# Impact Of Rainfall Variability Over Catchment Area On Hydro Power Production Over South India

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# OUTLINE of the Presentation

- **Objective**
- **Introduction**
- **Data sets and Methodology**
- **Hydro Power Resource Potential**
- **Climate variability and Resource potential**
- **Conclusion**

# OBJECTIVES

- Delineation of catchment area
- Rainfall over catchment area.
- Theoretical Power Production (Rainfall)
- Climate variability and resource potenial

# INTRODUCTION

•Negative energy balance

•1/3 of energy produced are from hydropower

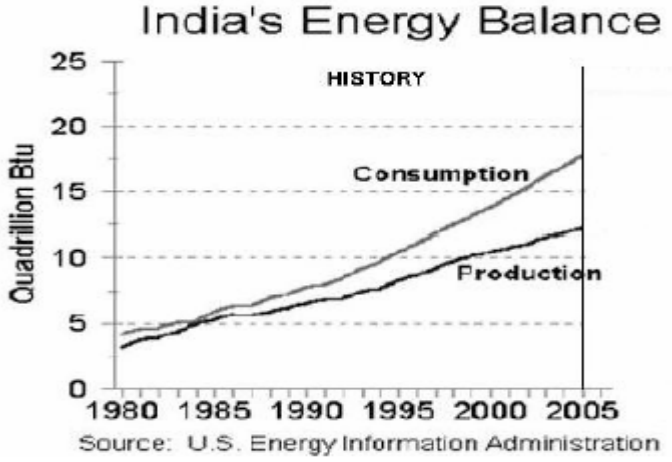
•Potential for an installed capacity of over 150,000 MW, and for an additional 90,000 MW of pumped storage schemes.

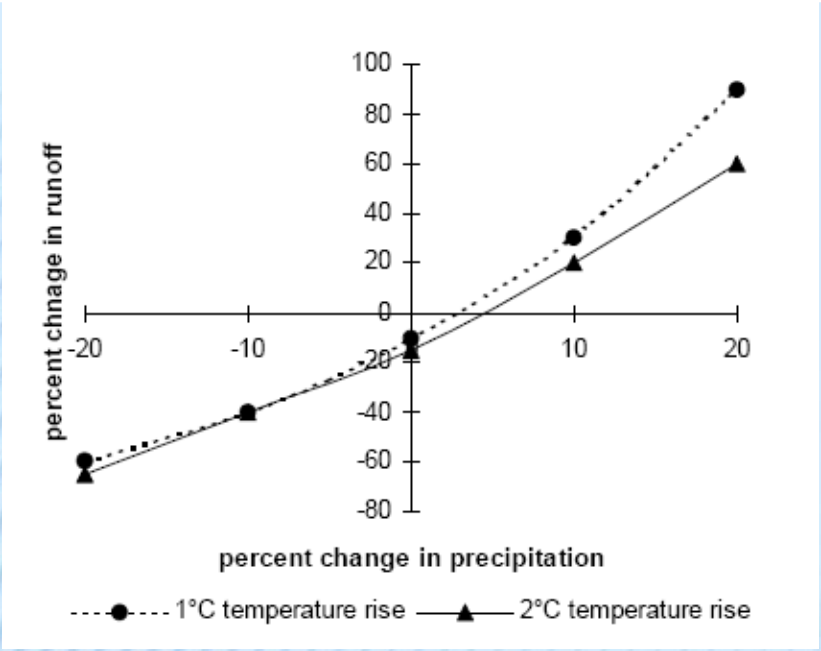
•However, of the total hydro potential in India, only 15% has so far been utilised, with another 7% under various stages of development.

•Rainfall is a good indicator of hydroelectric power,

•All hydropower plants are situated in regions of the major rainfall and elevated regions.

Mean rainfall (high) resolution & topography






Hydropower projects are one of the areas particularly affected by Climate change.

First, the available discharge of a river may change, since hydrology is usually related to local weather conditions, such as temperature and precipitation in the catchment area or drainage basin, area drained by a stream or other body of water. The limits of a given catchment area are the heights of land—often called drainage divides, or watersheds—separating it from neighboring drainage

Second, an expected increase in climate variability may trigger extreme climate events, i.e., floods and droughts.

Formula for approximating electric power production at a hydroelectric plant is:

$$P = \rho hrgk$$

*P* is Power in watts,

ρ is the density of water (~1000 $kg/m^3$),

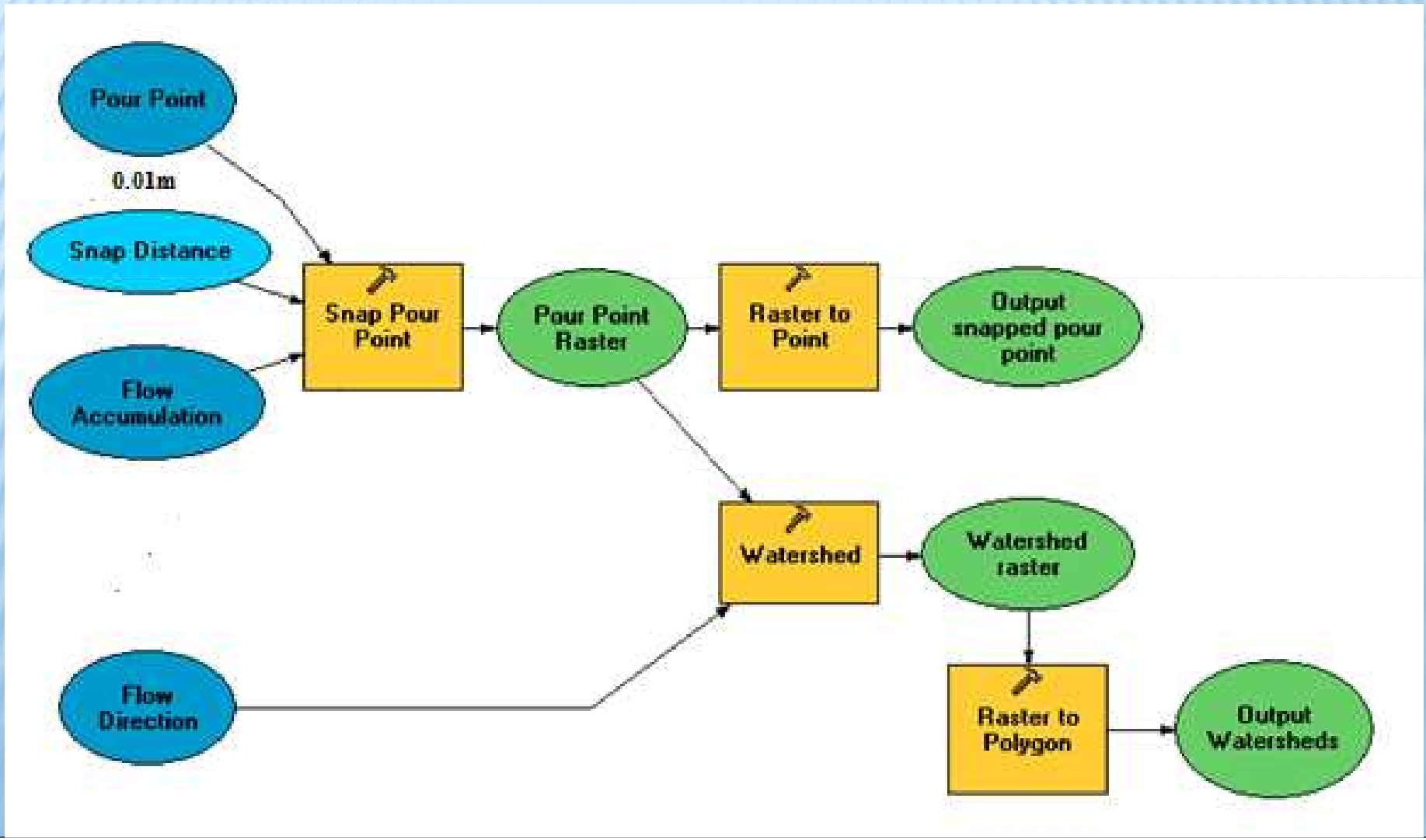
*h* is height in meters,

*r* is flow rate in cubic meters per second,

*g* is acceleration due to gravity of 9.8 $m/s^2$,

*k* is a coefficient of efficiency ranging from 0 to 1. Efficiency is often higher (that is, closer to 1) with larger and more modern turbines.

