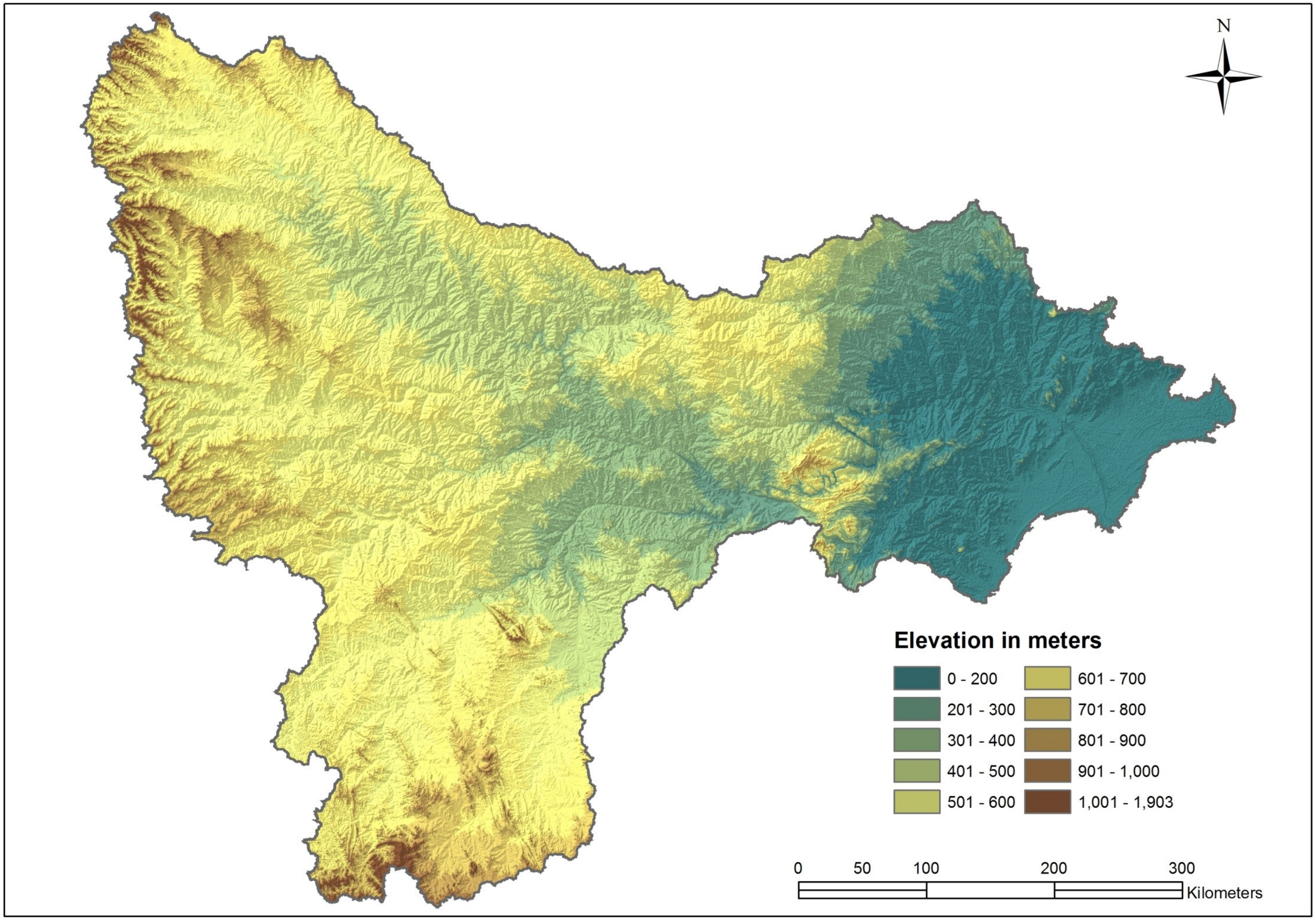
- Climate Change a major Global problem with an impact on all the sectors.
- Spatial and Temporal variations of Water Availability.
- Rural community dependent on Agriculture & Livestock.
- 75% of worlds Rice crop is produced in Asia. *(Van der Hoek et al. 2001)*
- Rice Crop Water Requirement in the region is 700 mm to 1500 mm. *(Bhuiyan 1992)*

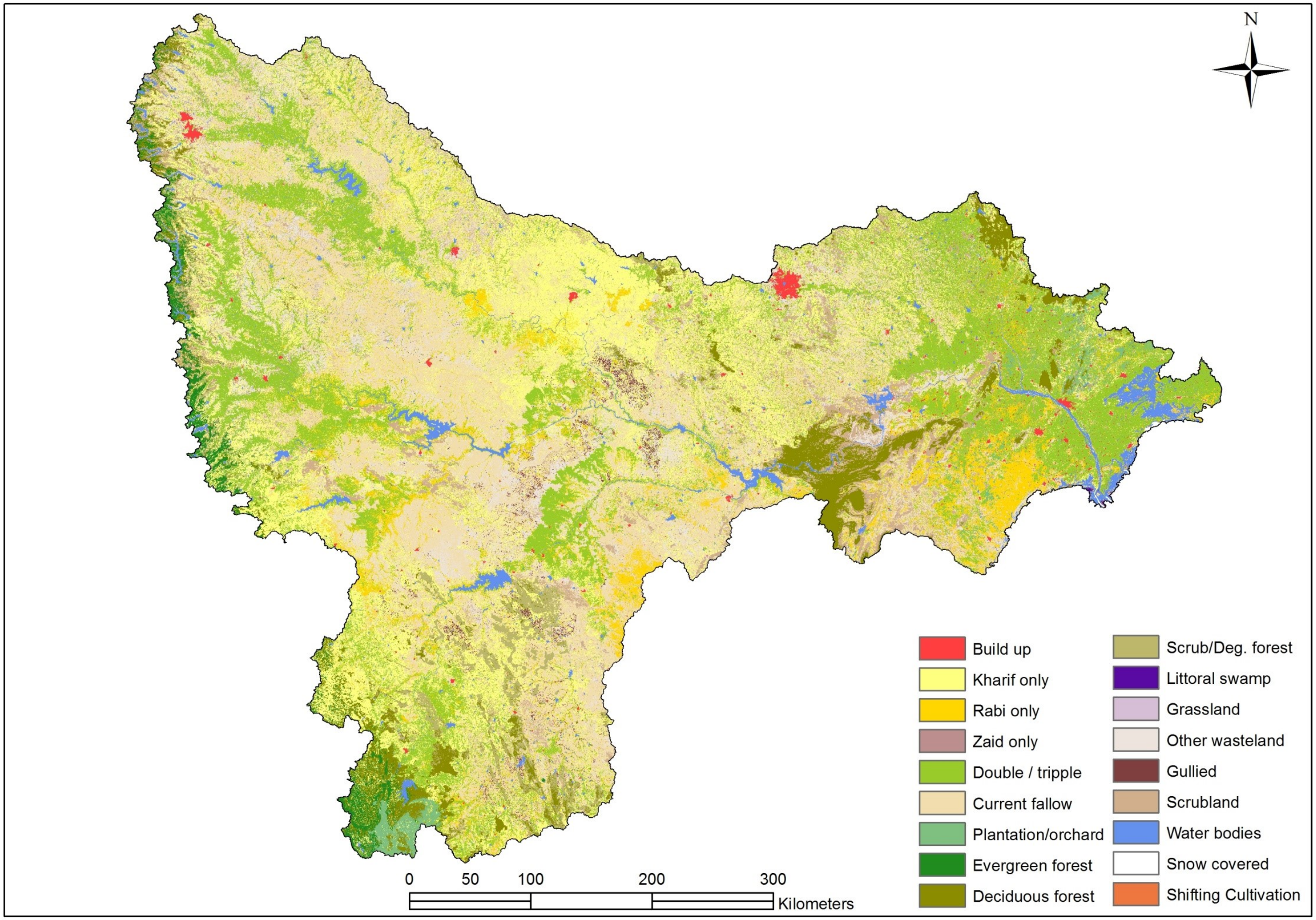
OBJECTIVES

- Setting up and running the Hydrology Model for climate simulations of 3 different periods (1981-2000, 2021-2050, 2081-2100)
- Assessment of the current and future water availability in Krishna Basin.
- Assessment of the anticipated impact of Climate Change on hydrology parameters, Water Yield, Potential Evapotranspiration and Soil Water.
- To understand the impact of climate change on crop water demand.

