

Crop Production in a changing climate of Krishna Basin –

**Assessment of Water Availability for crop production in a changing climate – Preliminary Results for Krishna Basin**

**2012 International SWAT Conference, New Delhi - India**



**CLIMARICE**



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[www.iwmi.org](http://www.iwmi.org)

# OBJECTIVES

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## Sustainable Rice Production in Changing Climate

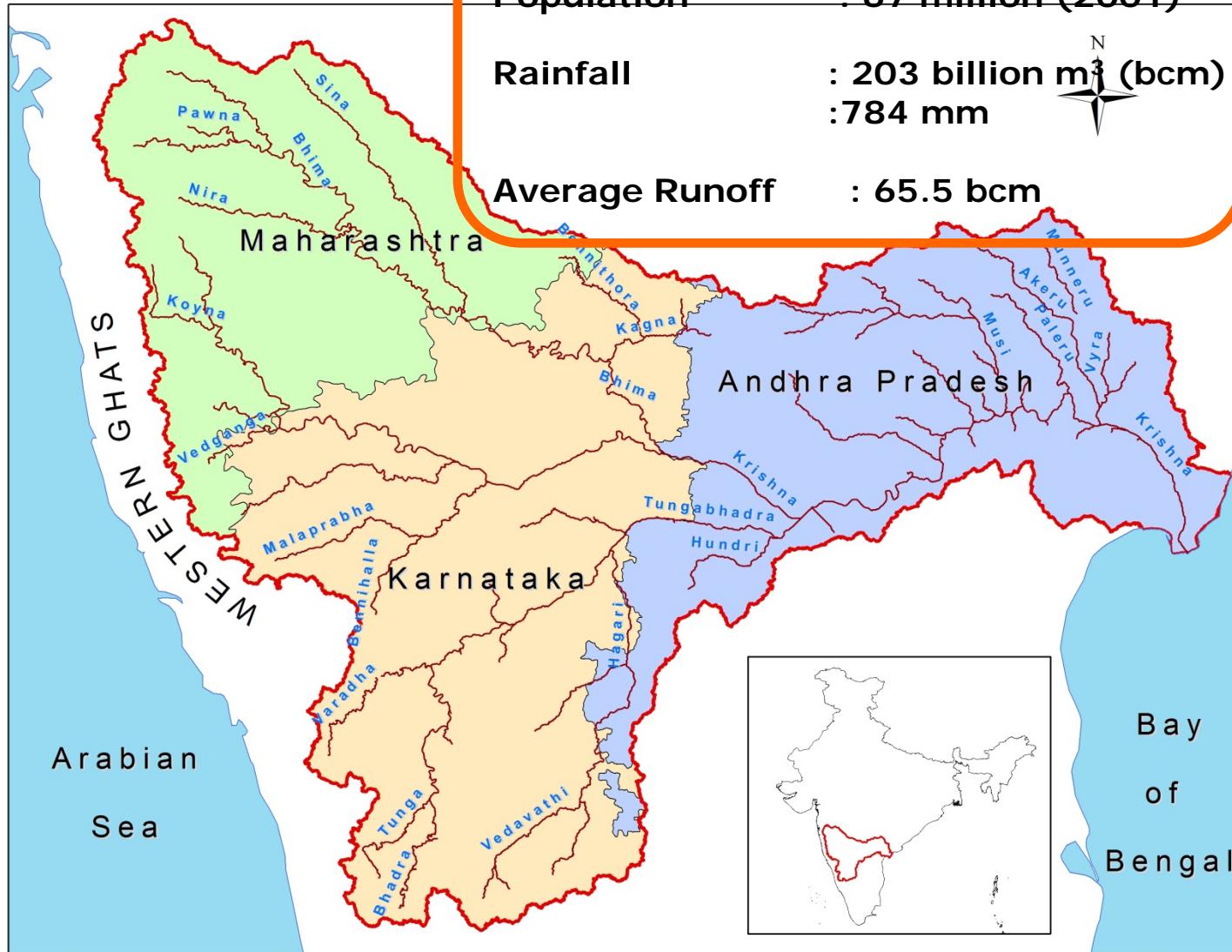
- Model Development for Krishna Basin
- Assessment of water availability in the basin

**Catchment Area : 2,65,835 Sq.km.**

**Population : 67 million (2001)**

**Rainfall : 203 billion m<sup>3</sup> (bcm)  
: 784 mm**

**Average Runoff : 65.5 bcm**

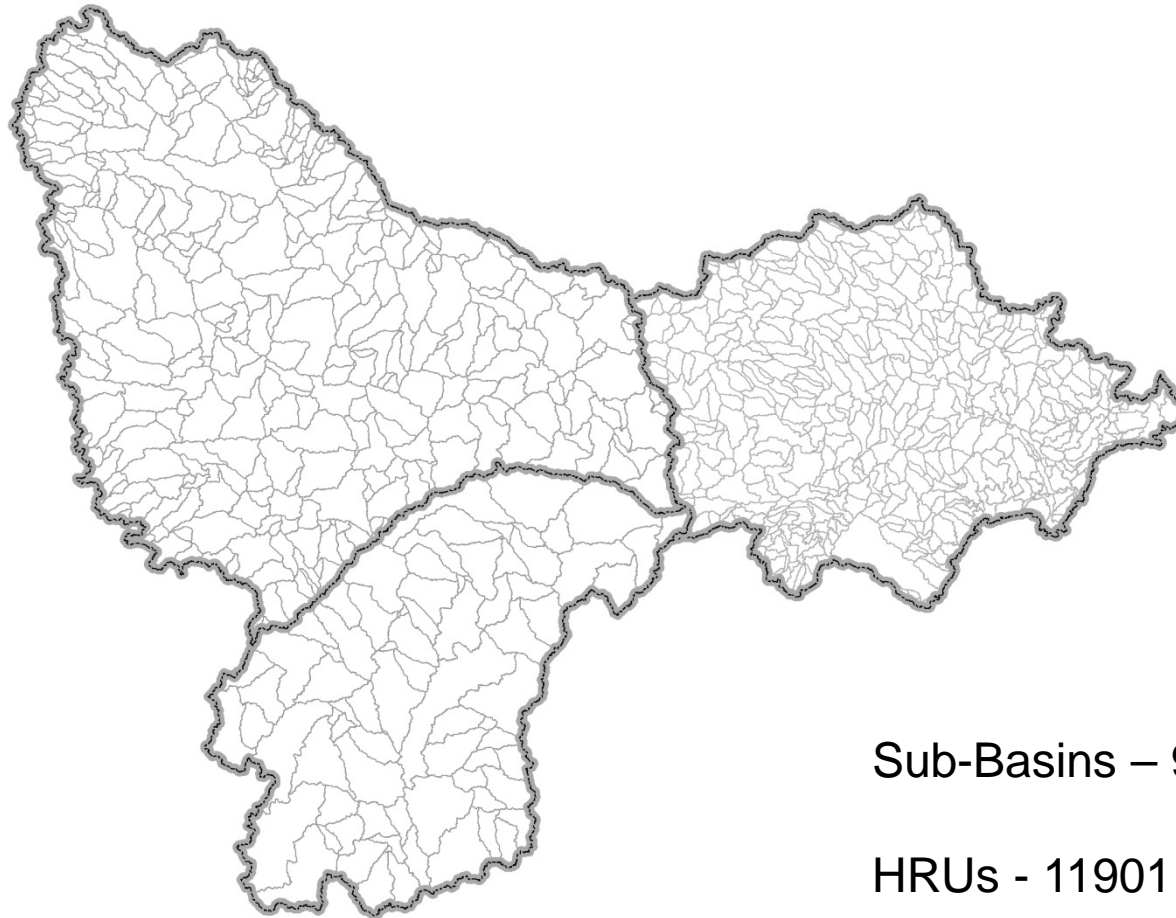


## Data Used

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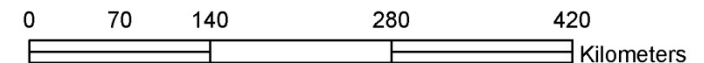
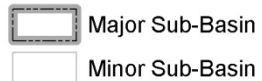
- DEM - SRTM 90 m
- Landuse - IRS AWIFS & GIAM
- Soil - NBSS&LUP, FAO
- Climate - IPRC, GFDL Data  
(1981-2000, 2021-2050)

## Krishna River Basin Major & Minor Sub-Basins



Sub-Basins – 937

HRUs - 11901



# Crop Sequence

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- Paddy - Paddy
- Sugarcane
- Paddy - Maize
- Paddy - Cotton
- Paddy - Chili
- Paddy - Groundnut
- Paddy - Sunflower
- Paddy - Onions



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

PLANT\_ID: Rice | CURYR\_MAT: 0 | Month: July | Day: 15 | Heat Units to Maturity: 1850 | LAI\_INIT: 0

BIO\_INIT: 0 | HI\_TARG: 0 | BIO\_TARG: 0 | CNOP: 0

Cancel | OK

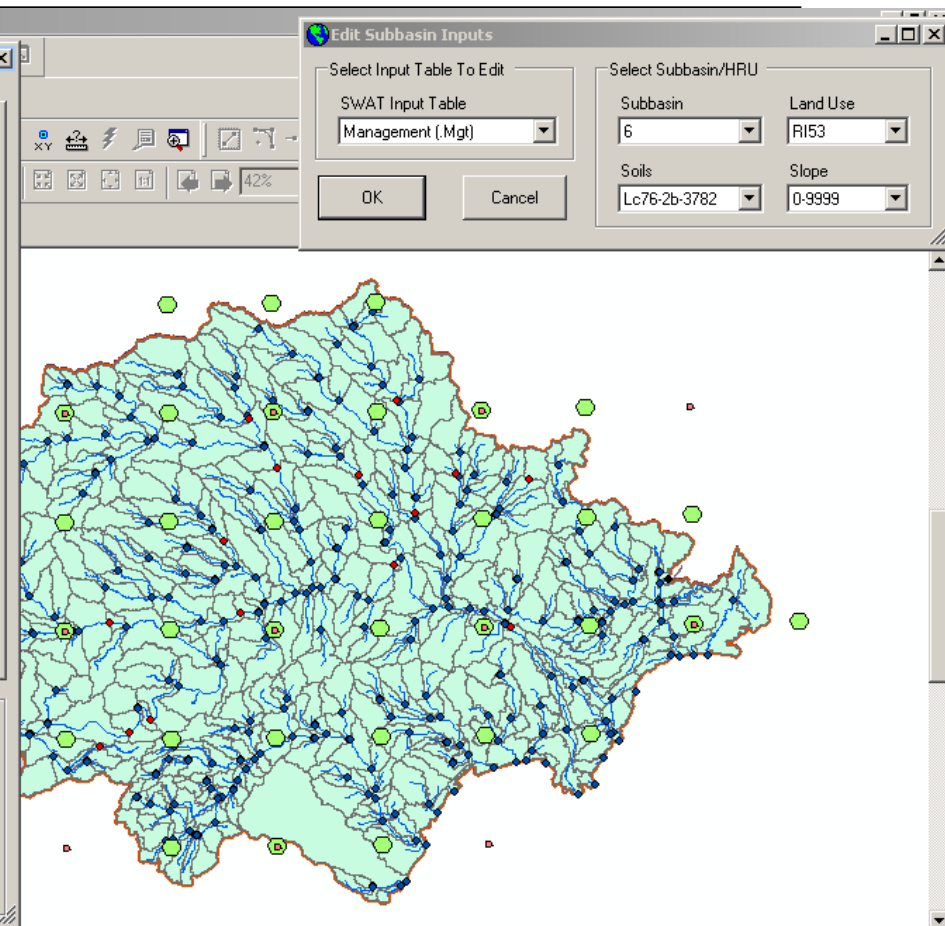
Edit Values | Cancel Edits | Save Edits | Exit