- A Catchment area is the upslope area contributing flow to a given location can be delineated from a SRTM-90m Elevation data by computing the flow direction and using it in the Watershed function.

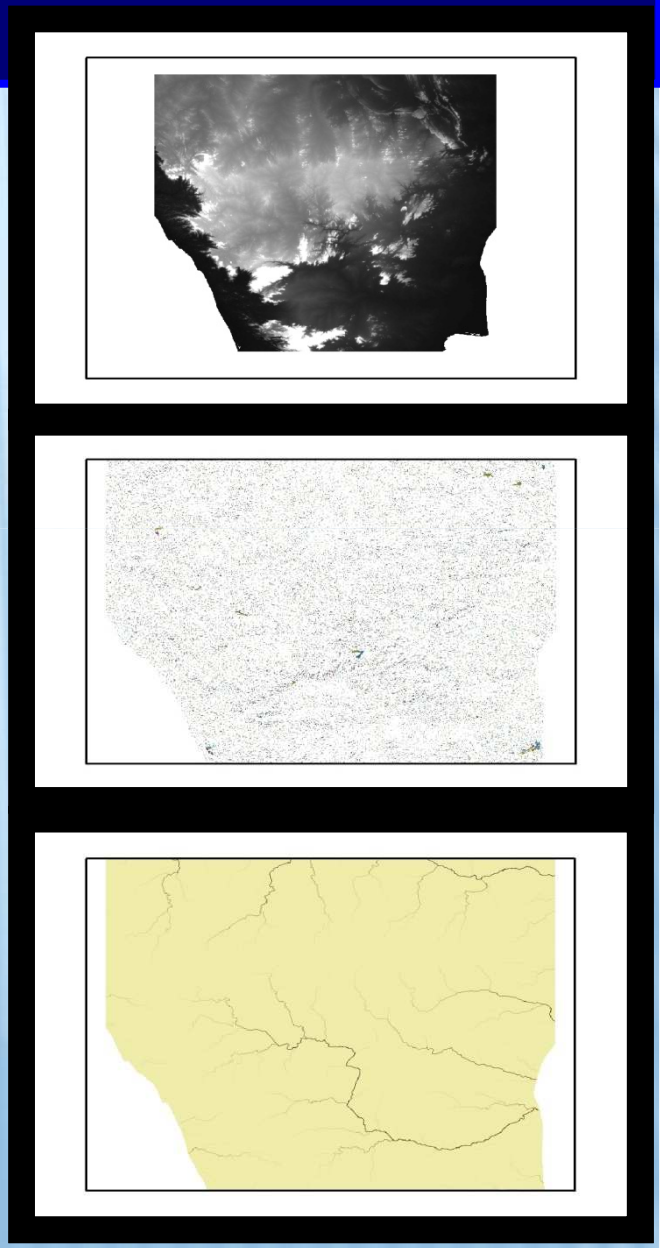


# FLOW CHART OF CATCHMENT AREA CALCULATION USING Arc GIS 9.3

SRTM -90m ON WHICH HYDROLOGIC ANALYSIS PERFOMED

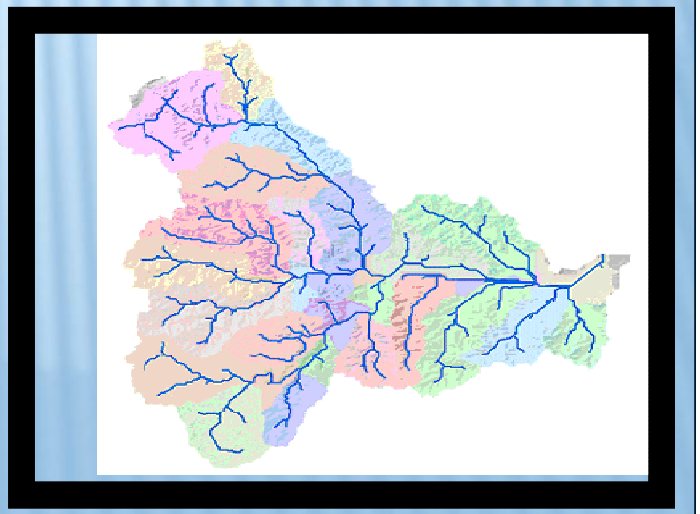
USING SRTM-90m INPUT IN FLOW DIRECTION TOOL

USING FLOW DIR INPUT IN FLOW ACC TOOL



- The flow accumulation threshold or the pour points to delineate catchment area.
- The value of watershed will be taken from the value of the source in input or raster or feature pour point data
- Better results obtained if snap pour point tool is used helps locating high accumulated flow