DATA USED

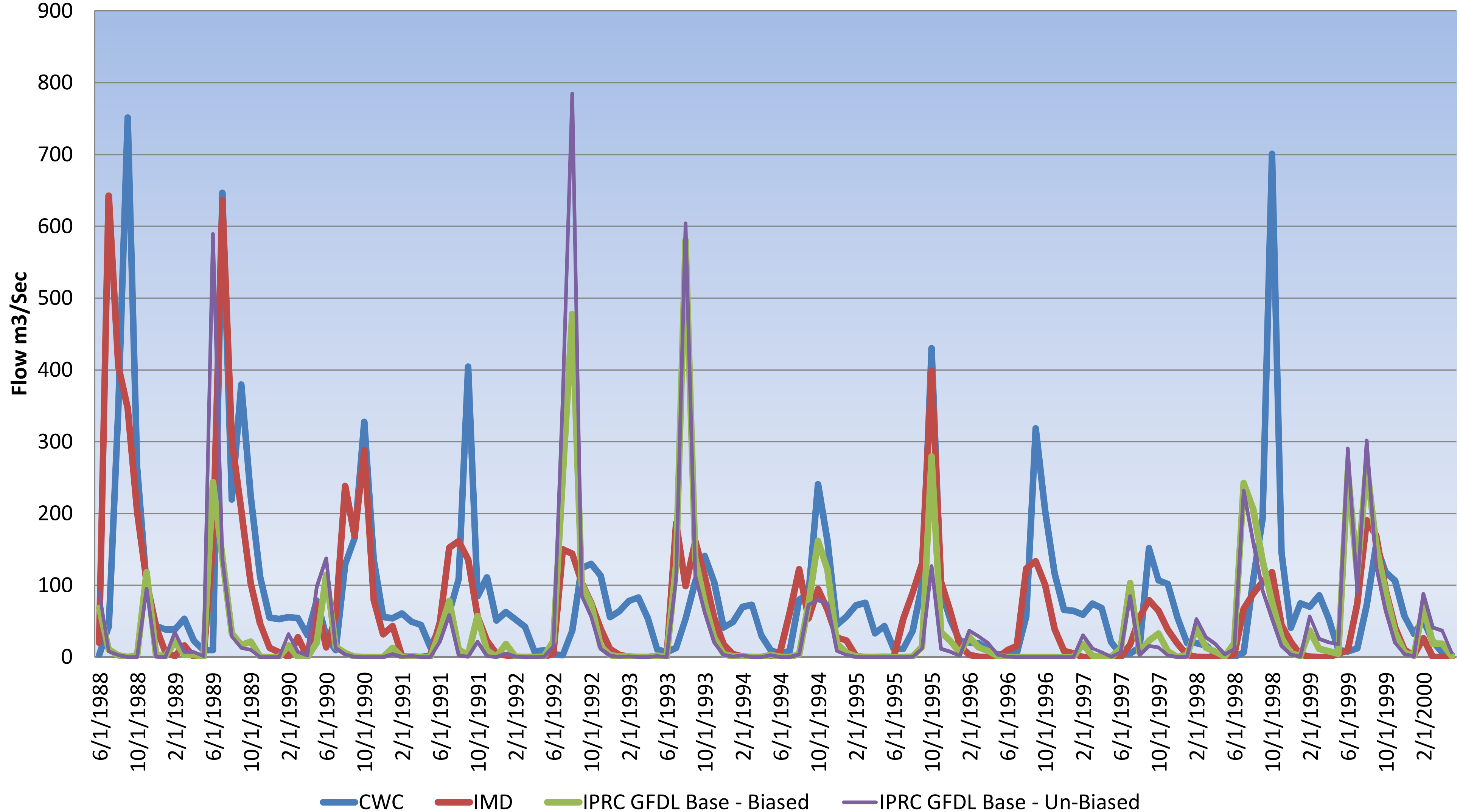
- Digital Elevation Model (DEM).
- Land use / Land cover.
- Soil Map and Soil properties.
- Climate Parameters
- River Discharge
- Crop Management Practices

