Assessing Impact of Land Use and Climate Changes on River Flow and Electricity Generation: Case Study at Citarum Watershed of Bandung District

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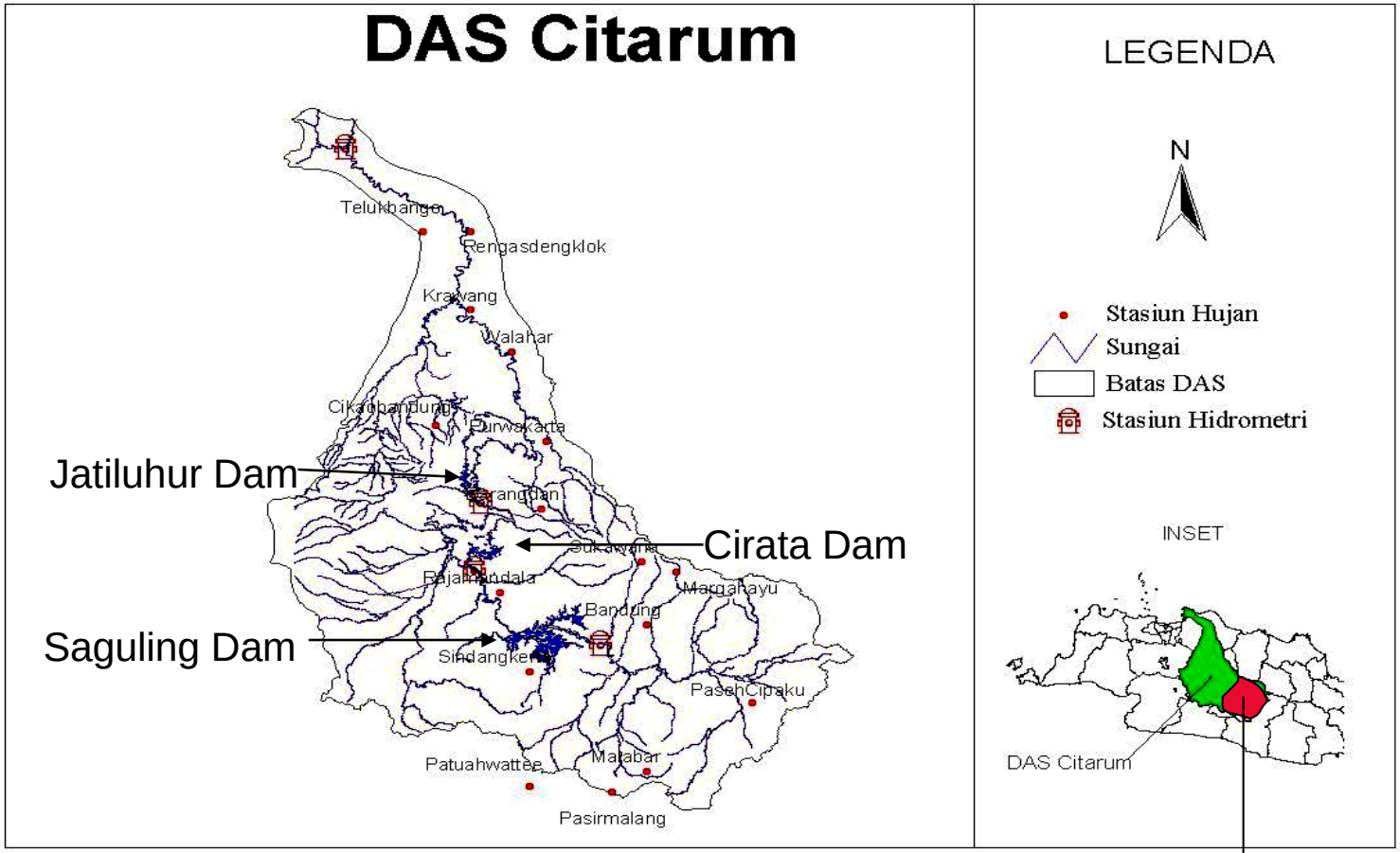
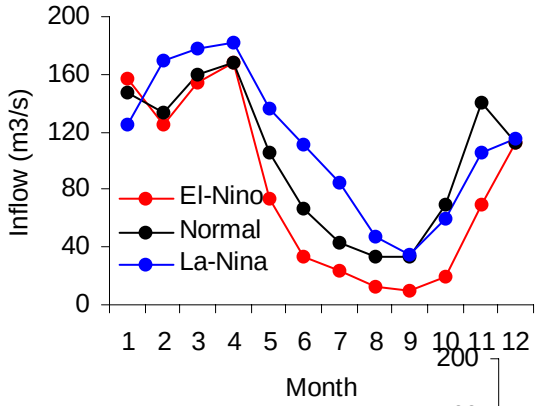
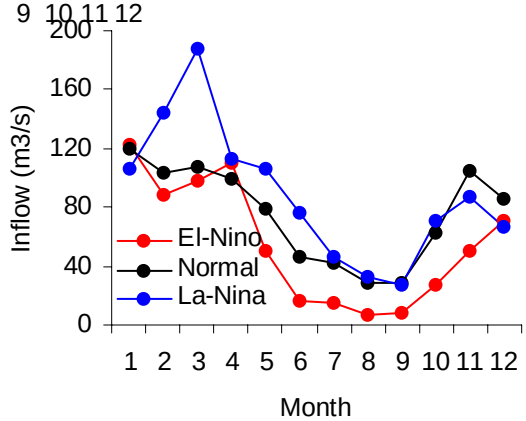
Study Site: Upper Citarum