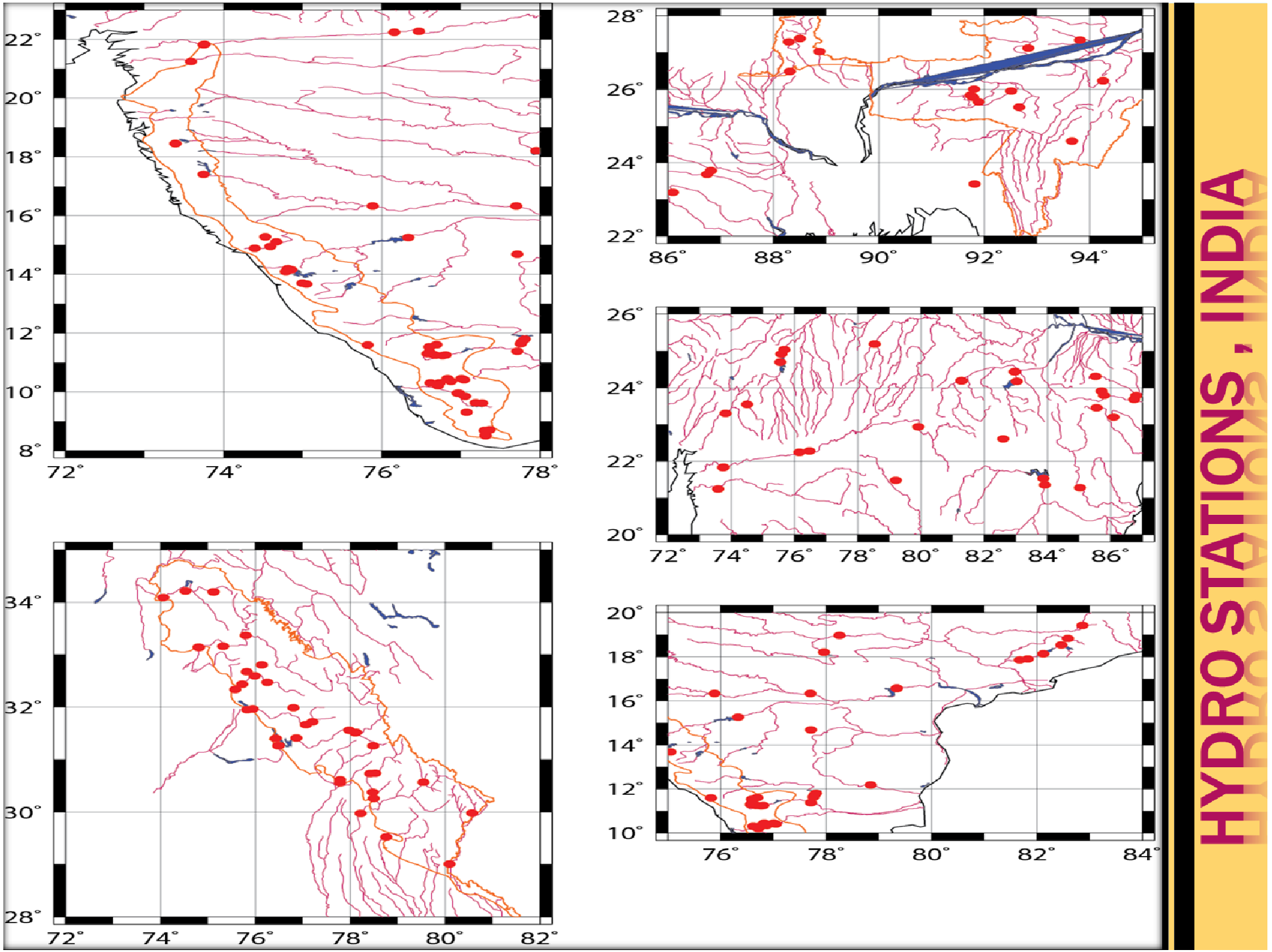
**USING FLOW DIR & SNAP POUR POINT INPUT IN WATERSHED TOOL**



# RESULTS.....

# GENERIC MAPPING TOOLS (GMT)

The projections and transformations ,drainage patterns, political boundaries, hydroelectric stations , reservoirs etc was done using GMT.


HYDRO STATIONS, INDIA