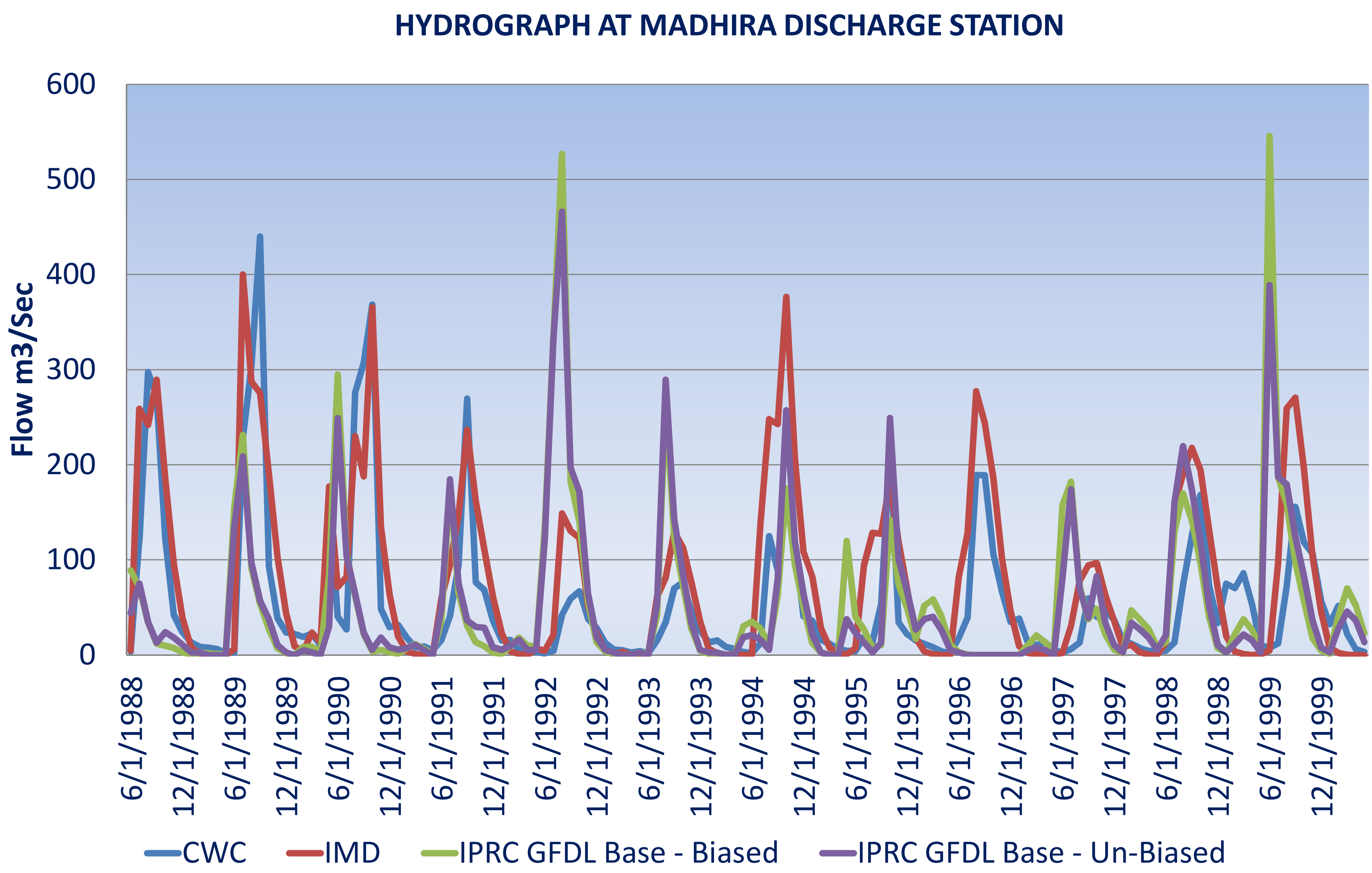

N
Elevation in meters
0 - 200
201 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 900
901 - 1,000
1,001 - 1,903
0
50
100
200
300
Kilometers

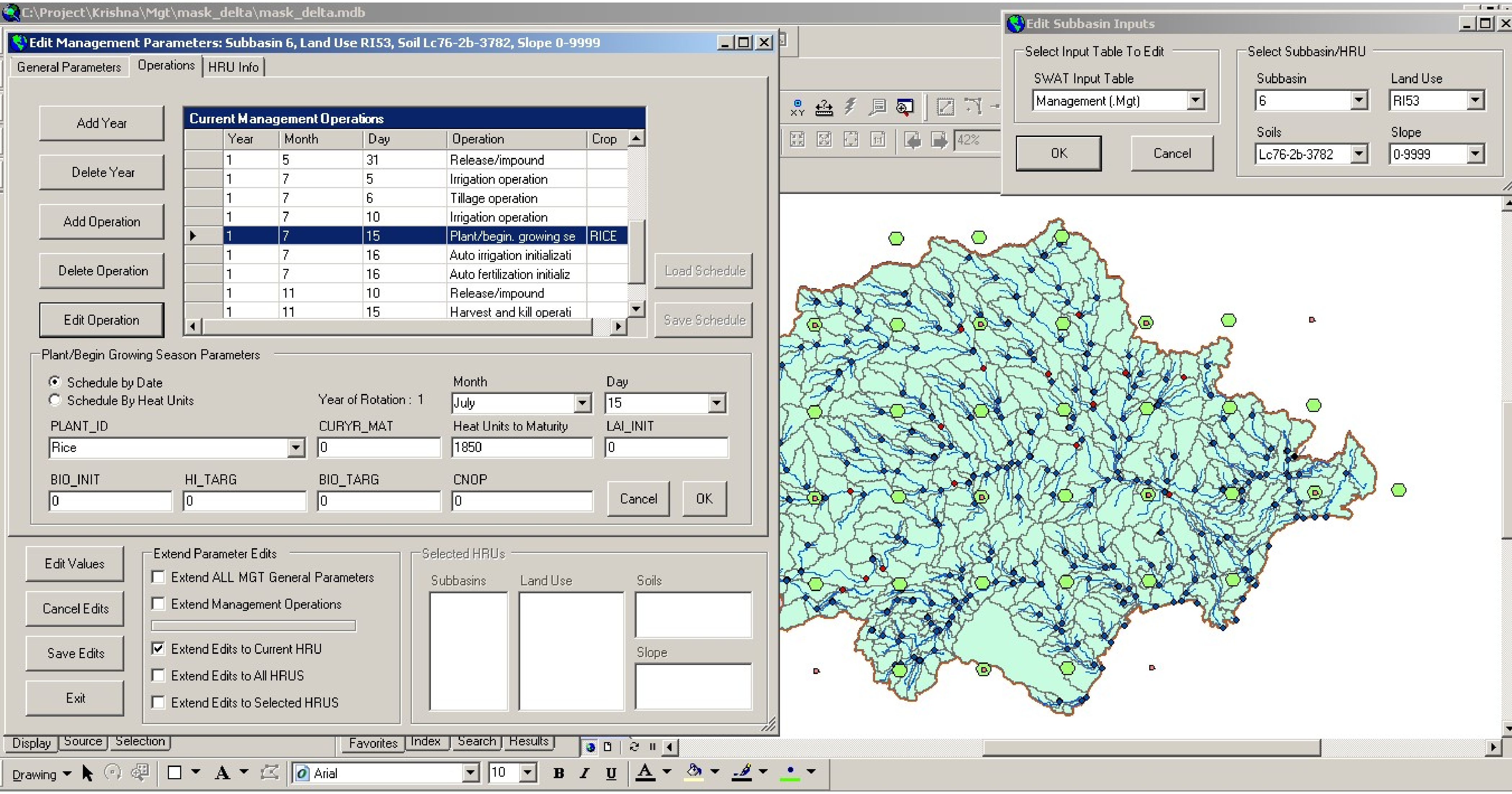

N
0
50
100
200
300
Kilometers
Build up
Kharif only
Rabi only
Zaid only
Double / tripple
Current fallow
Plantation/orchard
Evergreen forest
Deciduous forest
Scrub/Deg. forest
Littoral swamp
Grassland
Other wasteland
Gullied
Scrubland
Water bodies
Snow covered
Shifting Cultivation