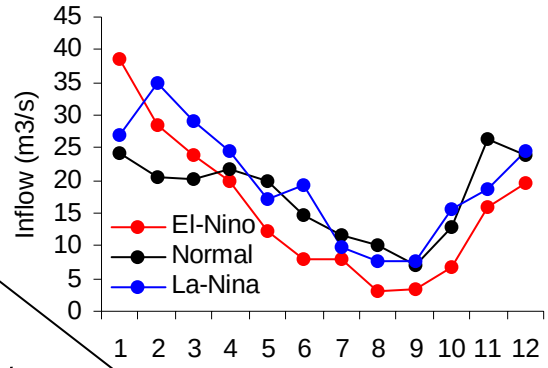


- Covering an area of about 720 thousand ha
- There are three dams ~ vital for meeting water demand of about 11 districts within watershed and 5 districts outside the watershed (north coast of West Java)

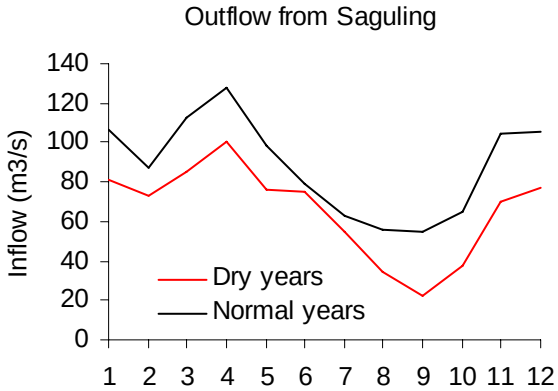
Monthly Average: Inflows to the three Dams in El-Nino, Normal and La-Nina years