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 |
|-----------|----------|-------|-------|
|           |          |       |       |



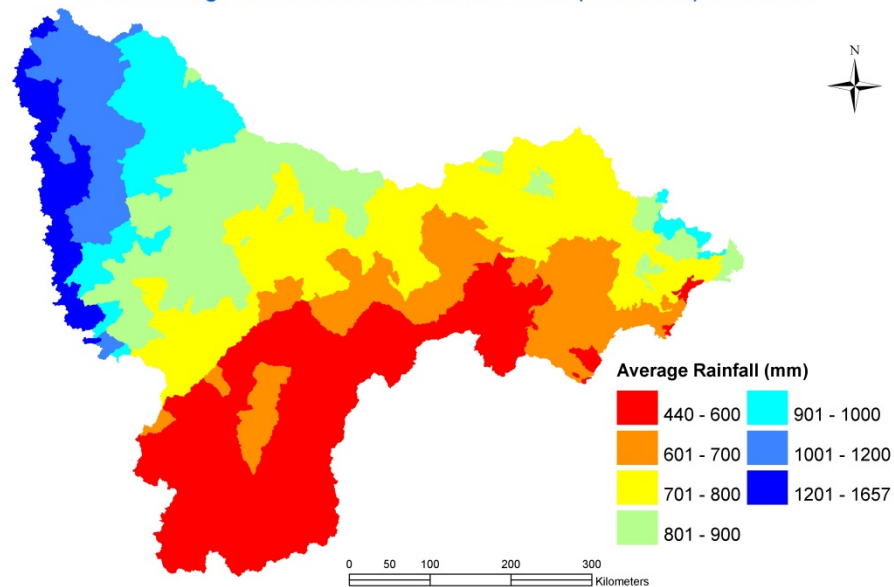
# Preliminary Results

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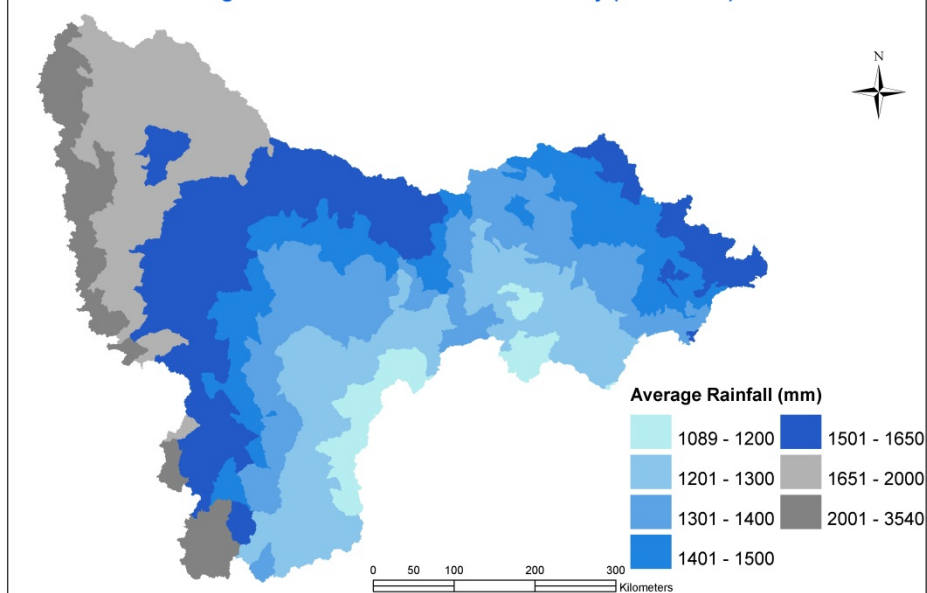
- How much is the current irrigation demand with the existing cropping practices?
  - How much water is available in major reservoirs?
- How much will be the future irrigation demand with climate change with no change in current practices?
  - How much water will be available in major reservoirs?



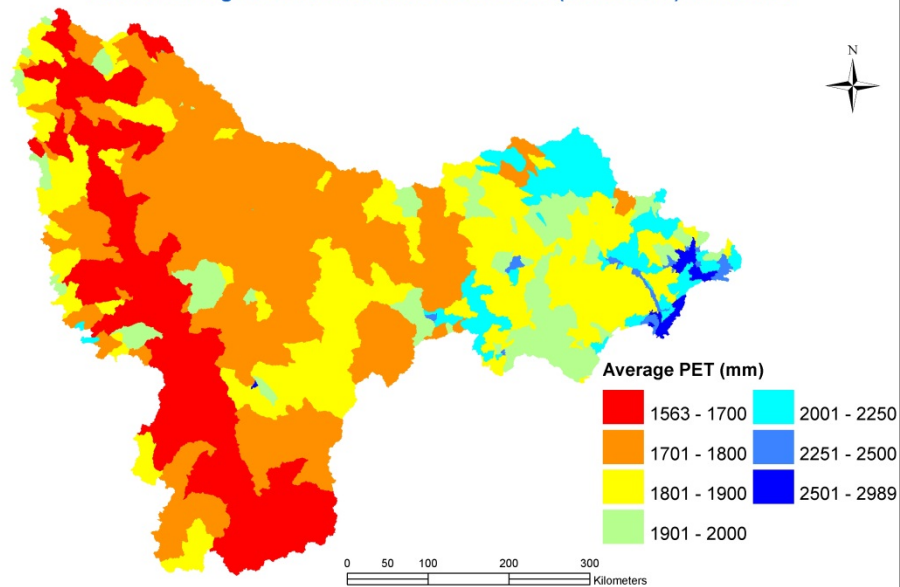
Annual Average Rainfall based on GFDL Base Data (1986 - 2000) Simulation



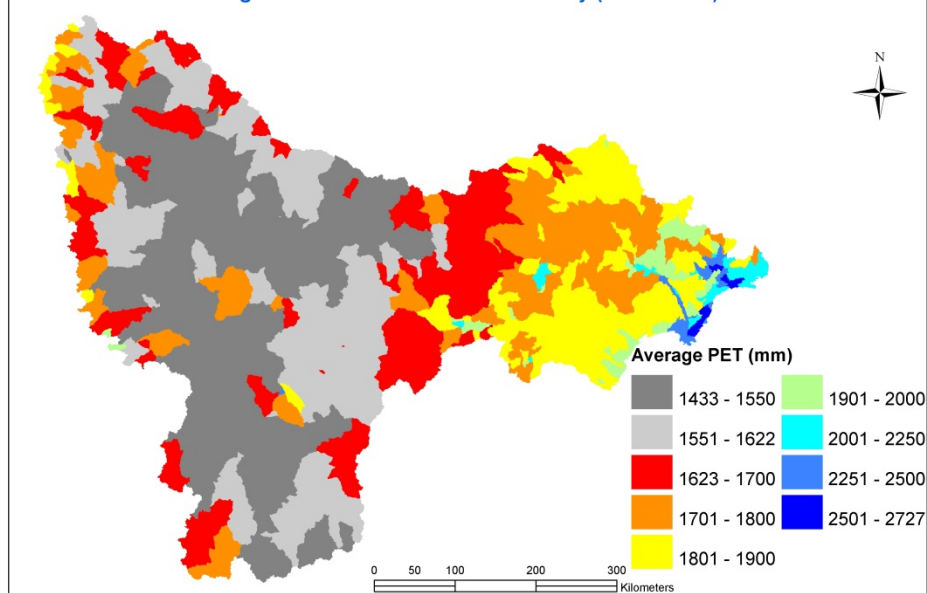
Annual Average Rainfall based on GFDL Mid Century (2021 - 2050) Simulation



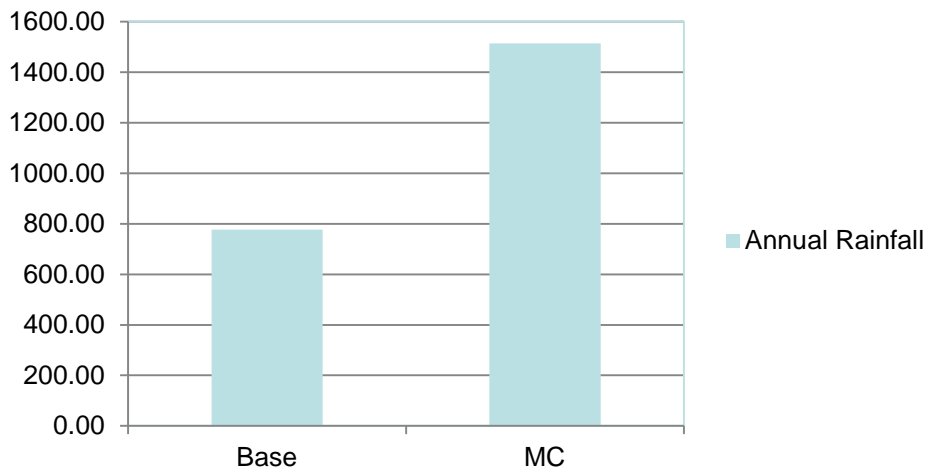
Annual Average PET based on GFDL Base Data (1986 - 2000) Simulation