Krishna River Basin Major & Minor Sub-Basins

HYDROGRAPH AT DAMERCHERLA DISCHARGE STATION OF KRISHNA RIVER BASIN



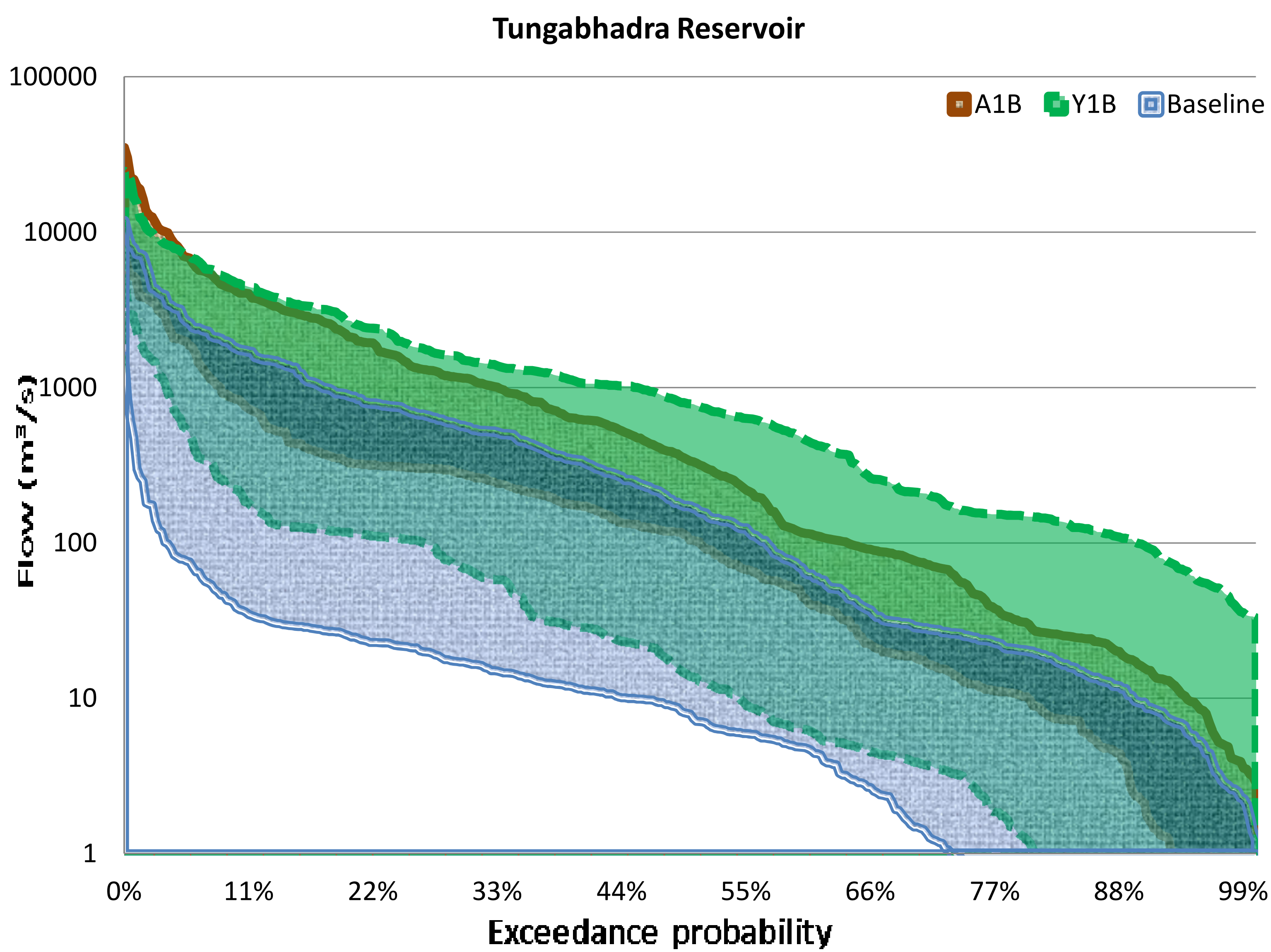

HYDROGRAPH AT MADHIRA DISCHARGE STATION
Flow m3/Sec
600
500
400
300
200
100
0
6/1/1988
12/1/1988
6/1/1989
12/1/1989
6/1/1990
12/1/1990
6/1/1991
12/1/1991
6/1/1992
12/1/1992
6/1/1993
12/1/1993
6/1/1994
12/1/1994
6/1/1995
12/1/1995
6/1/1996
12/1/1996
6/1/1997
12/1/1997
6/1/1998
12/1/1998
6/1/1999
12/1/1999
CWC
IMD
IPRC GFDL Base - Biased
IPRC GFDL Base - Un-Biased


C:\Project\Krishna\Mgt\mask_delta\mask_delta.mdb
Edit Management Parameters: Subbasin 6, Land Use RI53, Soil Lc76-2b-3782, Slope 0-9999
General Parameters
Operations
HRU Info
Add Year
Delete Year
Add Operation
Delete Operation
Edit Operation
Current Management Operations
Year Month Day Operation Crop
1 5 31 Release/impound
1 7 5 Irrigation operation
1 7 6 Tillage operation
1 7 10 Irrigation operation
1 7 15 Plant/begin. growing se RICE
1 7 16 Auto irrigation initializati
1 7 16 Auto fertilization initializ
1 11 10 Release/impound
1 11 15 Harvest and kill operati
Load Schedule
Save Schedule
Plant/Begin Growing Season Parameters
Schedule by Date
Schedule By Heat Units
Year of Rotation : 1
Month
July
Day
15
PLANT_ID
Rice
CURYR_MAT
0
Heat Units to Maturity
1850
LAI_INIT
0
BIO_INIT
0
HI_TARG
0
BIO_TARG
0
CNOP
0
Cancel
OK
Edit Values
Cancel Edits
Save Edits
Exit
Extend Parameter Edits
Extend ALL MGT General Parameters
Extend Management Operations
Extend Edits to Current HRU
Extend Edits to All HRUS
Extend Edits to Selected HRUS
Selected HRUs
Subbasins
Land Use
Soils
Slope
Edit Subbasin Inputs
Select Input Table To Edit
SWAT Input Table
Management (.Mgt)
OK
Cancel
Select Subbasin/HRU
Subbasin
6
Land Use
RI53
Soils
Lc76-2b-3782
Slope
0-9999
Display
Source
Selection
Favorites
Index
Search
Results
Drawing
Arial
10