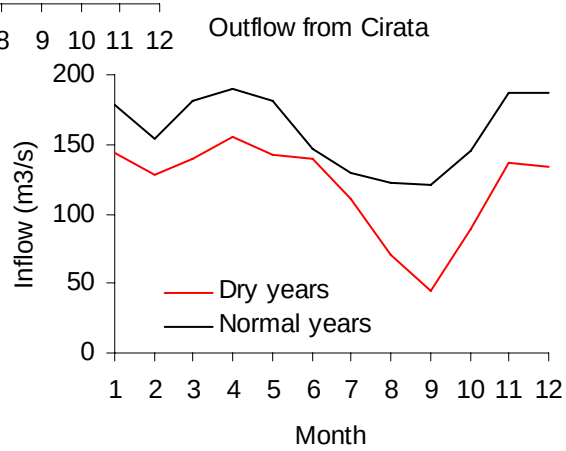


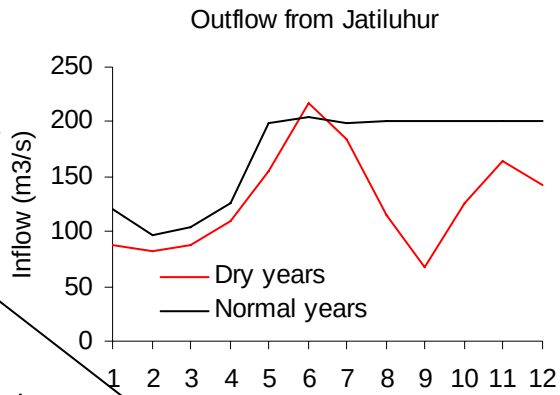




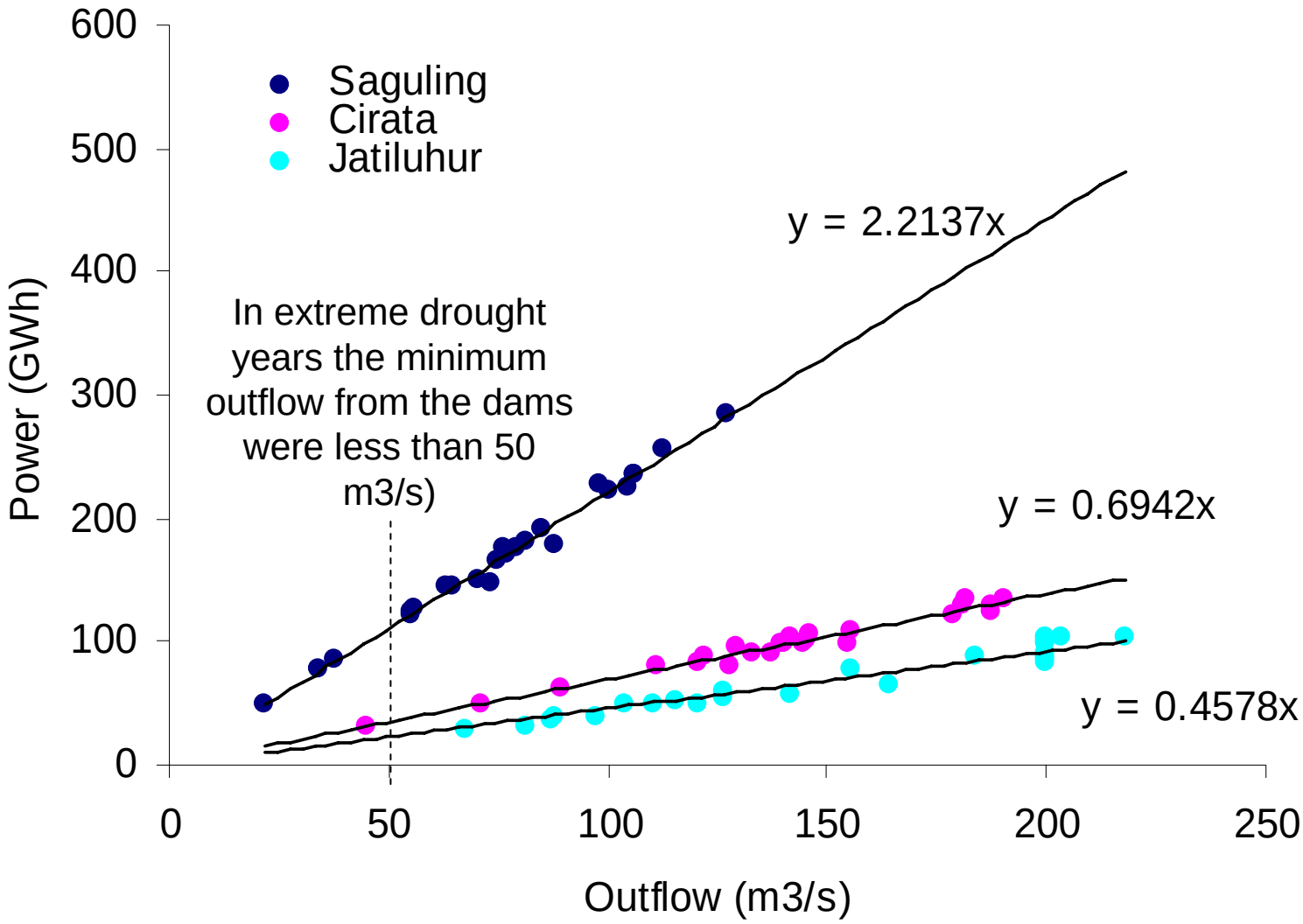
Outflows from the three dams in normal and dry years