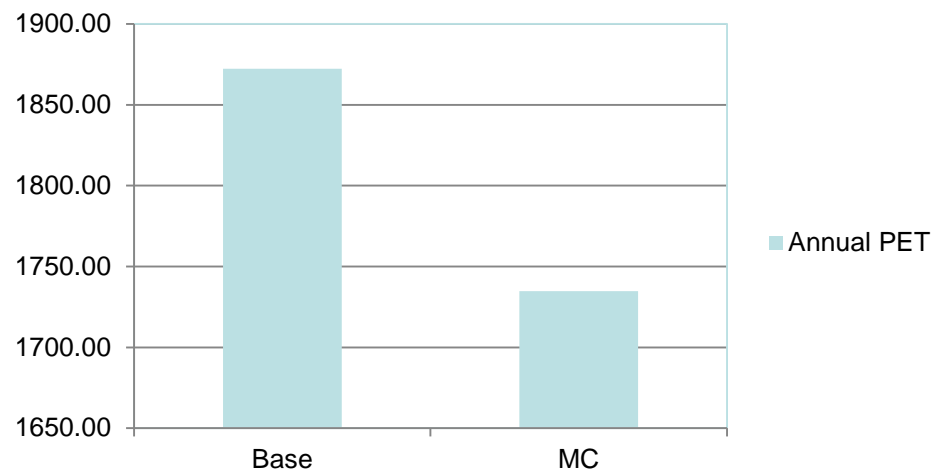
Annual Average PET based on GFDL Mid Century (2021 - 2050) Simulation



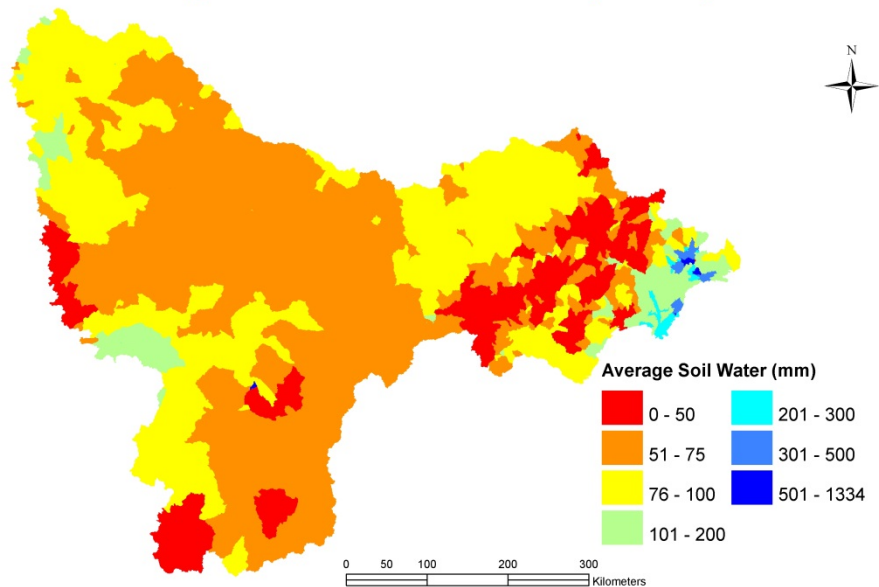
## Overall Average Annual Rainfall



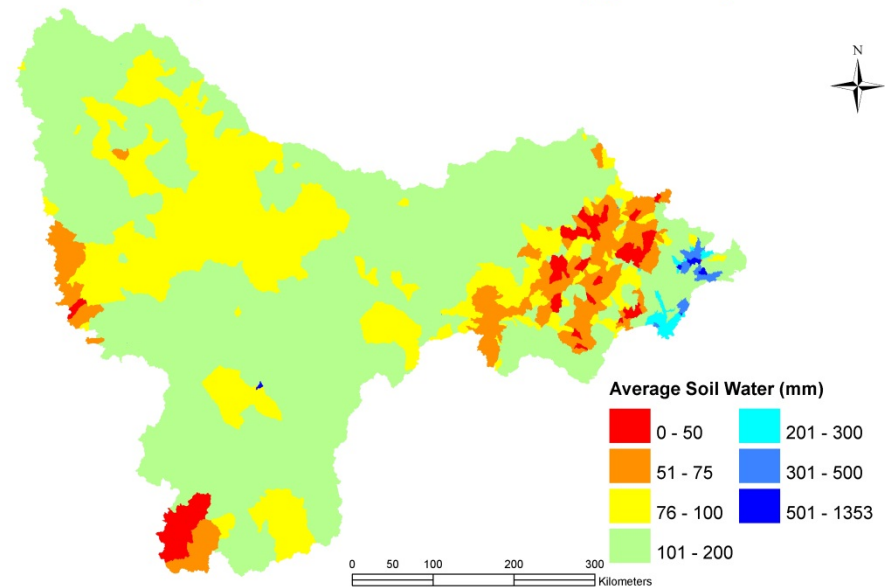
## Overall Average Annual PET



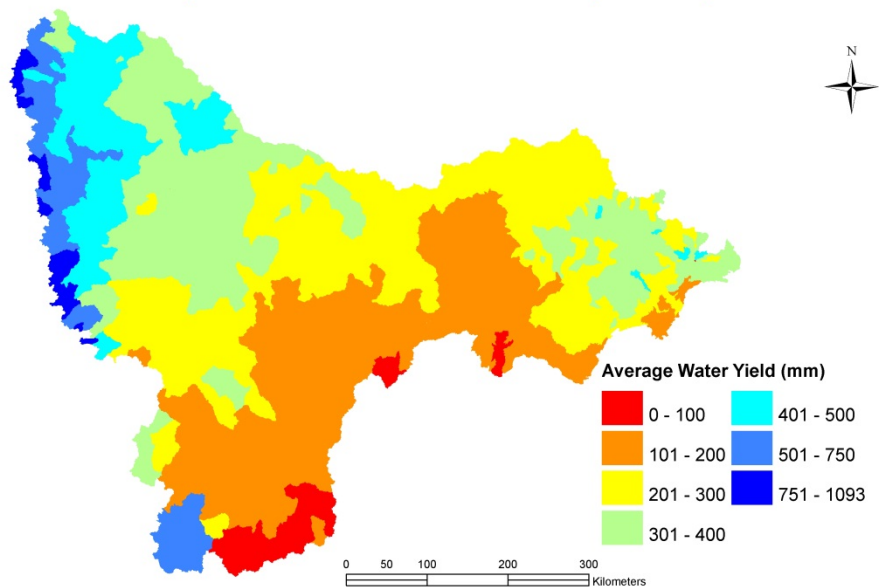
Annual Average Soil Water based on GFDL Base Data (1986 - 2000) Simulation



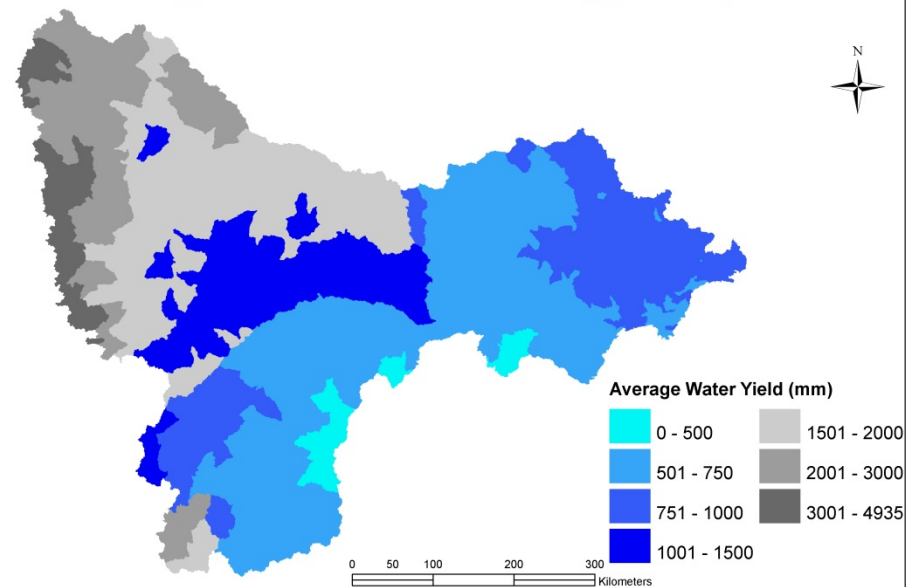
Annual Average Soil Water based on GFDL Mid Century (2021 - 2050) Simulation



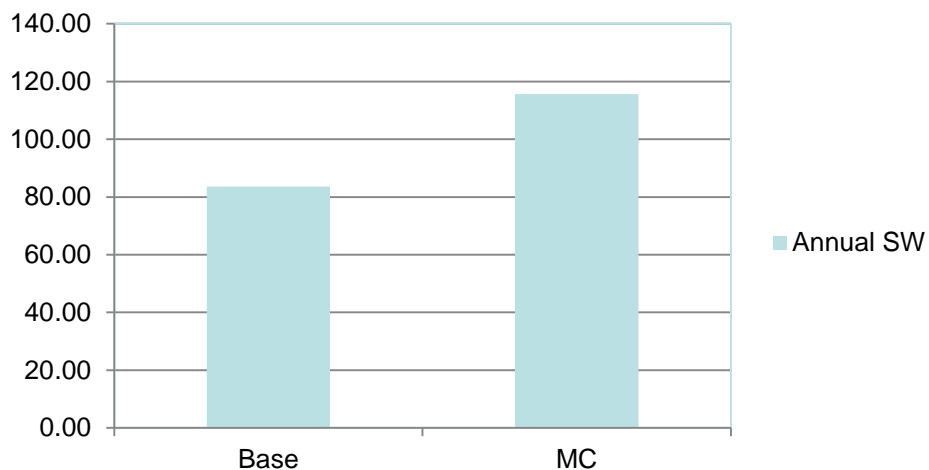
Annual Average Water Yield based on GFDL Base Data (1986 - 2000) Simulation