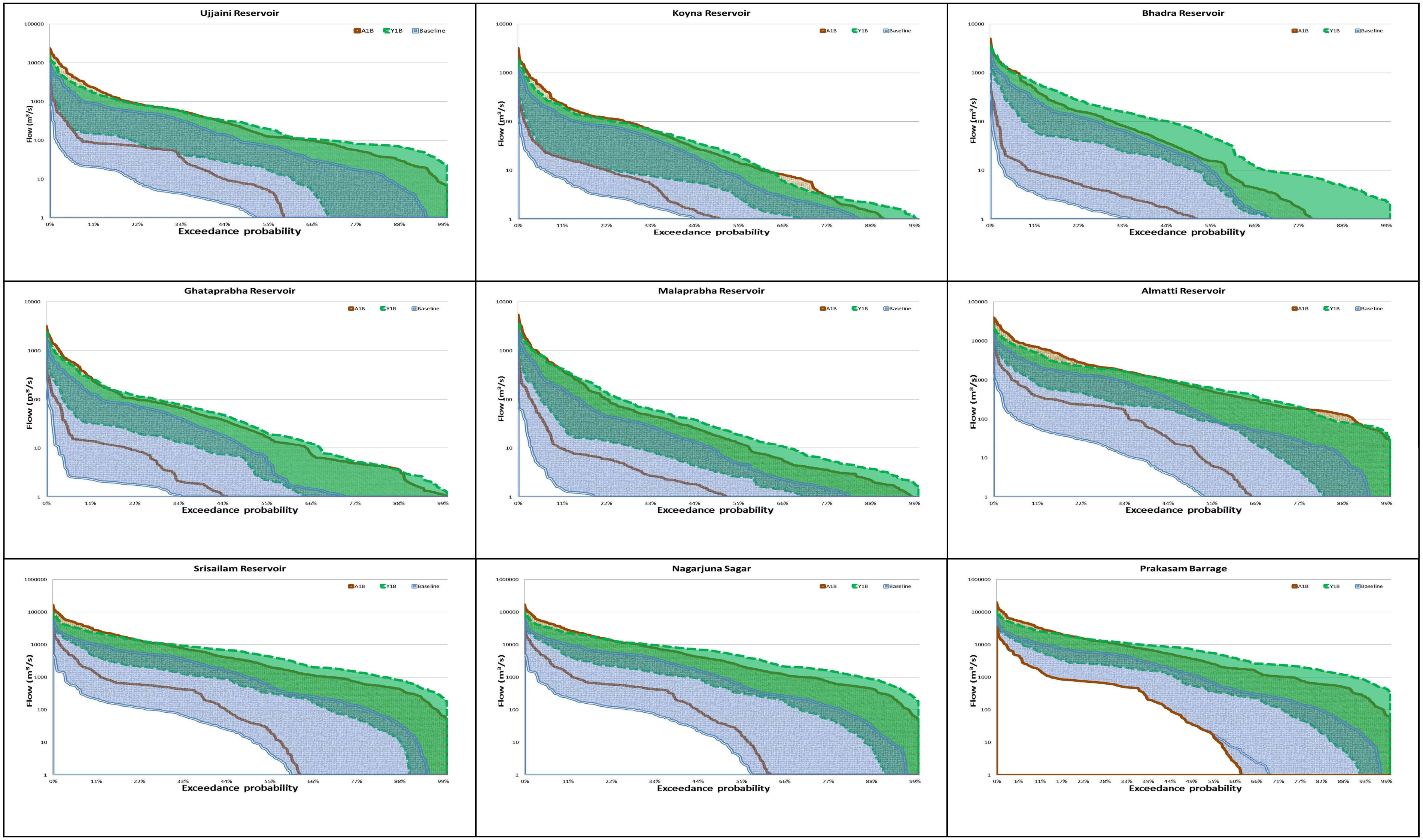
RESULTS AND DISCUSSIONS

- The model run resulted in 937 subbasins and 11,901 HRUs in Krishna Basin.
- Water Availability at Prime locations in 3 different Simulations is assessed.
- Observed stream flows and Simulated flows were matching well.
- Water Availability would increase in both Mid-Century and End-Century.
- Hydrology parameters - PET, Soil Moisture and Water Yield, were assesed.
- Reduction in water demand is anticipated, with increase in rainfall and decrease in PET.
- Water Demand with input as crop details is assessed.

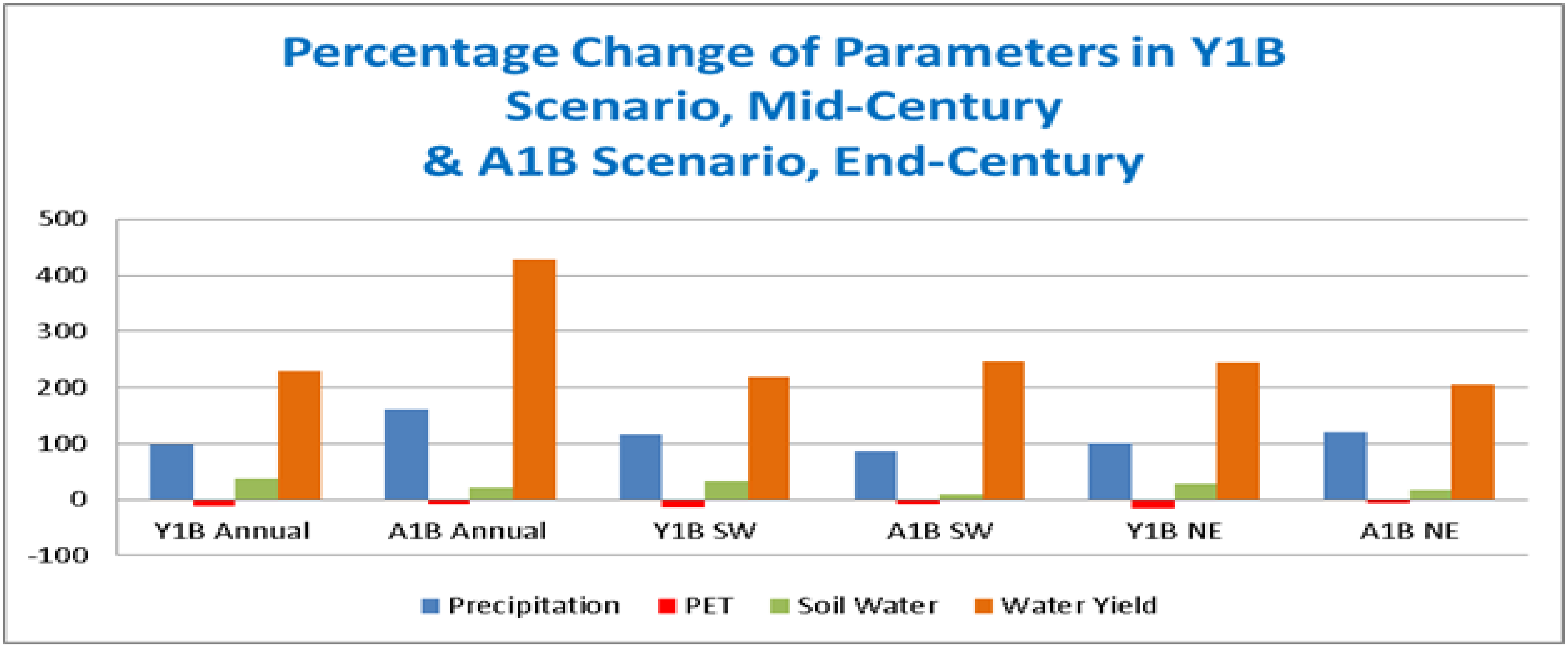
Water Balace Ratios	Basin – 1				Basin – 2				Basin – 3			
Scenarios	IMD	Base	Y1B	A1B	IMD	Base	Y1B	A1B	IMD	Base	Y1B	A1B
Streamflow/Precip	0.45	0.29	0.6	0.5	0.47	0.34	0.6	0.6	0.43	0.31	0.5	0.5
Baseflow/Total Flow	0.33	0.31	0.3	0.3	0.36	0.37	0.4	0.3	0.47	0.41	0.4	0.3
Surface Runoff/Total Flow	0.67	0.69	0.7	0.8	0.64	0.63	0.6	0.8	0.53	0.59	0.6	0.7
Perc/Precip	0.16	0.1	0.2	0.1	0.18	0.14	0.2	0.2	0.22	0.14	0.3	0.2
Deep Recharge/Precip	0.01	0	0	0	0.01	0.01	0	0	0.01	0.01	0	0
ET/Precipitation	0.54	0.72	0.4	0.5	0.53	0.67	0.4	0.4	0.59	0.74	0.5	0.5



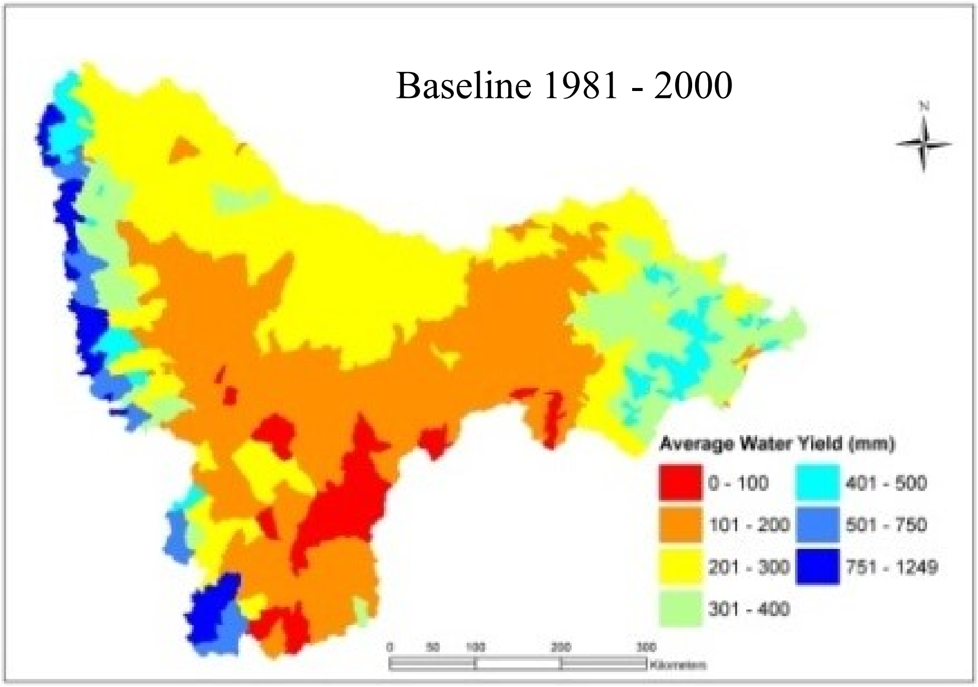
Tungabhadra Reservoir
A1B
Y1B
Baseline
100000
10000
1000
100
10
1
Flow (m³/s)
0%
11%
22%
33%
44%
55%
66%
77%
88%
99%
Exceedance probability