22°
20°
18°
16°
14°
12°
10°
8°
72°
74°
76°
78°
28°
26°
24°
22°
86°
88°
90°
92°
94°
26°
24°
22°
20°
72°
74°
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78°
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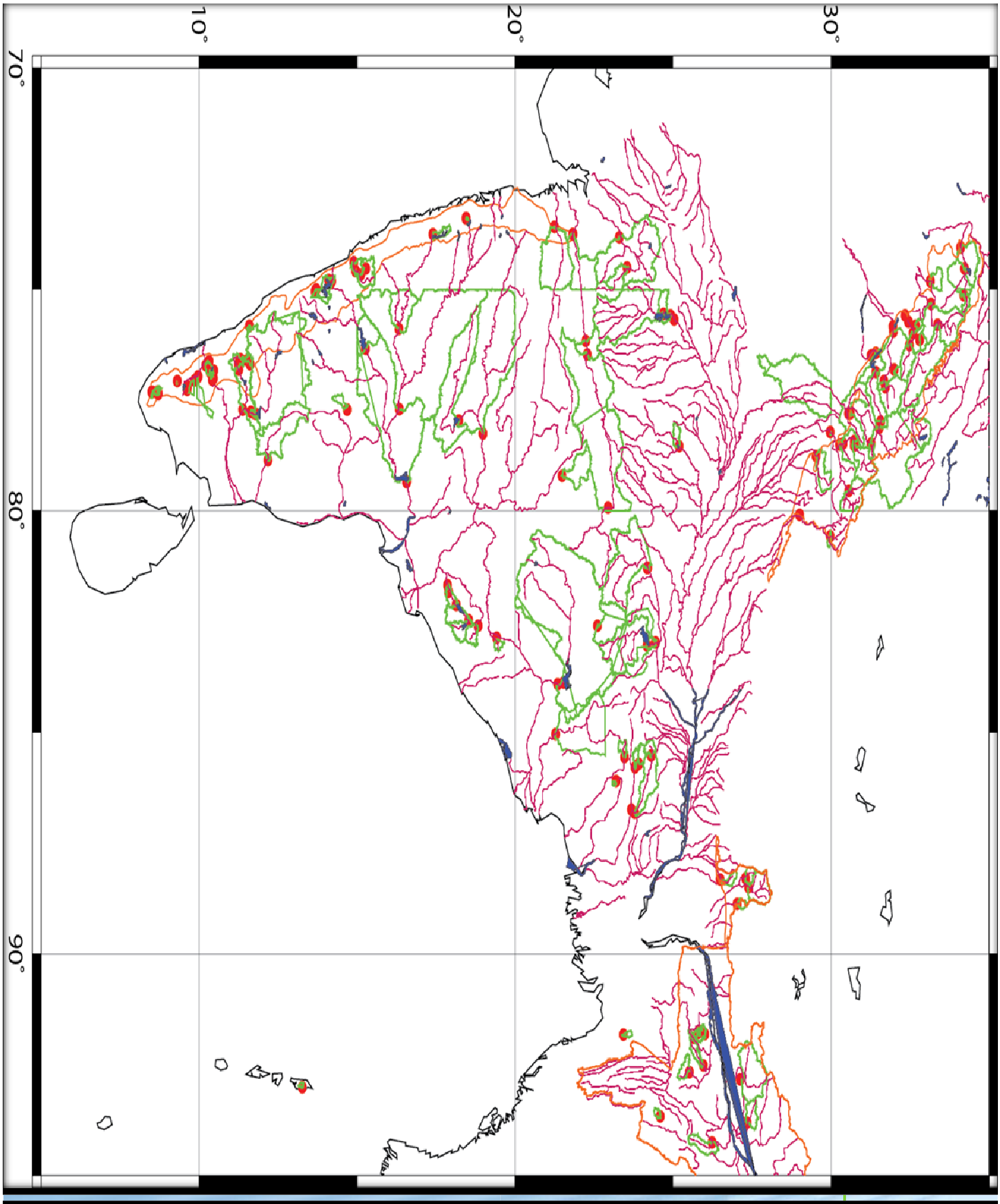
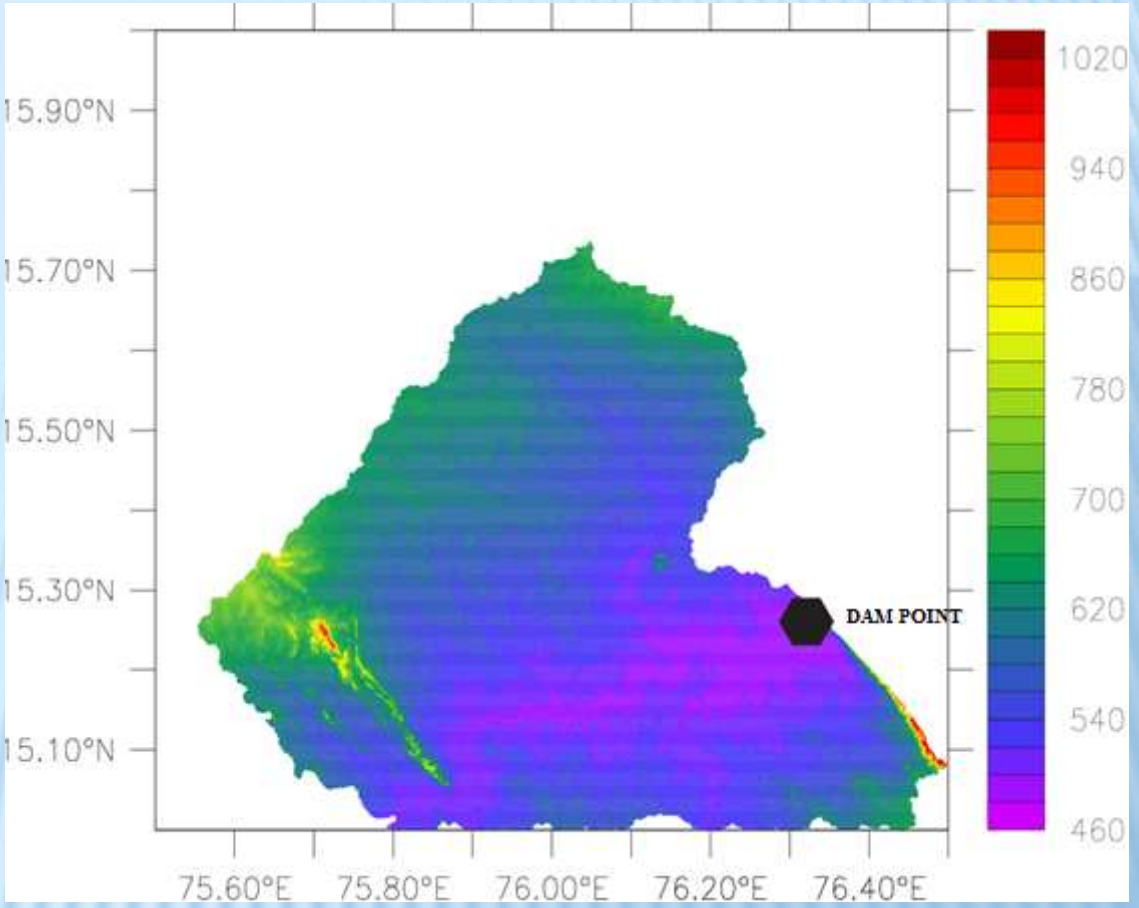