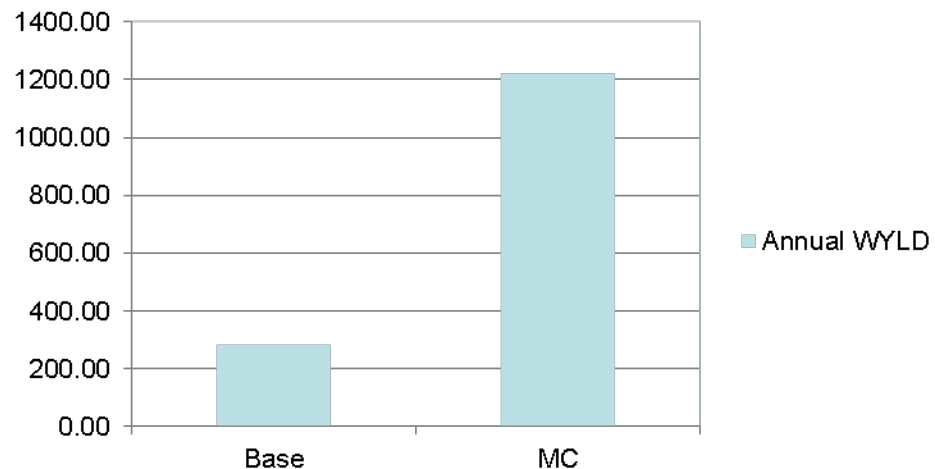
Annual Average Water Yield based on GFDL Mid Century (2021 - 2050) Simulation



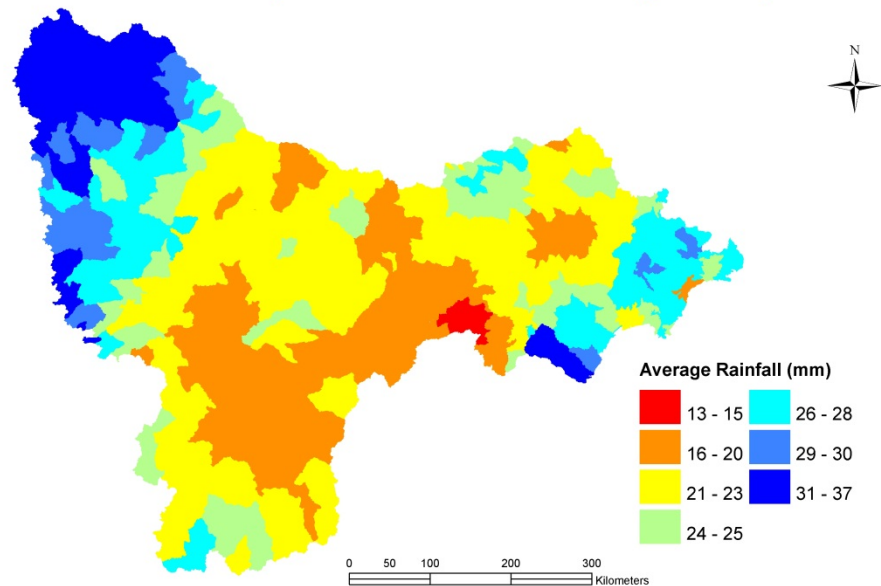
## Overall Average Annual SW



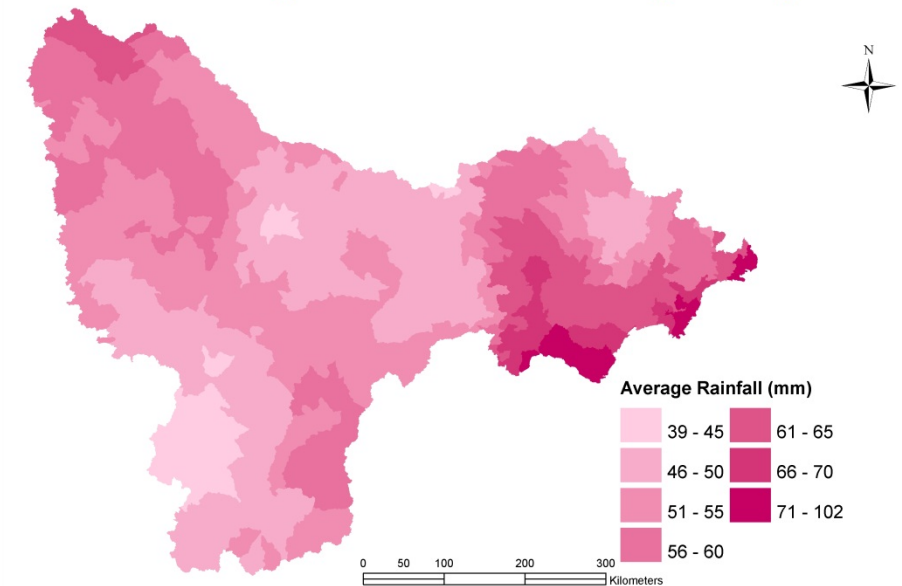
## Overall Average Annual WYLD



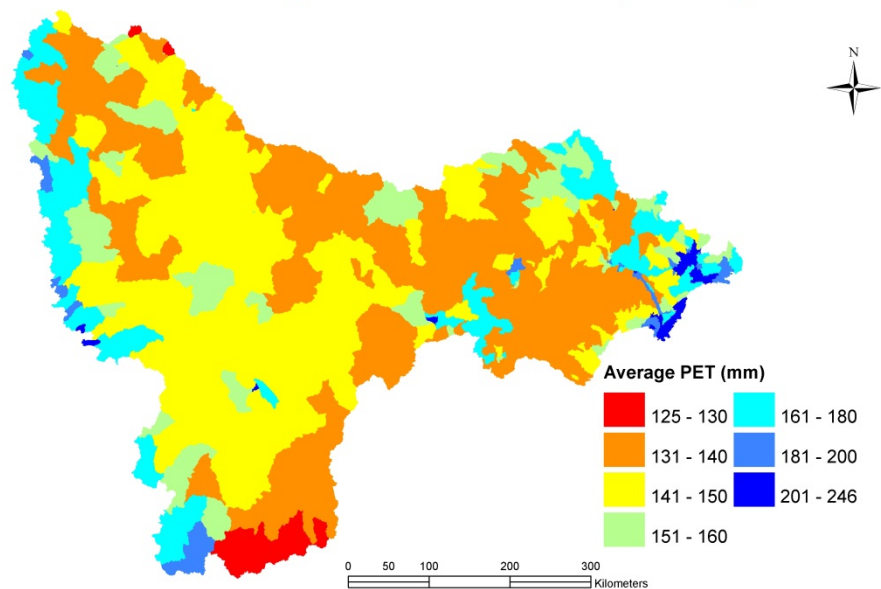
North-East Monsoon Average Rainfall based on GFDL Base Data (1986 - 2000) Simulation



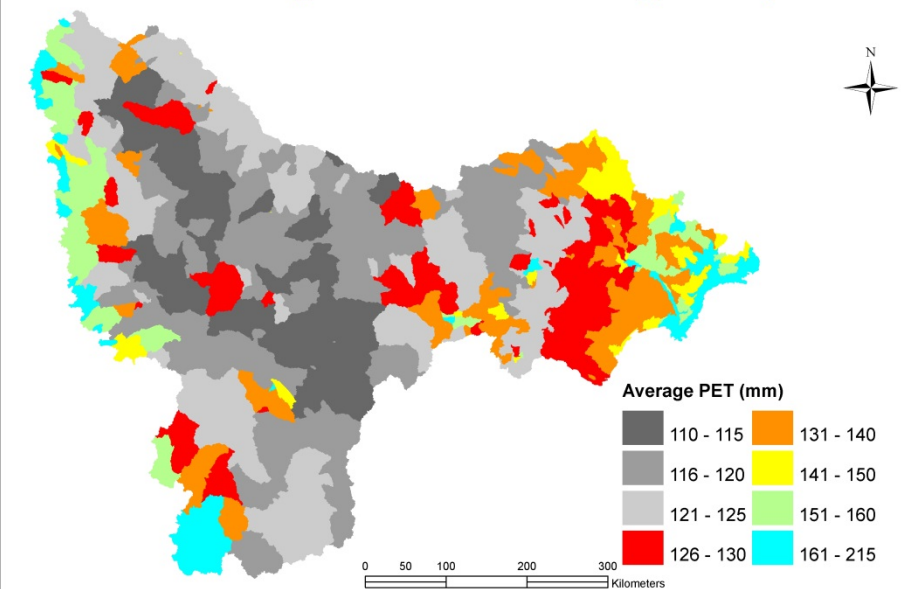
North-East Monsoon Average Rainfall based on GFDL Mid Century (2021 - 2050) Simulation



North-East Monsoon Average PET based on GFDL Base Data (1986 - 2000) Simulation

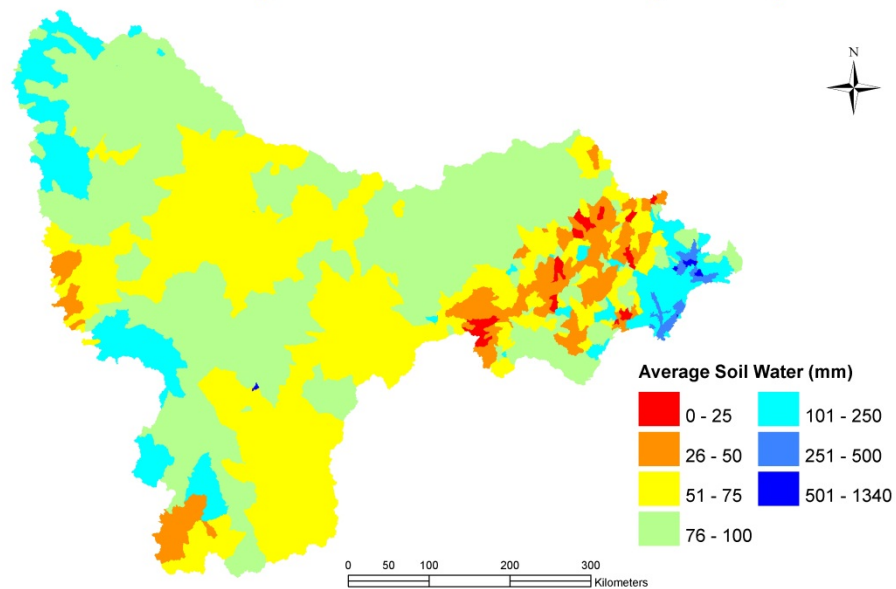


North-East Monsoon Average PET based on GFDL Mid Century (2021 - 2050) Simulation