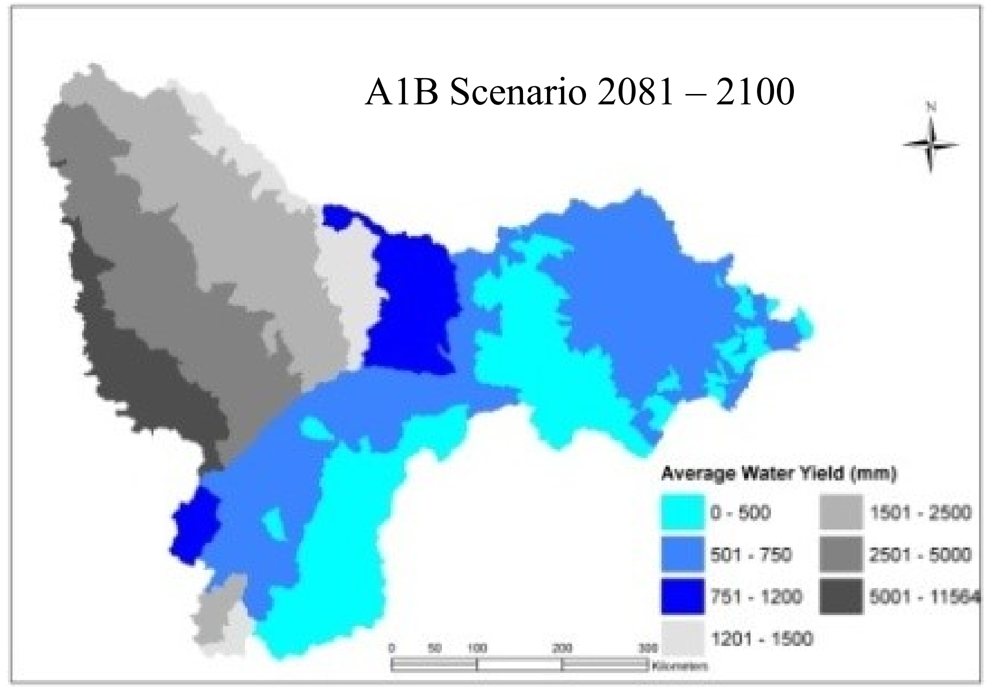


Ujjaini Reservoir
Koyna Reservoir
Bhadra Reservoir
Ghataprabha Reservoir
Malaprabha Reservoir
Almatti Reservoir
Srisailam Reservoir
Nagarjuna Sagar
Prakasam Barrage
A1B
Y1B
Baseline
Flow (m^3/s)
Exceedance probability

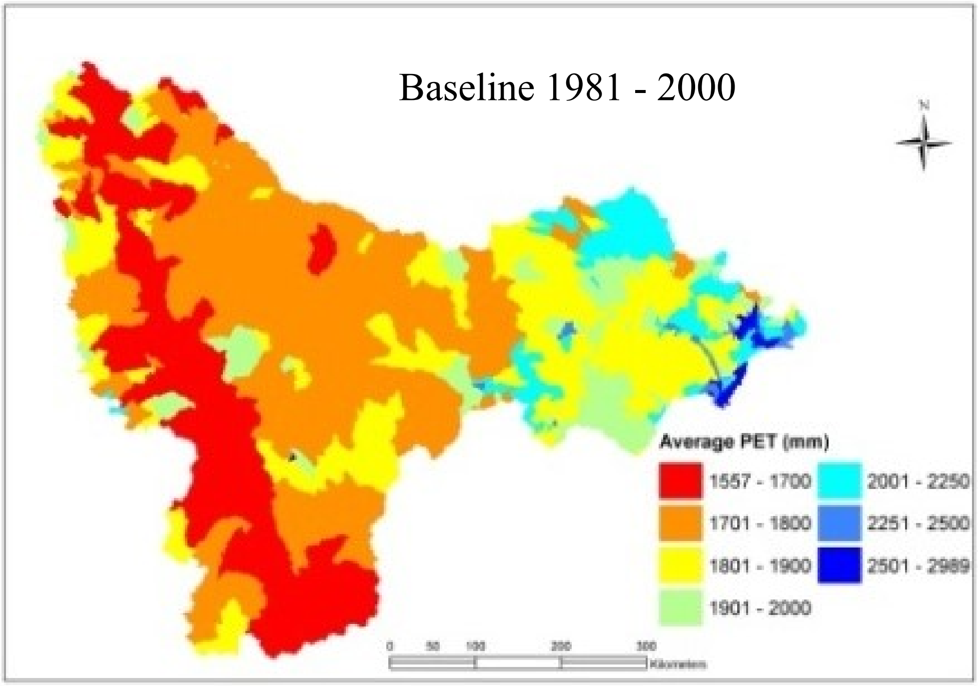

Percentage Change of Parameters in Y1B Scenario, Mid-Century & A1B Scenario, End-Century
500
400
300
200
100
0
-100
Y1B Annual
A1B Annual
Y1B SW
A1B SW
Y1B NE
A1B NE
Precipitation
PET
Soil Water
Water Yield