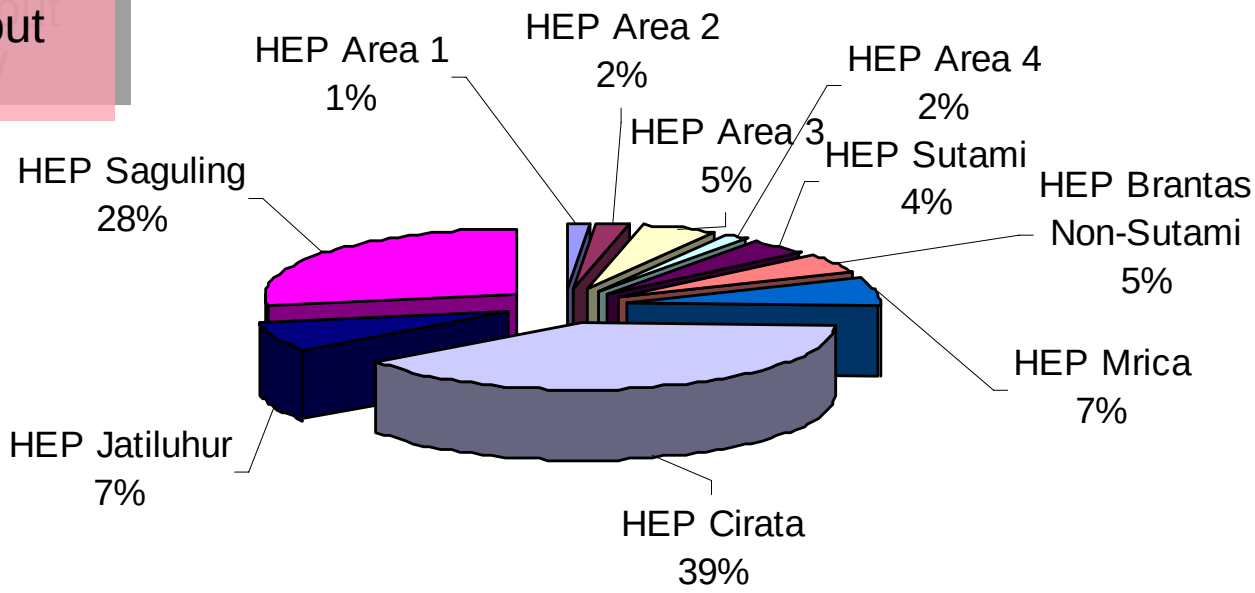


Outflow and power generation



Contribution of Saguling, Cirata and Jatiluhur HEP to Total Electricity Production of HEPs in Jamali