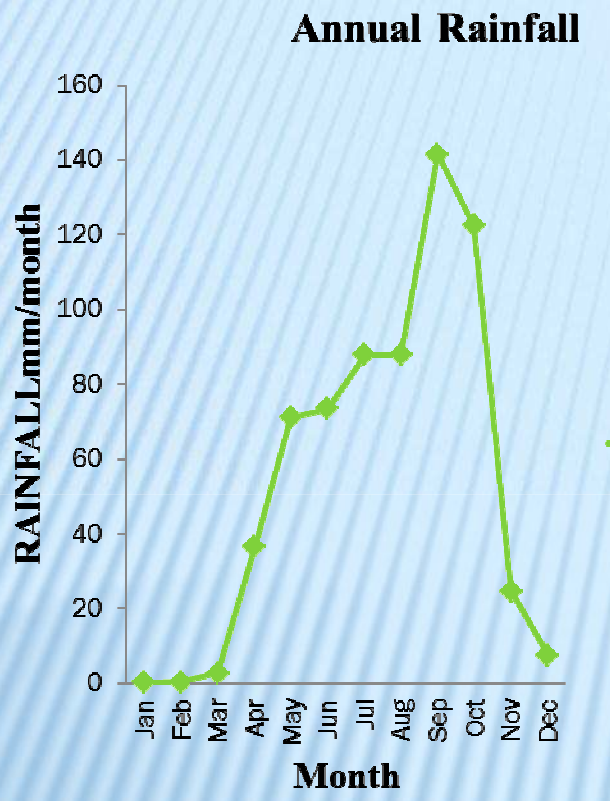

# WATERSHED OF DAMS , INDIA

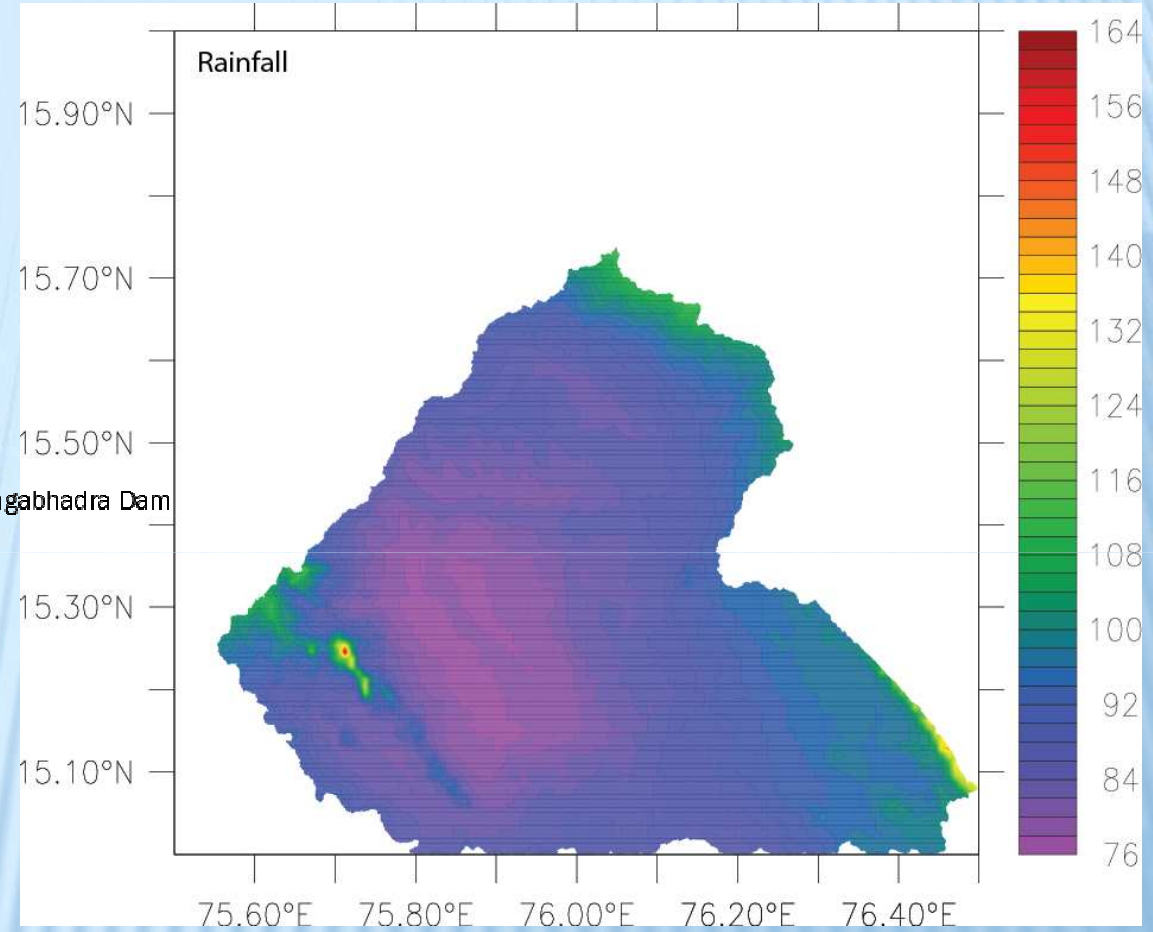
DAM DETAILS

- FRL :497.7m
- Head : 49.5m
- Catchment Area : 2818 Th ha
- Live Storage Capacity: 3700MCM
- Avg. Discharge Rate :100.26 $m^3$/sec
- Installed Capacity : 72 MW
- Theoretical Power Produced: 48.60MW