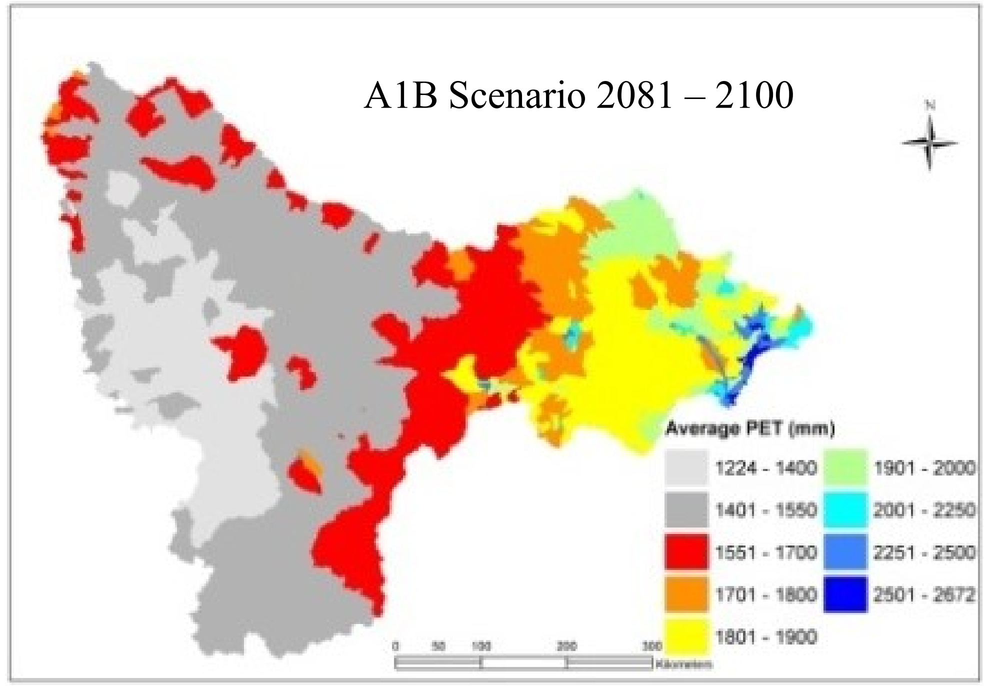
WATER YIELD – ANNUAL AVERAGE



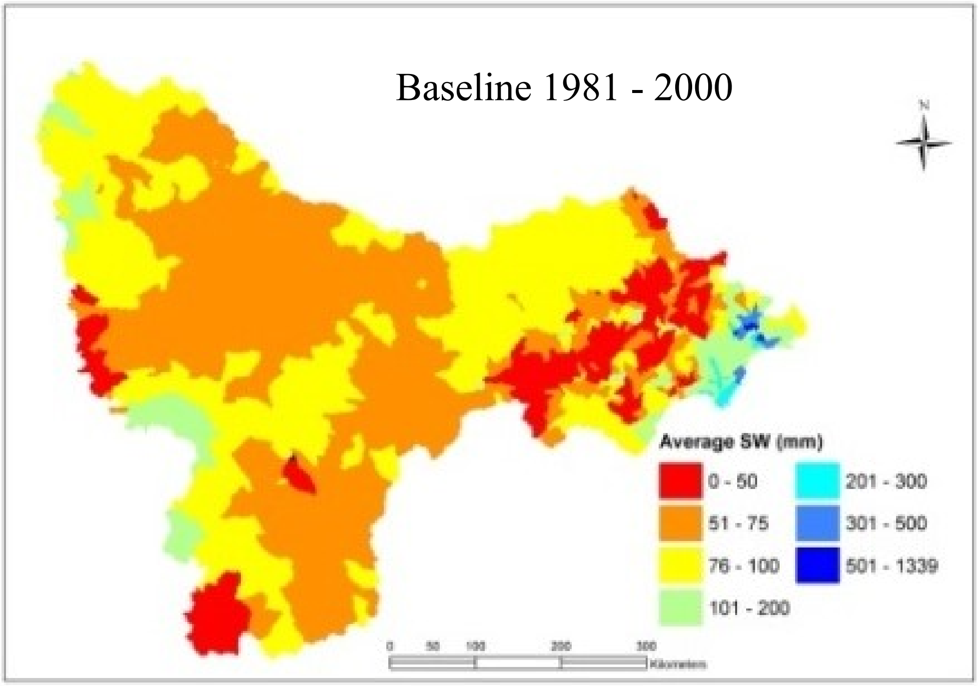


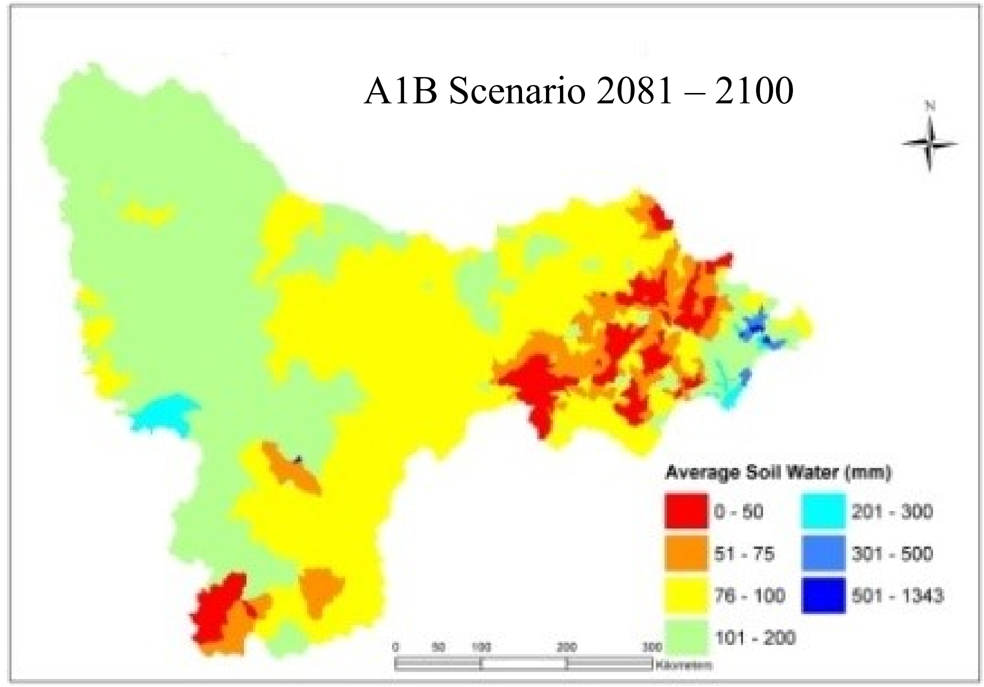
POTENTIAL EVAPOTRANSPIRATION – ANNUAL AVERAGE