Total HEPs capacity about 2520 MW

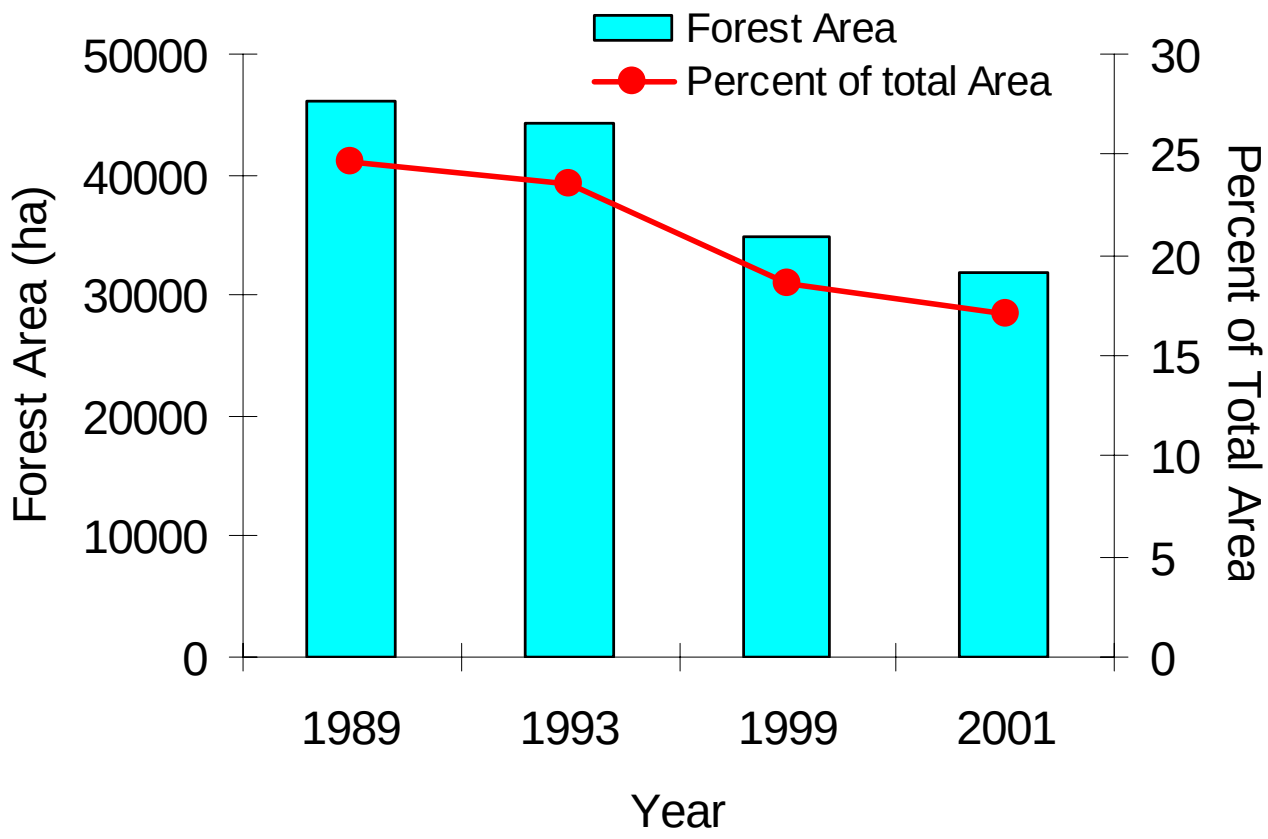


The three HEPs contributes to about 74% of the Total HEPs of Jamali. The decrease in electricity production from these three HEPs will have serious effect on economic activities. In drought years, HEPs capacity drops by about 60%. Many people believes that the decrease in forest cover has deteriorate the impact