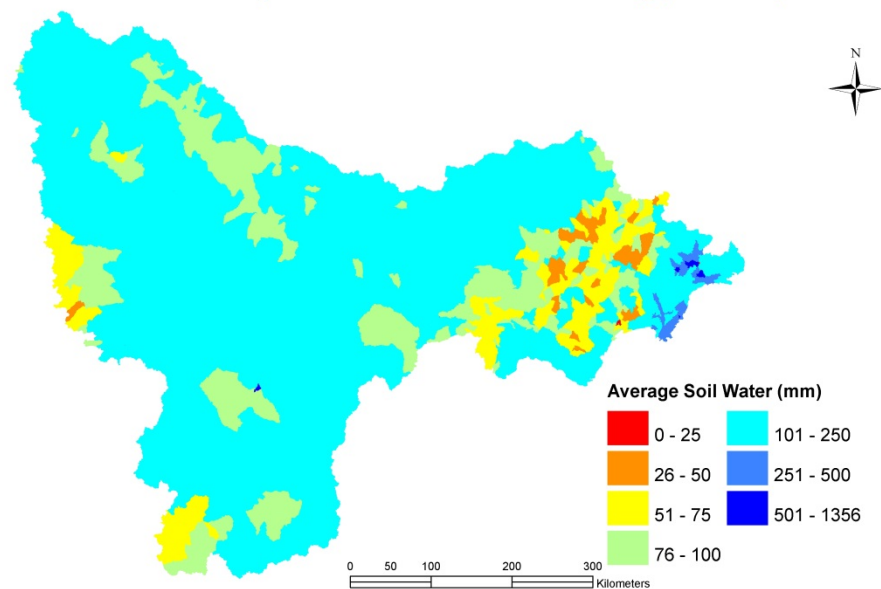




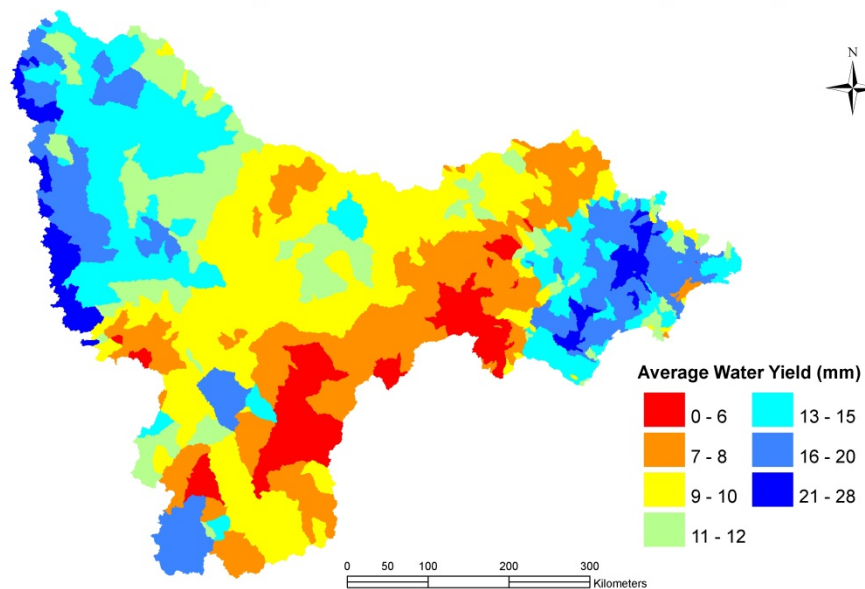
North-East Monsoon Average Soil Water based on GFDL Base Data (1986 - 2000) Simulation



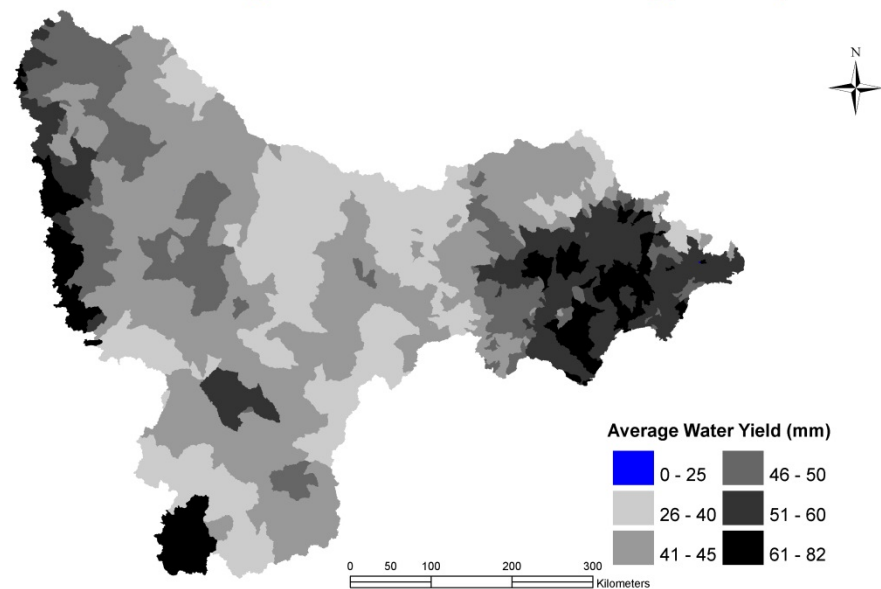
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North-East Monsoon Average Water Yield based on GFDL Base Data (1986 - 2000) Simulation

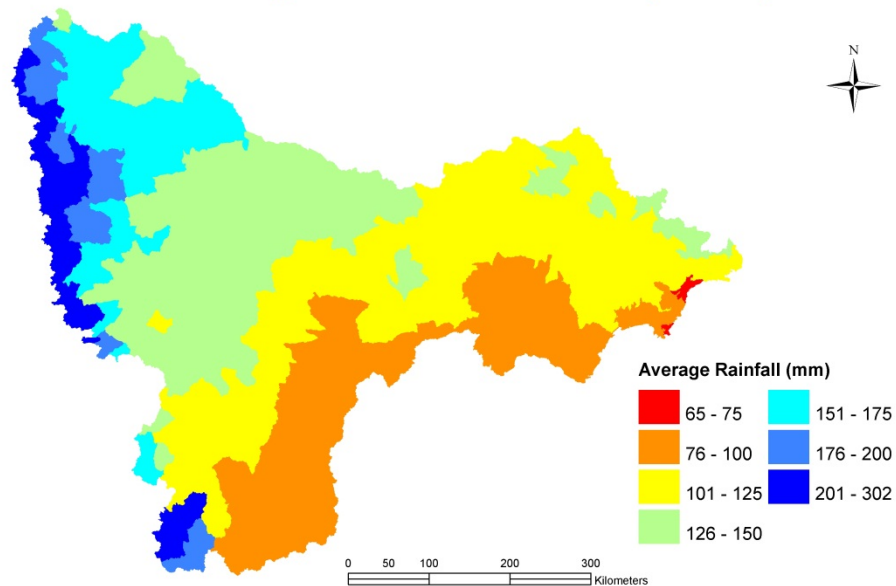


North-East Monsoon Average Water Yield based on GFDL Mid Century (2021 - 2050) Simulation

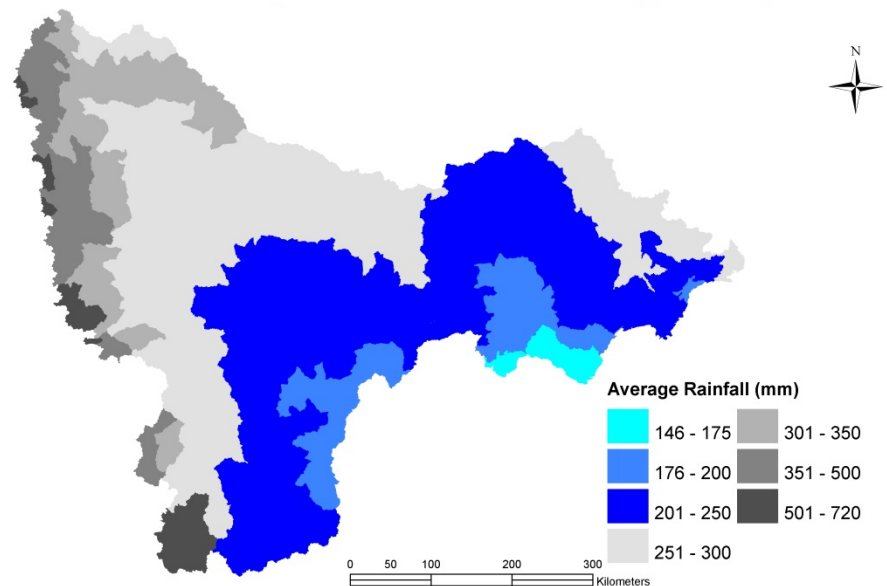




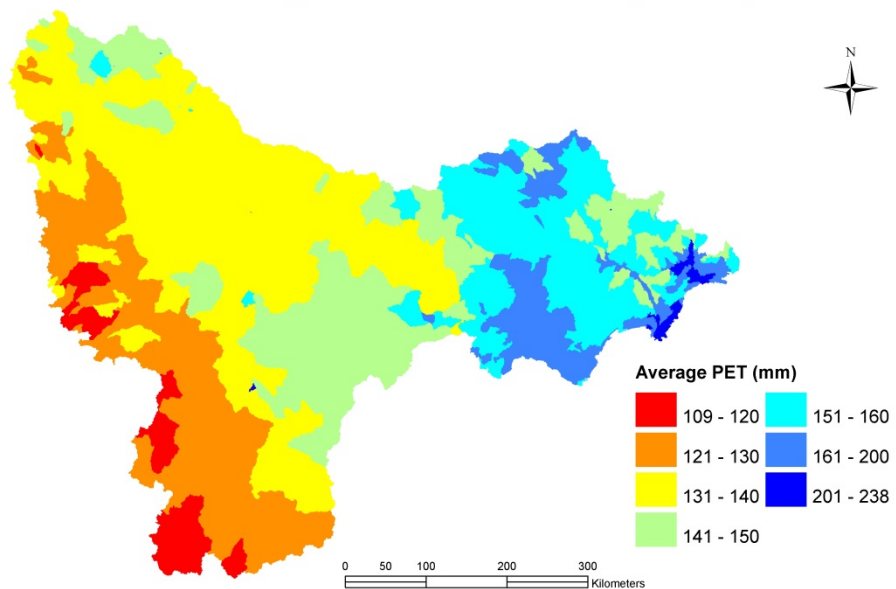
South-West Monsoon Average Rainfall based on GFDL Base Data (1986 - 2000) Simulation