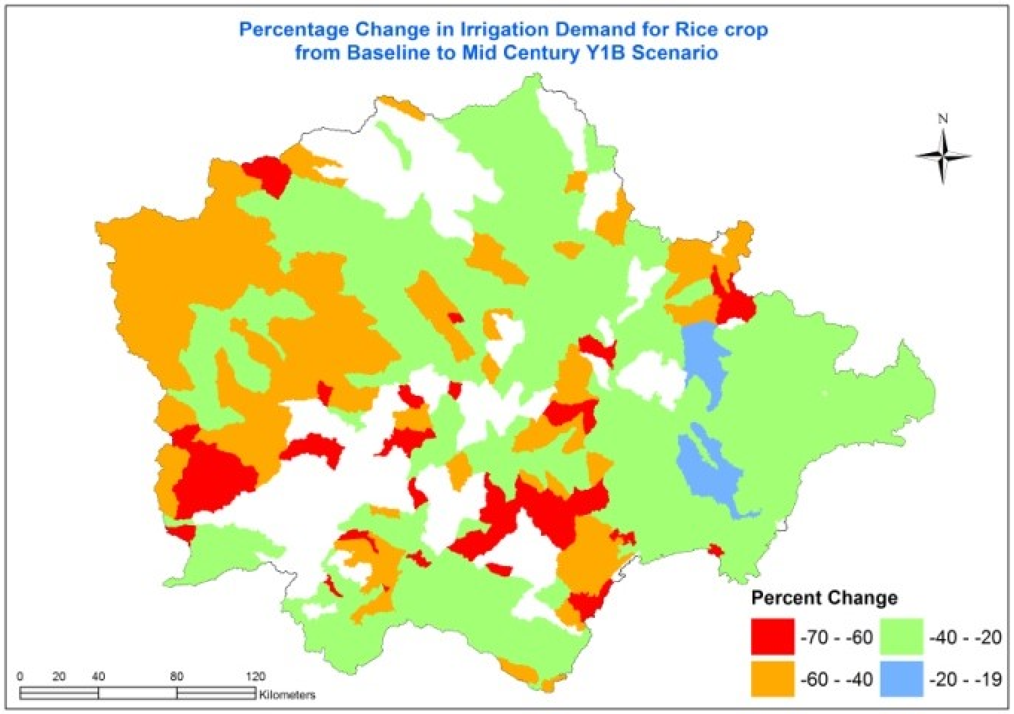


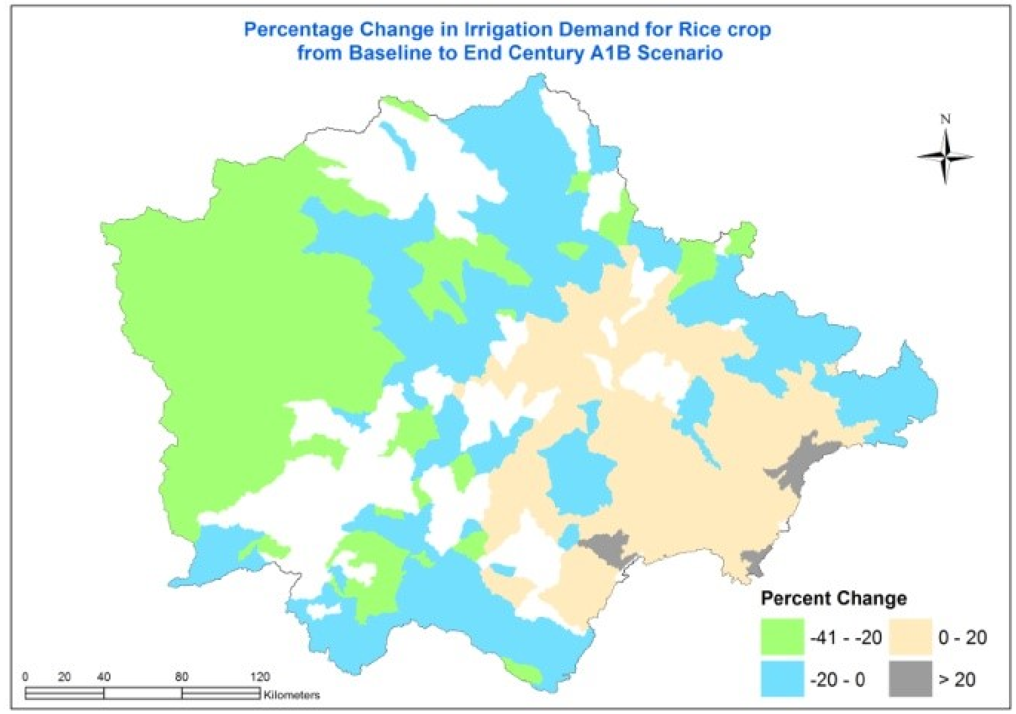
SOIL WATER – ANNUAL AVERAGE

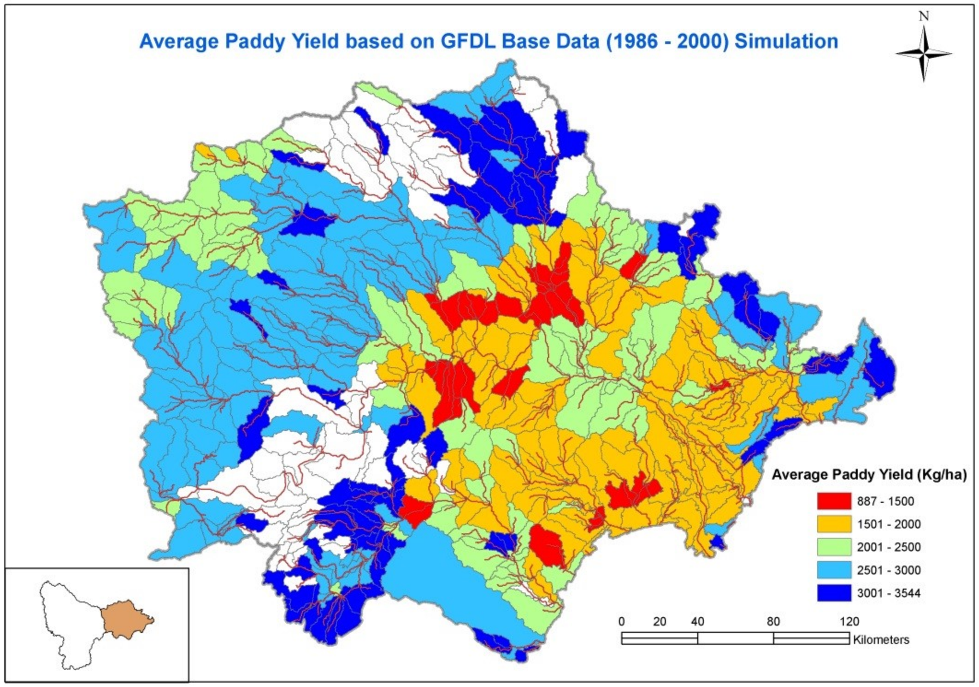


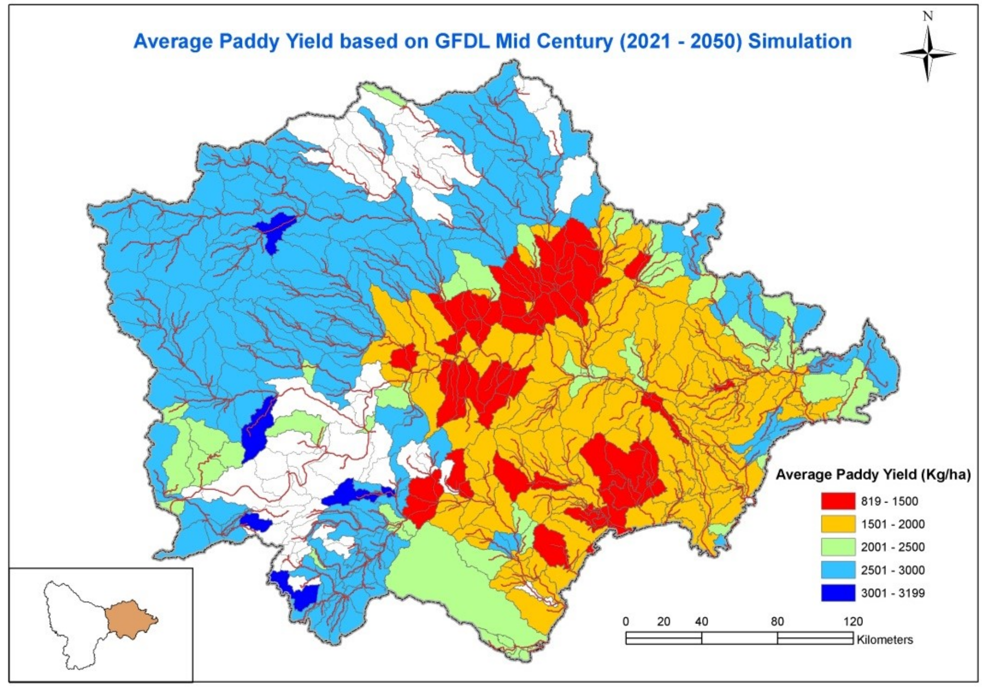


CHANGE OF WATER DEMAND






Average Paddy Yield based on GFDL Base Data (1986 - 2000) Simulation
N
Average Paddy Yield (Kg/ha)
887 - 1500
1501 - 2000
2001 - 2500
2501 - 3000
3001 - 3544
0 20 40 80 120
Kilometers


Average Paddy Yield based on GFDL Mid Century (2021 - 2050) Simulation
N
Average Paddy Yield (Kg/ha)
819 - 1500
1501 - 2000
2001 - 2500
2501 - 3000
3001 - 3199
0 20 40 80 120
Kilometers

CONCLUSIONS

- From Climate Simulations, it is observed that there would be increase in rain water, but it is not because of increase in number of rainy days but increase in flash floods.

- Research studies and investigations for developing the improved seed varieties of short duration and that which could with stand floods should be encouraged.

- Simulations with other climate models and dynamic landuse change would be taken up.

Thanks for kind attention