TUNGABHADRA DAM, HOSPET IN KARNATAKA, INDIA

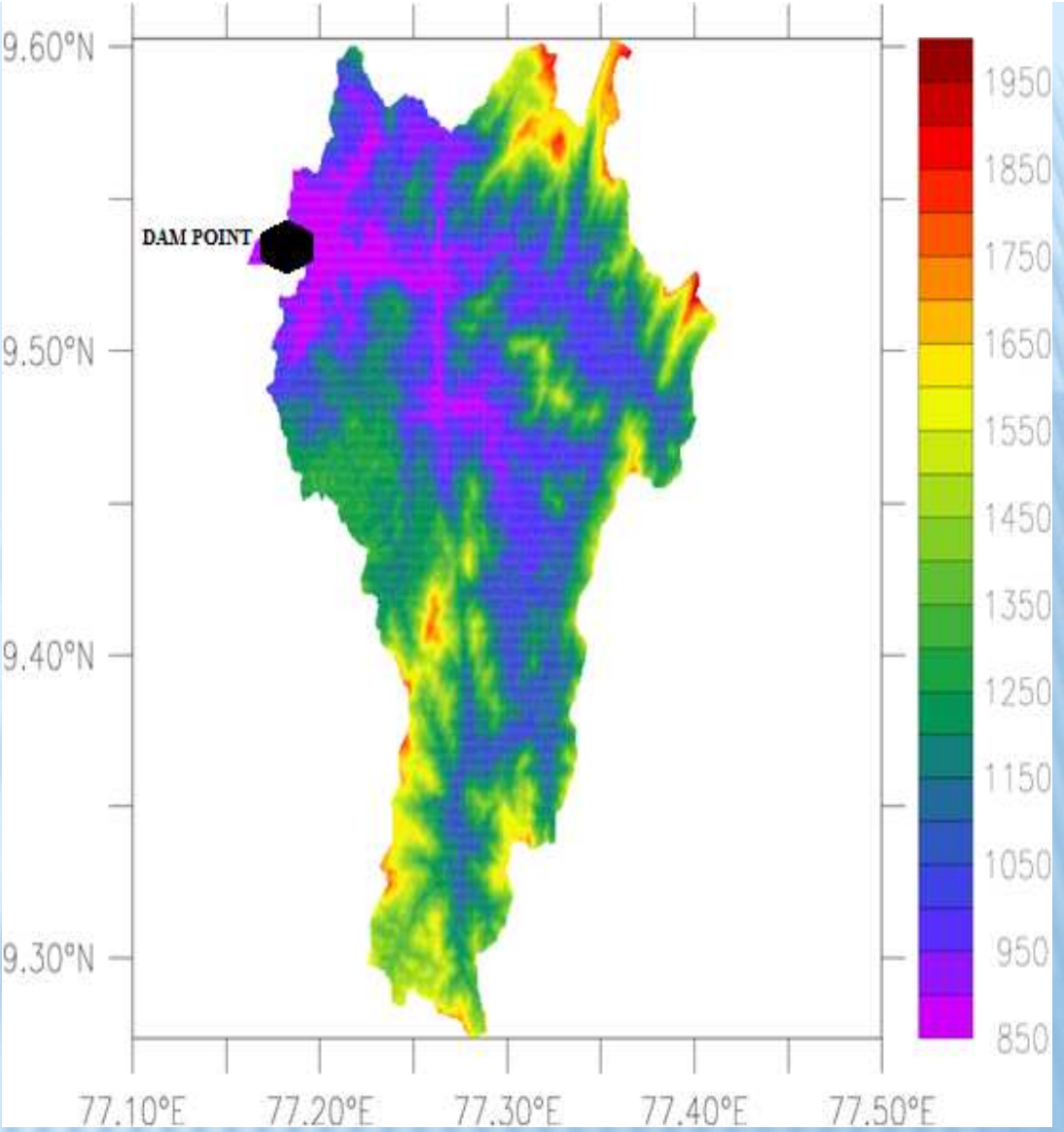


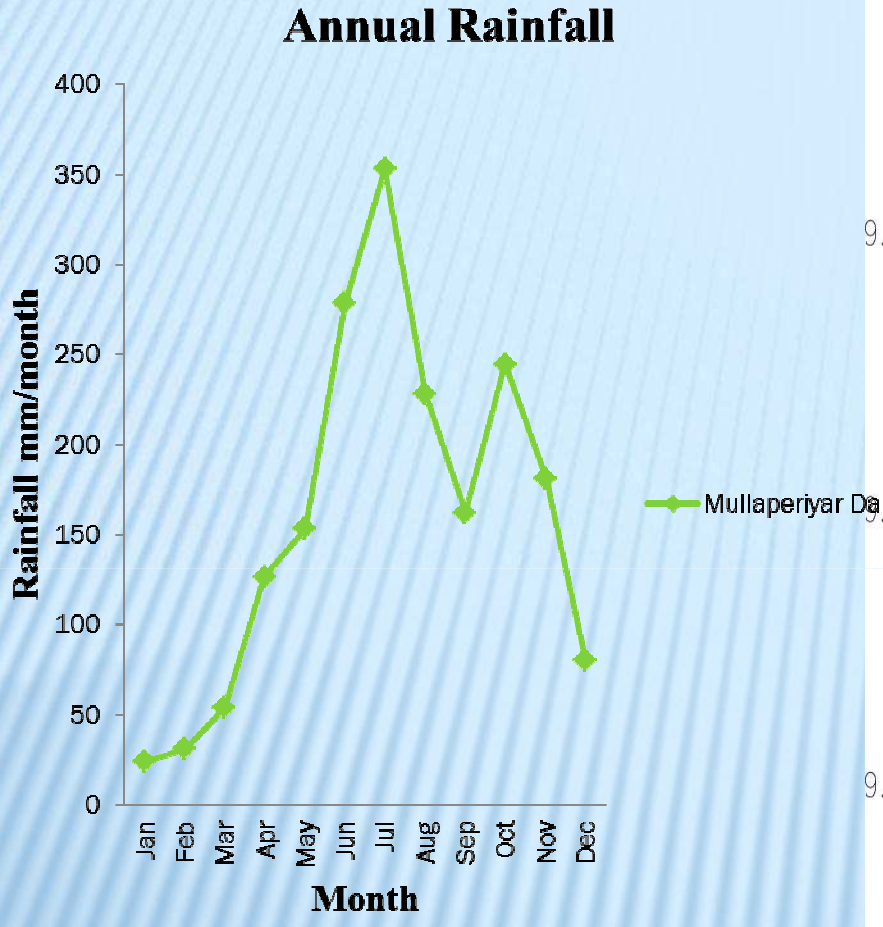

# ANNUAL RAINFALL ON TUNGABHADRA DAM(mm/month)

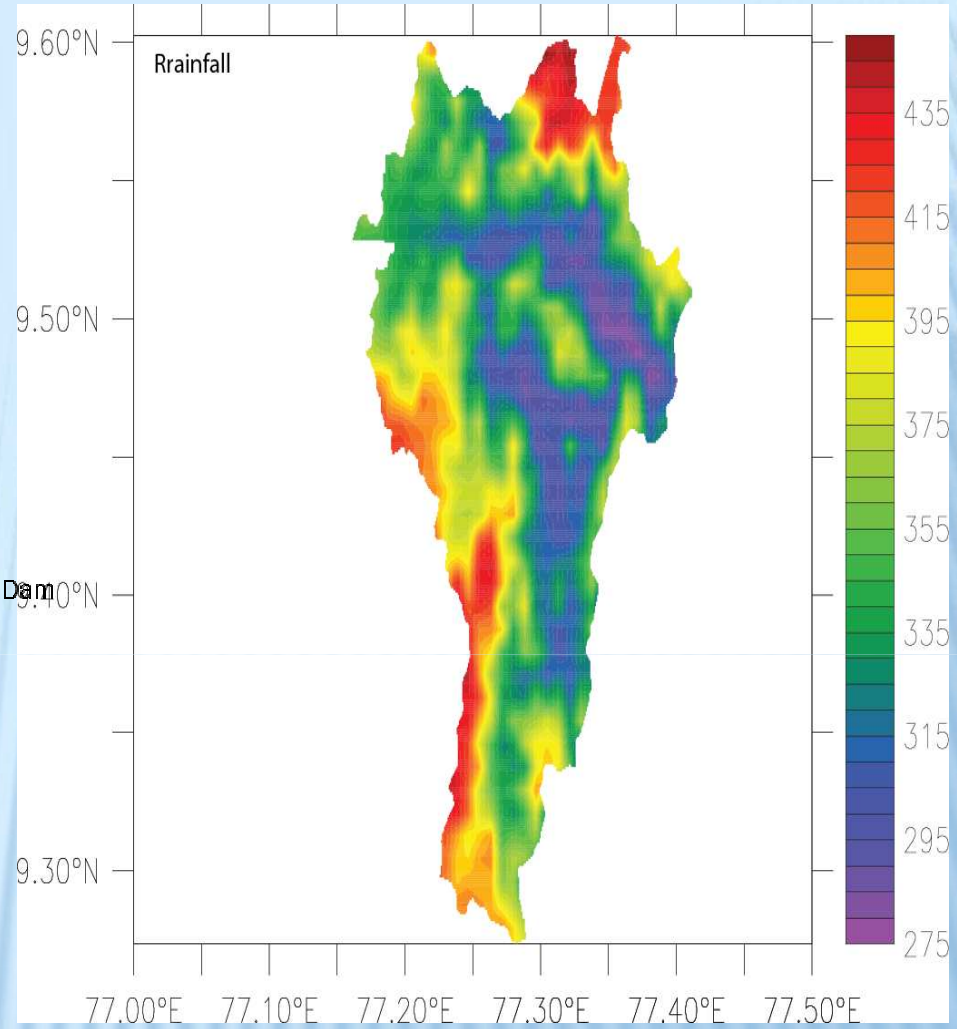
DAM DEATAILS

- FRL :881m
- Head : 56.66m
- Catchment Area : 5398 Km²
- Live Storage Capacity: 443.23MCM
- Avg. Discharge Rate :295 m³/sec
- Installed Capacity : 175 MW
- Theoretical Power Produced:155.131MW