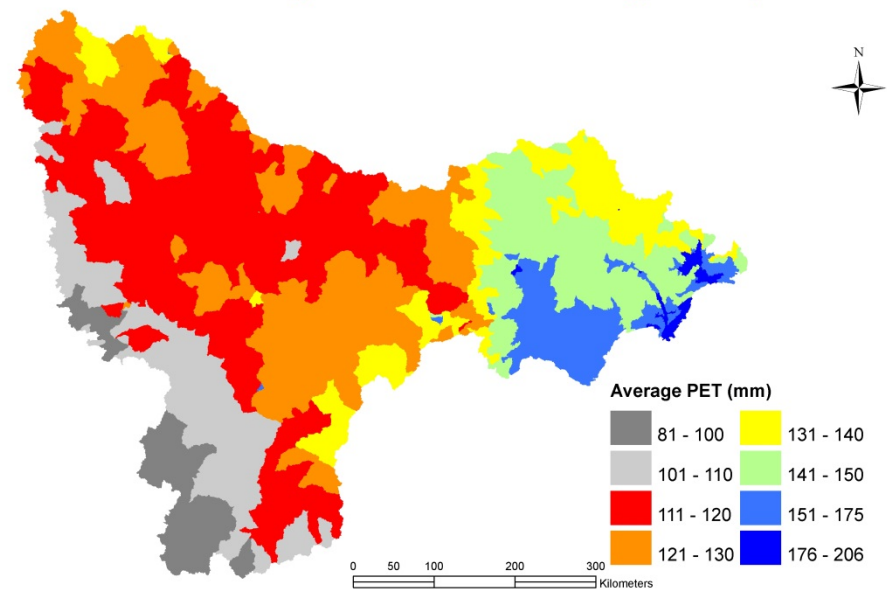
South-West Monsoon Average Rainfall based on GFDL Mid Century (2021 - 2050) Simulation



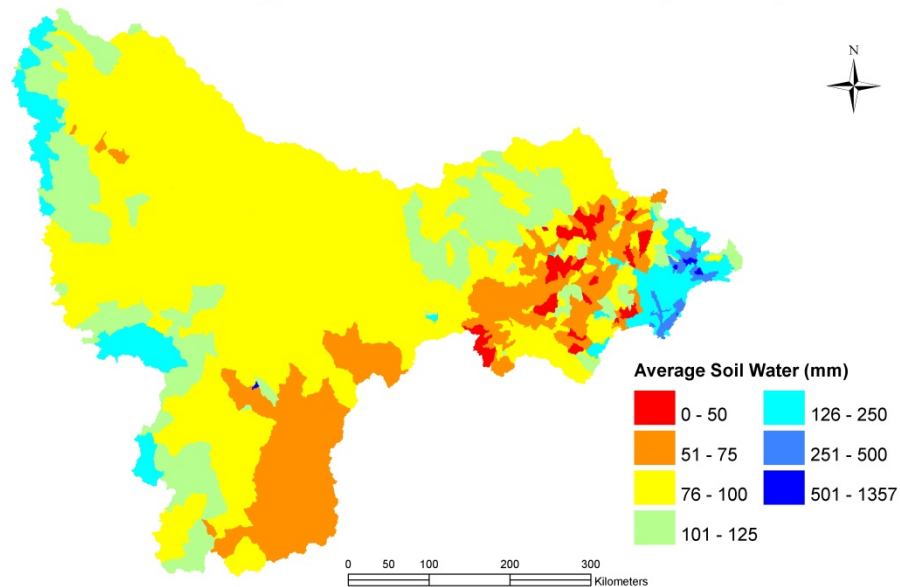
South-West Monsoon Average PET based on GFDL Base Data (1986 - 2000) Simulation



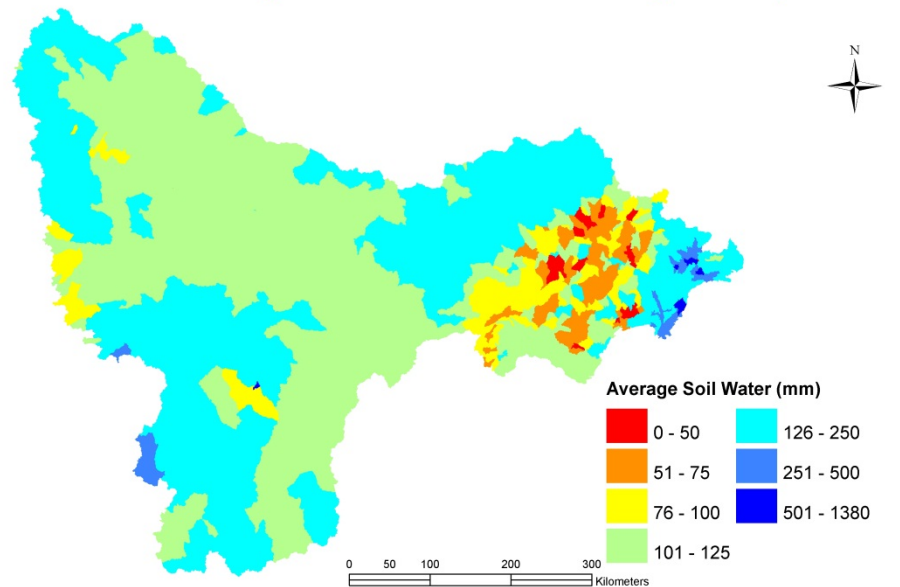
South-West Monsoon Average PET based on GFDL Mid Century (2021 - 2050) Simulation



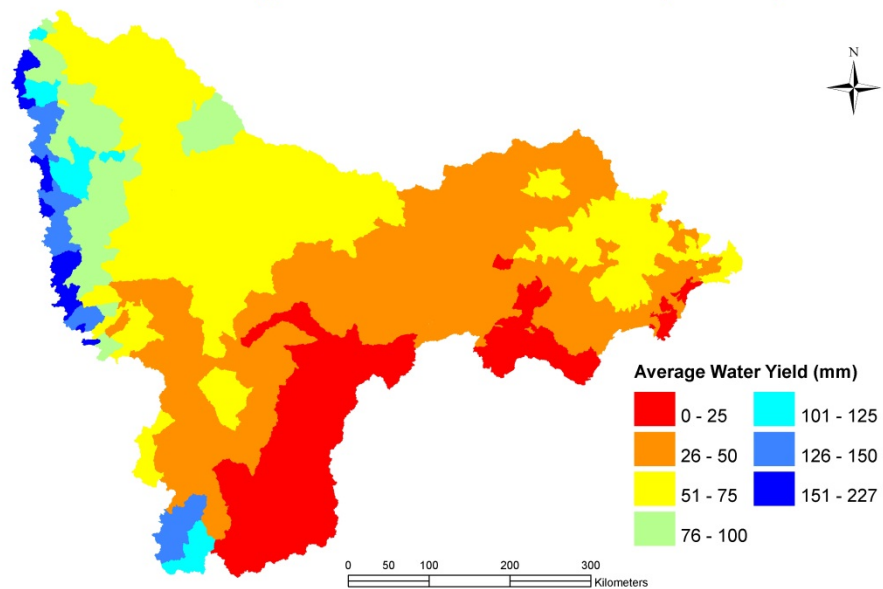
South-West Monsoon Average Soil Water based on GFDL Base Data (1986 - 2000) Simulation