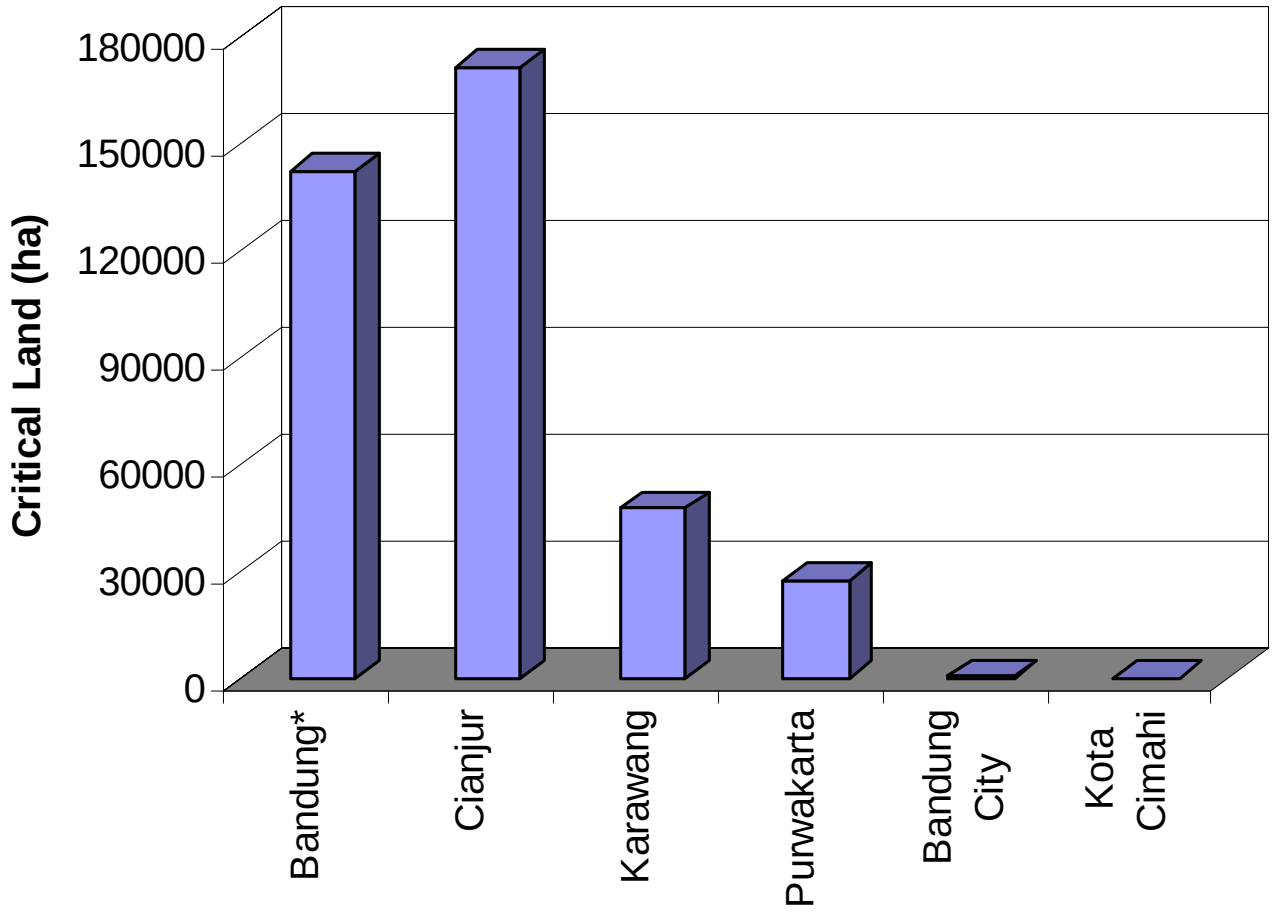
Historical Land Use Changes

Land Use	Area (ha)				Percent change			
	‘89	‘93	‘99	‘01	89-93	93-99	99-01	89-01
Bare land and shrub land	2694	5105	10469	11860	89.5	105.1	13.3	340.3
Agriculture area[1/]	126536	124755	126501	126335	-1.4	1.4	-0.1	-0.2
Forest & vegetation covers[2/]	46105	44182	34928	31951	-4.2	-20.9	-8.5	-30.7
Settlements	2639	3429	4547	5522	29.9	32.6	21.4	109.2
Urban and Industries	9030	9597	10627	11426	6.3	10.7	7.5	26.5
Dam/Lakes	312	247	243	223	-20.9	-1.5	-8.5	-28.7
TOTAL	187316	187316	187316	187316				