MULLAPERIYAR DAM ,KERALA INDIA

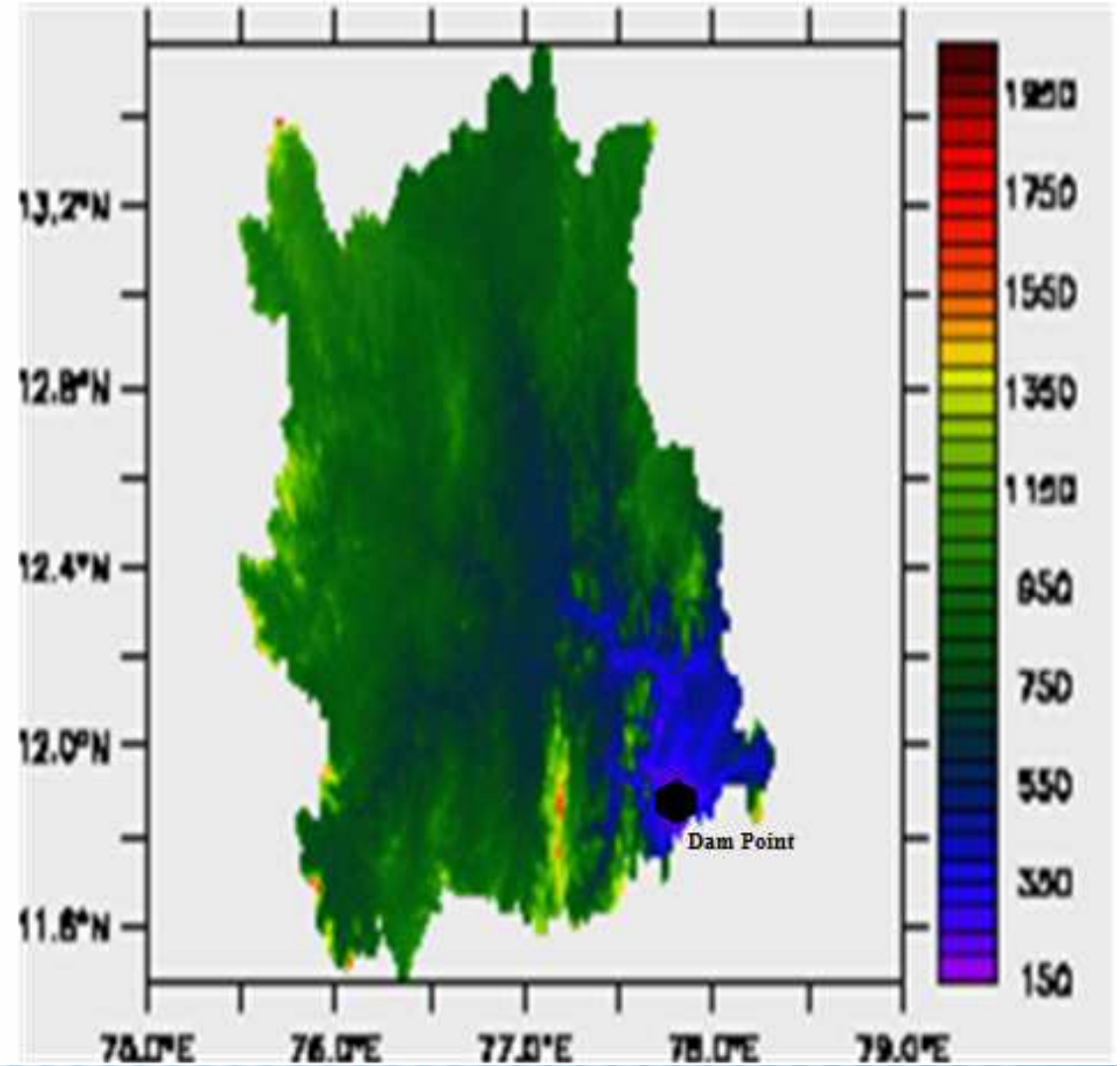


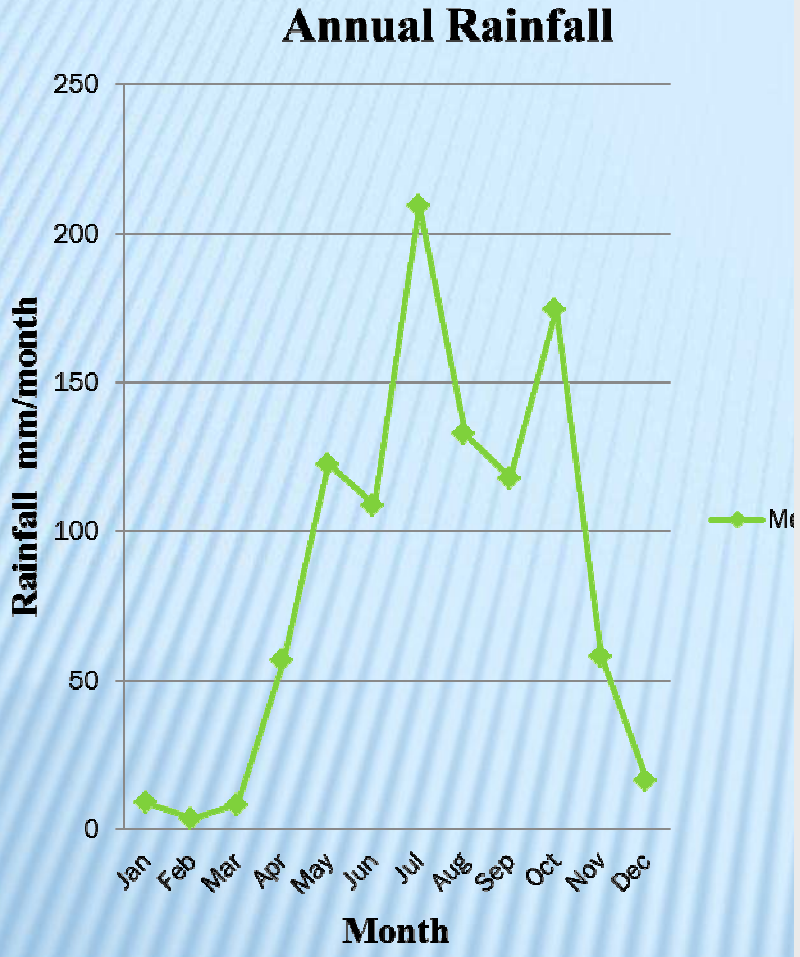

ANNUAL RAINFALL ON MULLAPERIYAR DAM(mm/month)

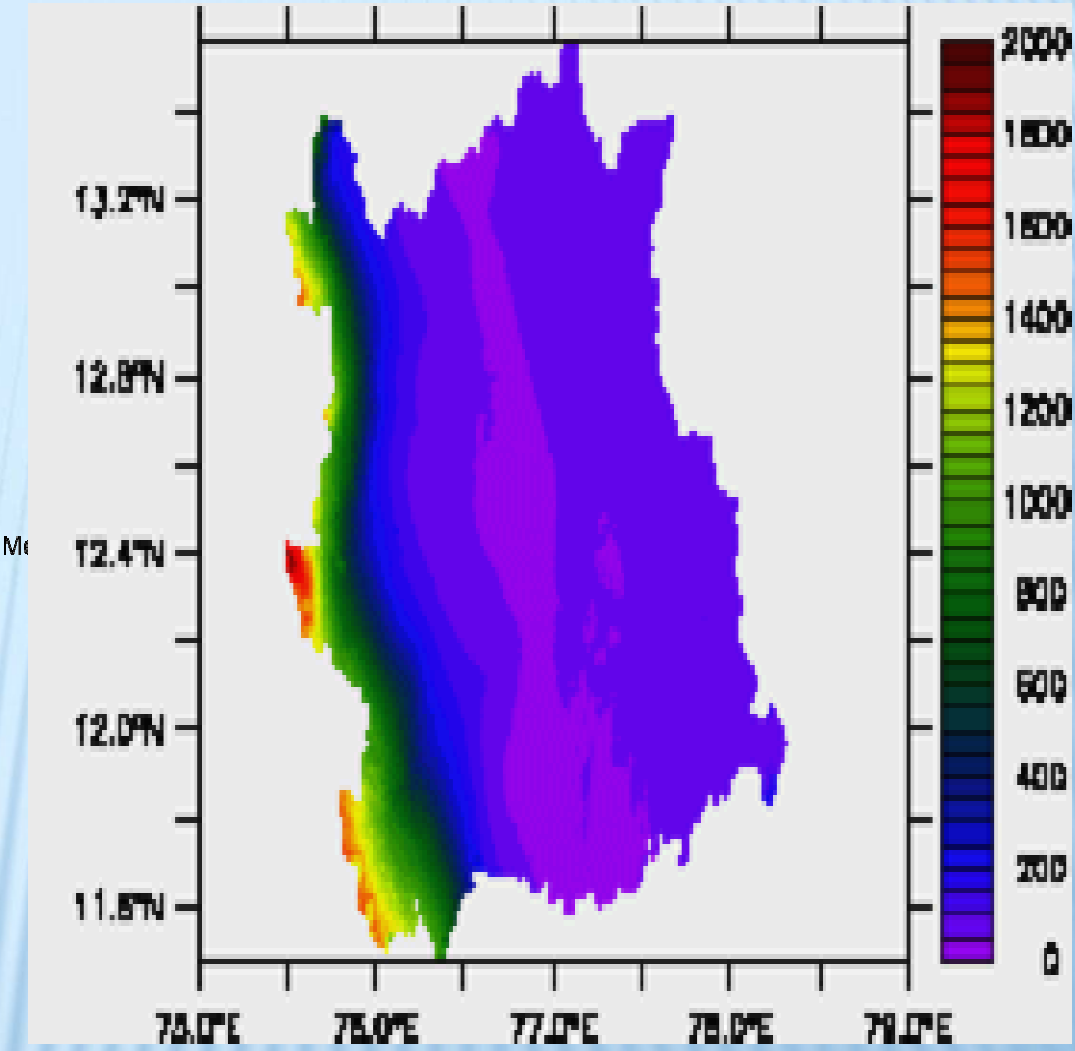
DAM DEATAILS

- FRL :36.57m
- Head : 37m
- Catchment Area : 16,300m²
- Live Storage Capacity: 93470MCFT
- Avg. Discharge Rate :28.31 m³/sec
- Installed Capacity : 32 MW
- Theoretical Power Produced:10.26 MW