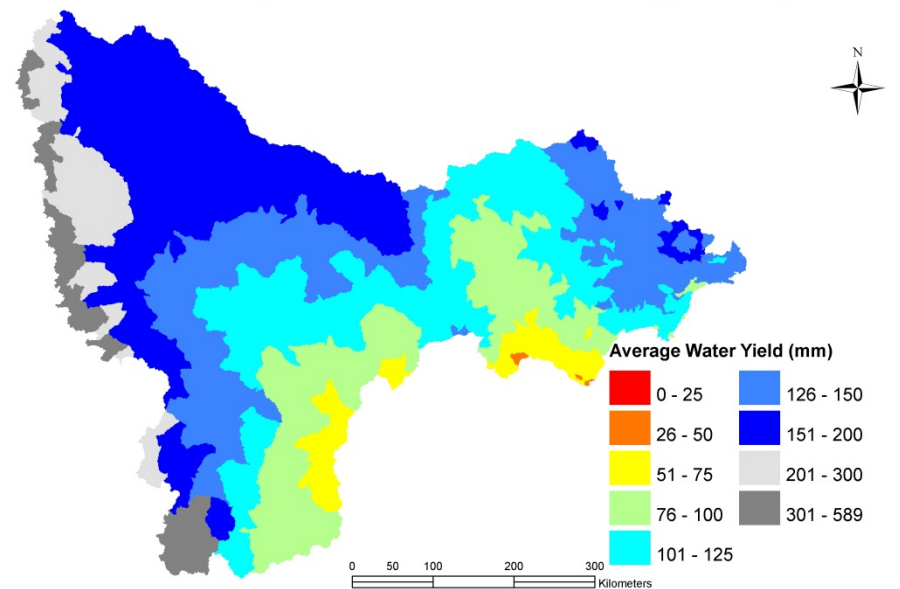
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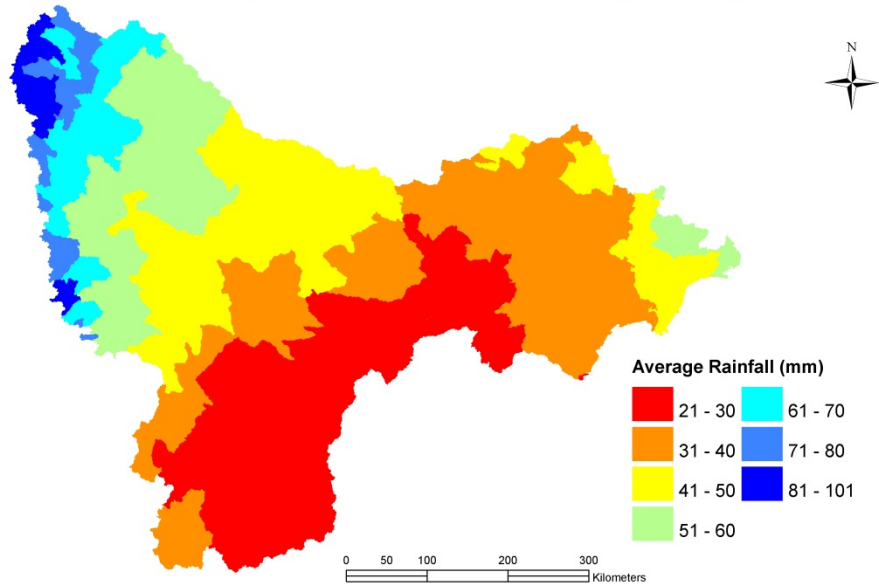
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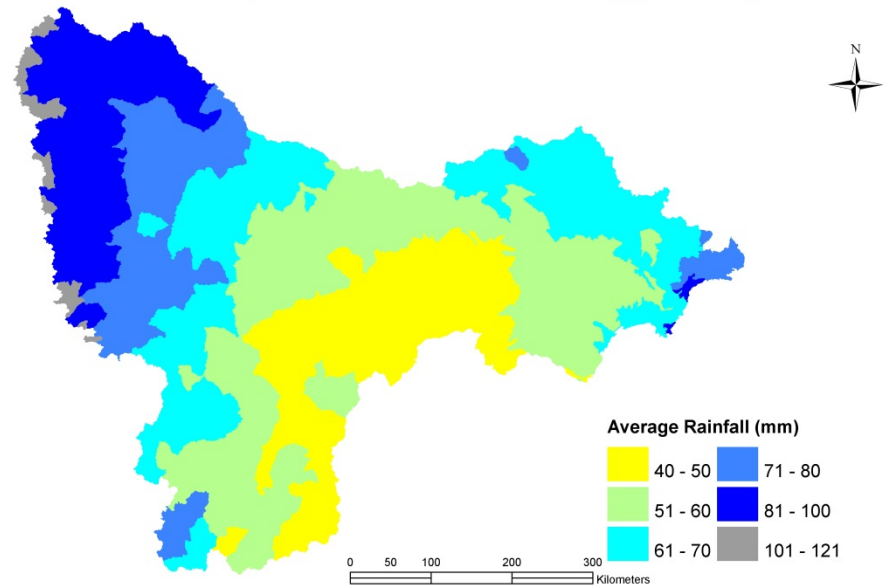
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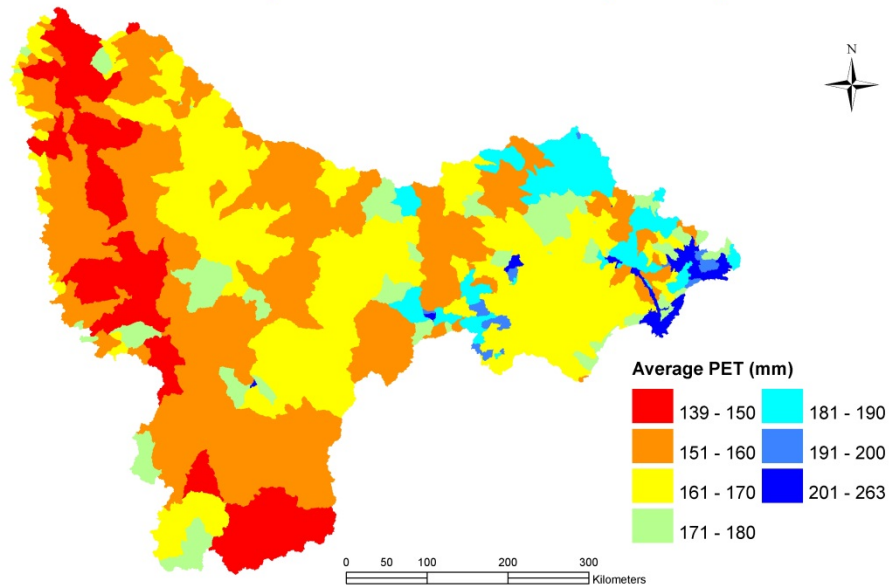
Summer Season Average Rainfall based on GFDL Base Data (1986 - 2000) Simulation



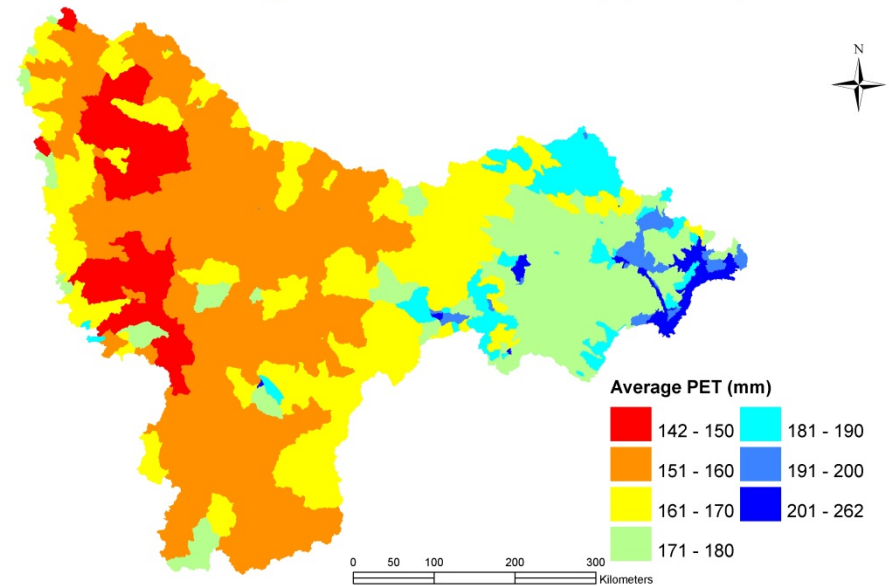
Summer Season Average Rainfall based on GFDL Mid Century (2021 - 2050) Simulation



Summer Season Average PET based on GFDL Base Data (1986 - 2000) Simulation

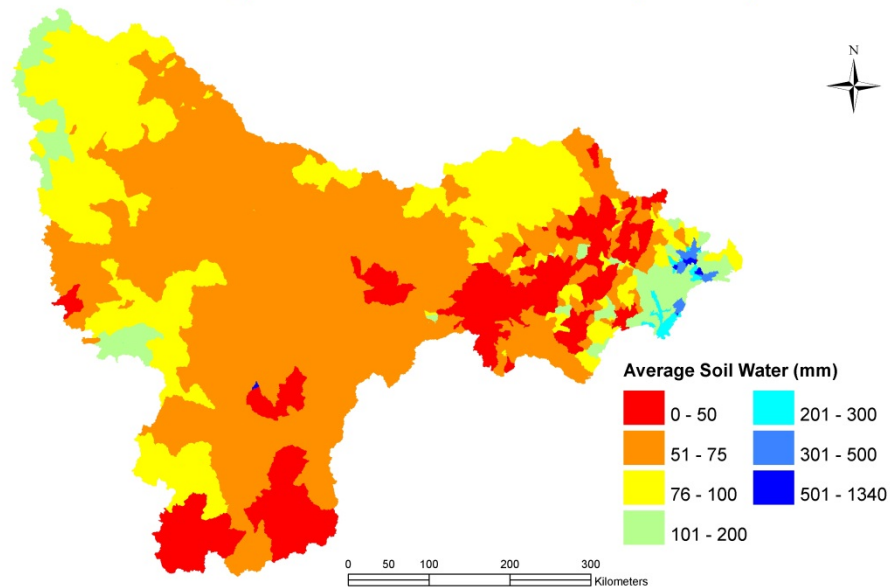


Summer Season Average PET based on GFDL Mid Century (2021 - 2050) Simulation

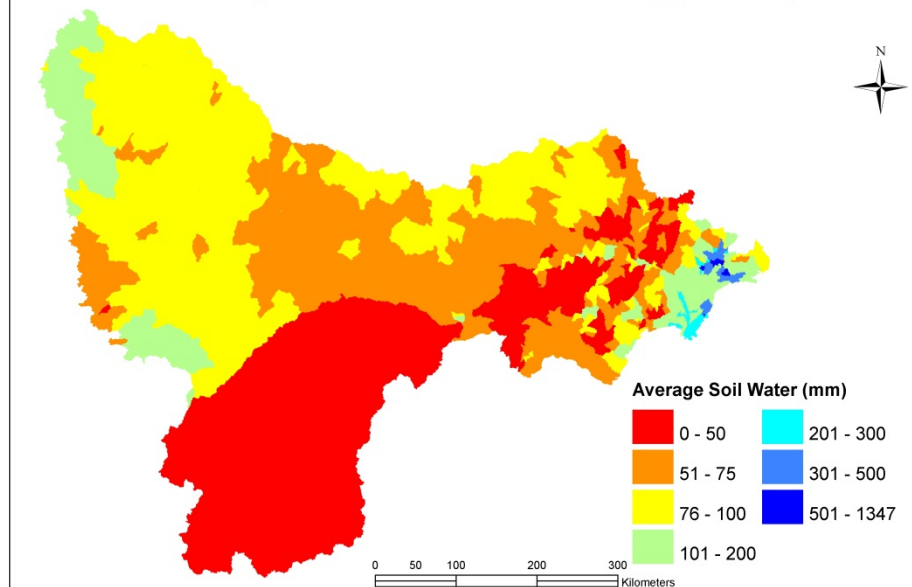




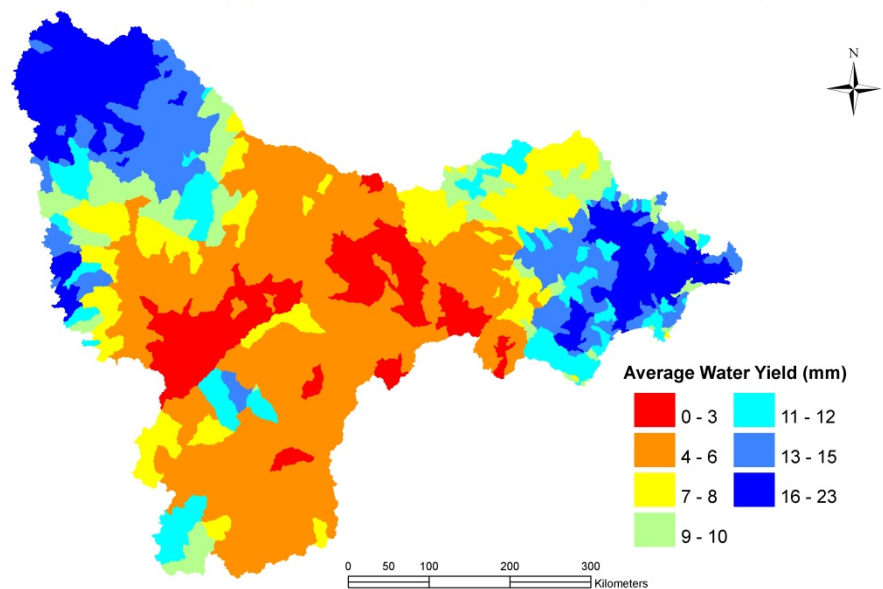
Summer Season Average Soil Water based on GFDL Base Data (1986 - 2000) Simulation