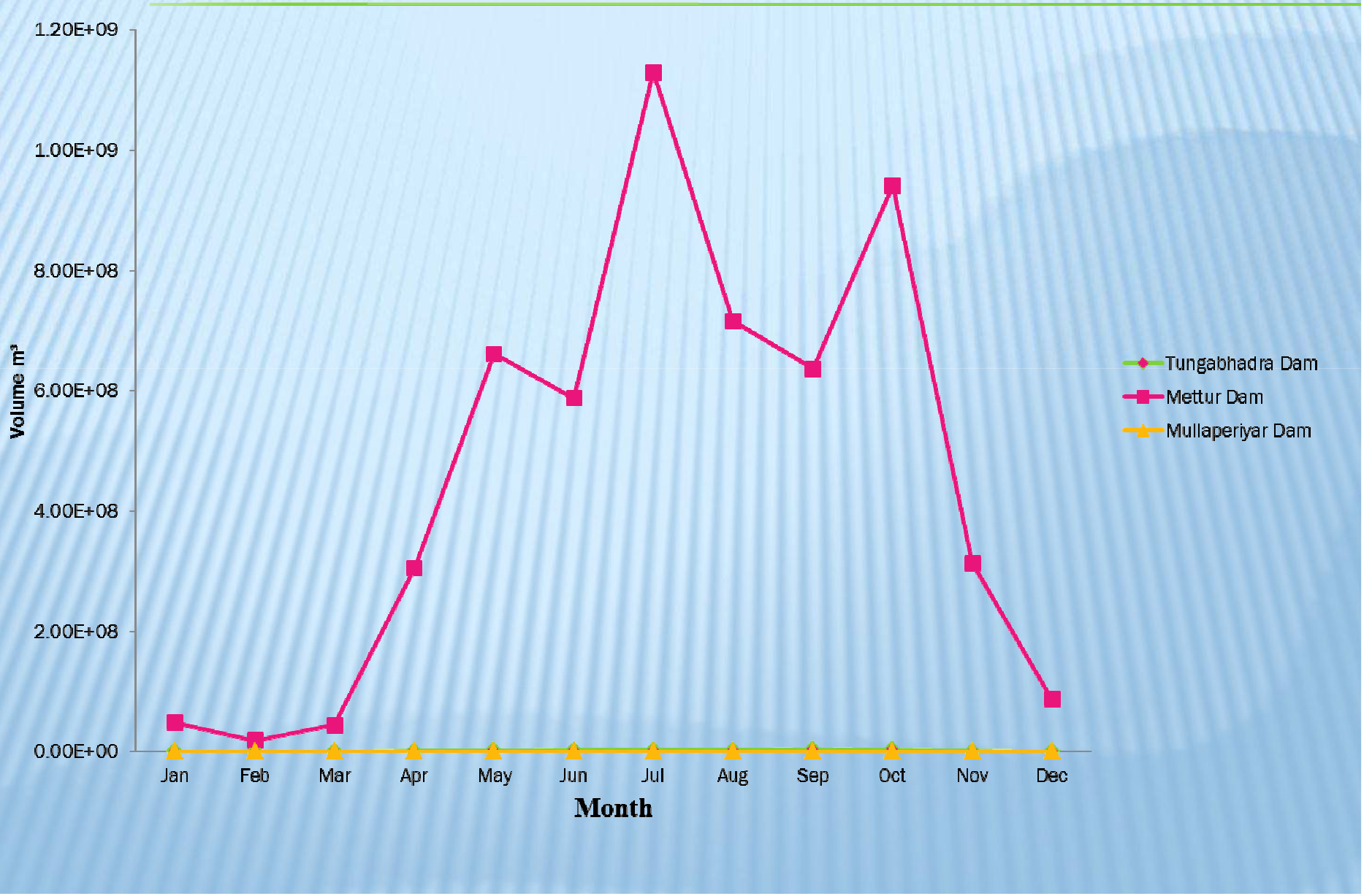

# METTUR DAM, TAMILNADU



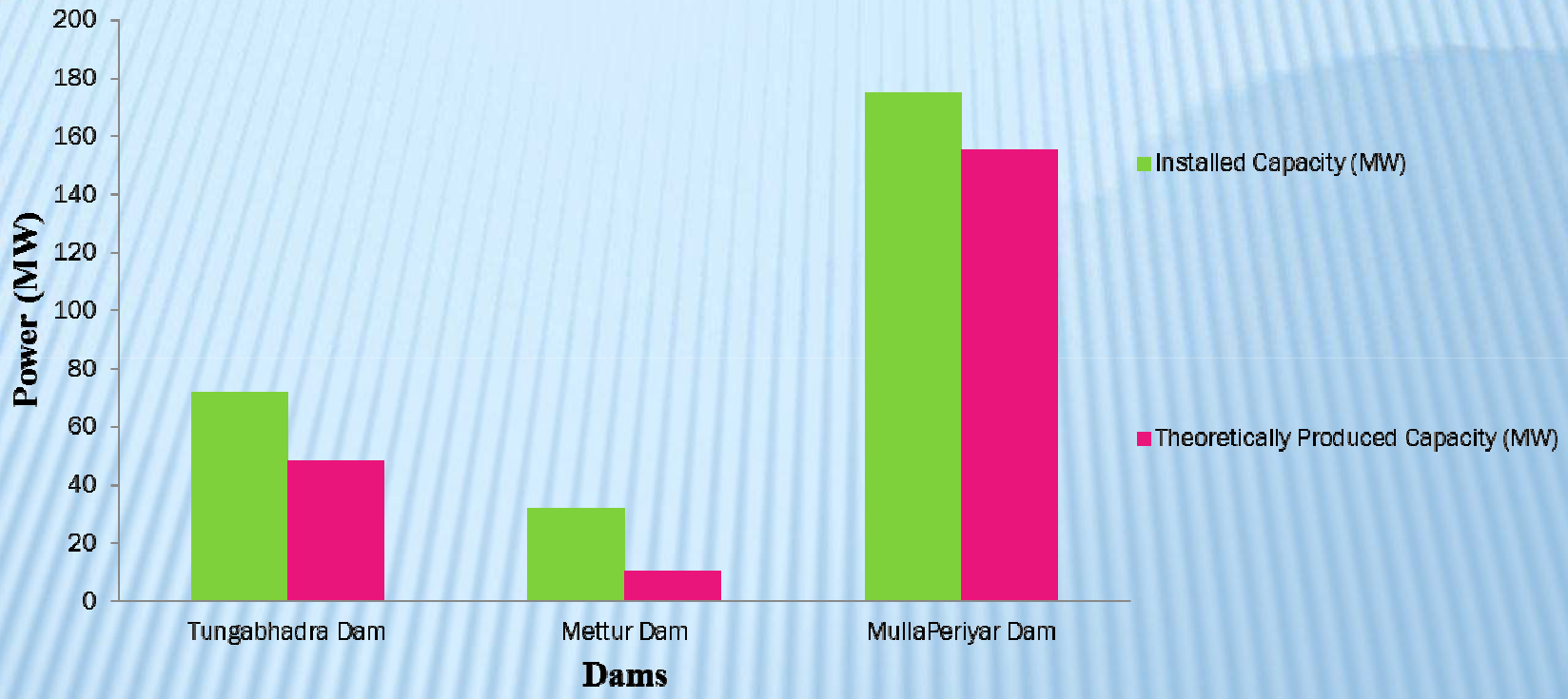




ANNUAL RAINFALL ON METTUR DAM(mm/month)

# Volume of Rainfall in Catchment Area



# Hydro power theoretical estimate (MW)




Estimates are based on the annual climatological rainfall for the period 1951-2006

- Rainfall over all catchment areas of INDIA(106) have been calculated using Arc GIS ,FERRET .Source (Rainfall Net CDF file).

- The yearly mean trend and seasonal mean trend of rainfall from 1970-2009 was calculated using R and FORTRAN Program ,for some stations it was observed to have +ve and –ve effect

# CONCLUSION

Preliminary results shows rainfall as critical effect over the catchment area

To estimate realistic estimates it is necessary to include temperature and Evaporation etc.


Thank You