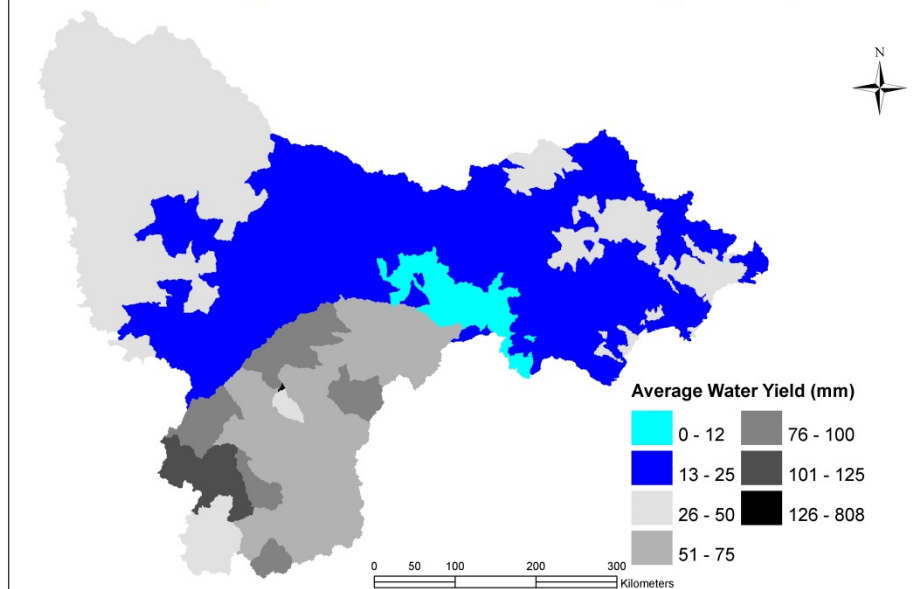
Summer Season Average Soil Water based on GFDL Mid Century (2021 - 2050) Simulation



Summer Season Average Water Yield based on GFDL Base Data (1986 - 2000) Simulation



Summer Season Average Water Yield based on GFDL Mid Century (2021 - 2050) Simulation



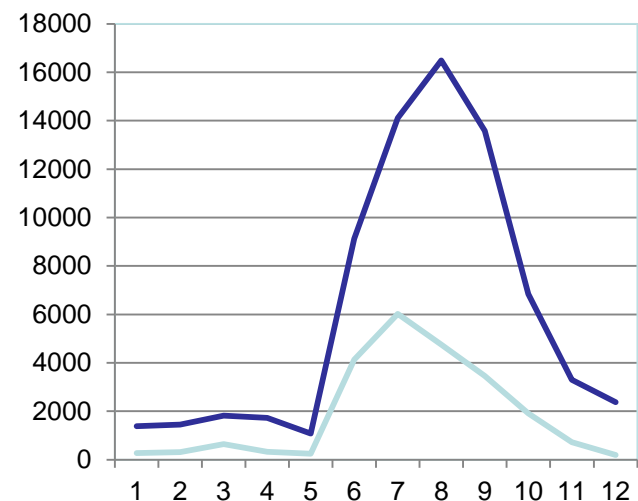
| Map    | IMD Rainfall | MC Rainfall | Percent Increase |
|--------|--------------|-------------|------------------|
| Annual | 776.61       | 1514.22     | 94.98            |
| NE     | 23.64        | 55.48       | 134.63           |
| SW     | 125.49       | 258.70      | 106.16           |
| Summer | 42.25        | 64.38       | 52.39            |

| Map    | IMD PET | MC PET  | Percent Increase |
|--------|---------|---------|------------------|
| Annual | 1872.36 | 1734.87 | -7.34            |
| NE     | 148.17  | 131.19  | -11.46           |
| SW     | 148.00  | 132.50  | -10.47           |
| Summer | 166.34  | 170.02  | 2.21             |

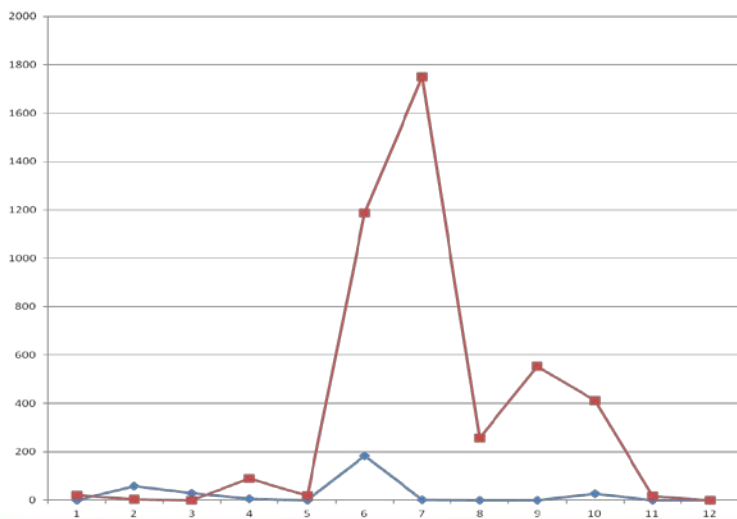
| Map    | IMD SW | MC SW  | Percent Increase |
|--------|--------|--------|------------------|
| Annual | 83.64  | 115.66 | 38.28            |
| NE     | 90.83  | 117.78 | 29.68            |
| SW     | 103.09 | 132.42 | 28.45            |
| Summer | 82.63  | 82.67  | 0.05             |

| Map    | IMD WYLD | MC WYLD | Percent Increase |
|--------|----------|---------|------------------|
| Annual | 283.11   | 1220.81 | 331.21           |
| NE     | 11.33    | 46.49   | 310.35           |
| SW     | 52.01    | 141.33  | 171.73           |
| Summer | 9.50     | 27.55   | 189.88           |

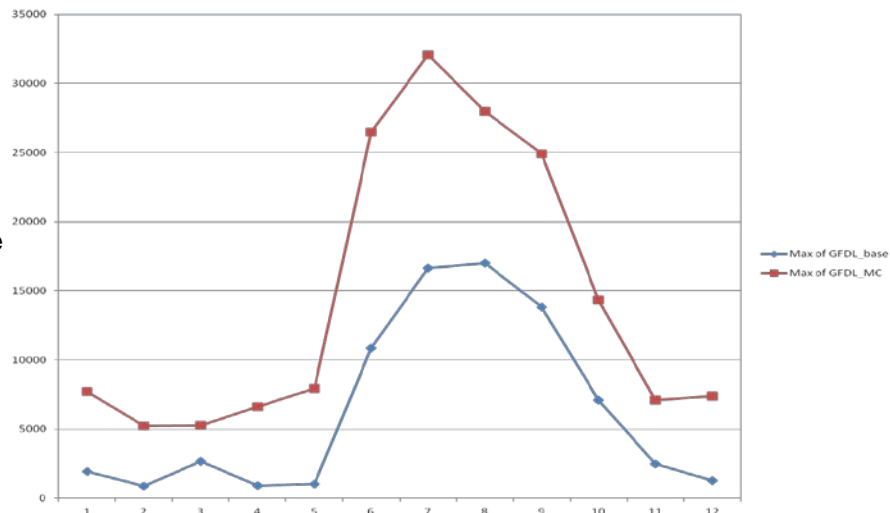
# Water Available at Major Reservoirs



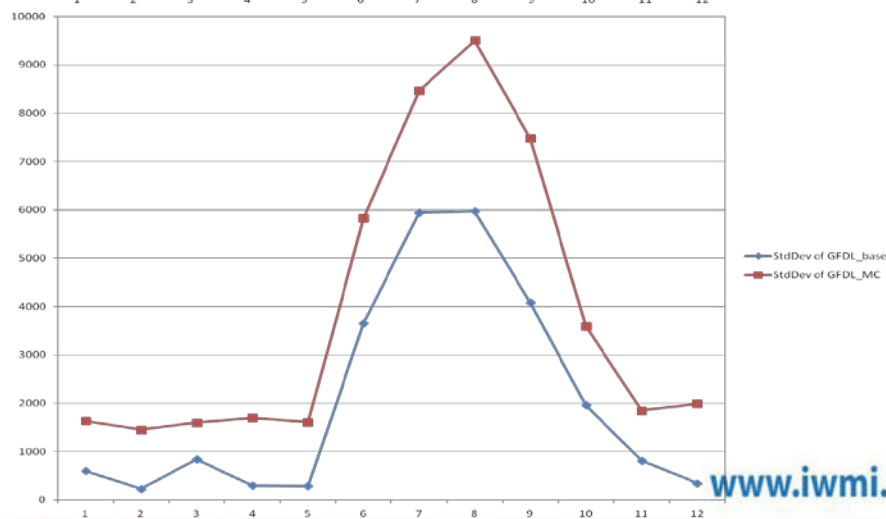
Average of  
GFDL\_base  
Average of  
GFDL\_MC



Min of GFDL\_base  
Min of GFDL\_MC



Max of GFDL\_base  
Max of GFDL\_MC



StdDev of GFDL\_base  
StdDev of GFDL\_MC



# Expected Outcomes

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- What is the impact of alternative cropping practices?
  - Say if 10% or 20% or 30% of unirrigated area convert to a more/less water intensive crop(Rice/Sugarcane).
- What is the impact of more Reservoirs
  - Say 10% or 20% or 30%

# Key Questions

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- How could we manage if there is such magnitude of surplus water?
  - Reservoir Management
  - Infrastructure Management
  - Crop Management

# Conclusion

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- The Model development for Krishna Basin gave a thorough understanding about the Basin and the uncertainties involved in the Climate Models
- The results are preliminary; will be validated using near future climate projections.

*Thank you*

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