Change of Forest Cover in the Upper Citarum



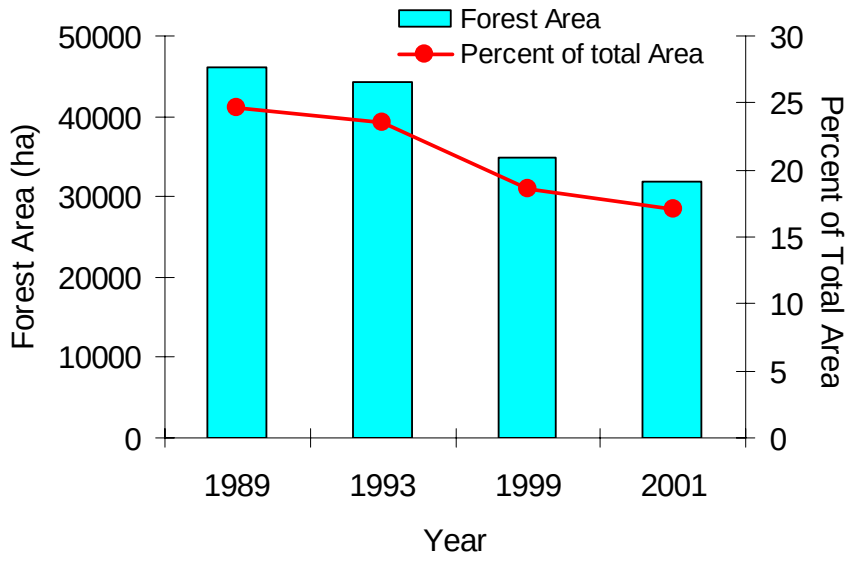
Critical Land in Citarum



Source: BP-DAS Citarum-Ciliwung (2003)

Community Perception

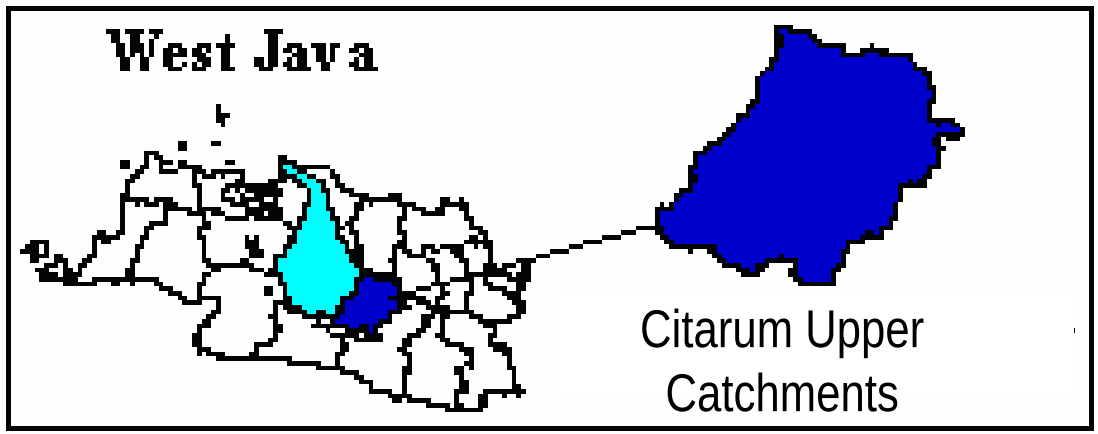
- About 85% of respondents stated that there is an increase in drought and flood frequency and intensity (Sulandari et al., 2004)
- Dialog between stakeholders and scientist at Bandung, it was suggested that at least 40% of watershed area should be maintained as conservation zone (forest cover) ~ It is believed that increasing forest cover will diminish the damage of flood and drought risk



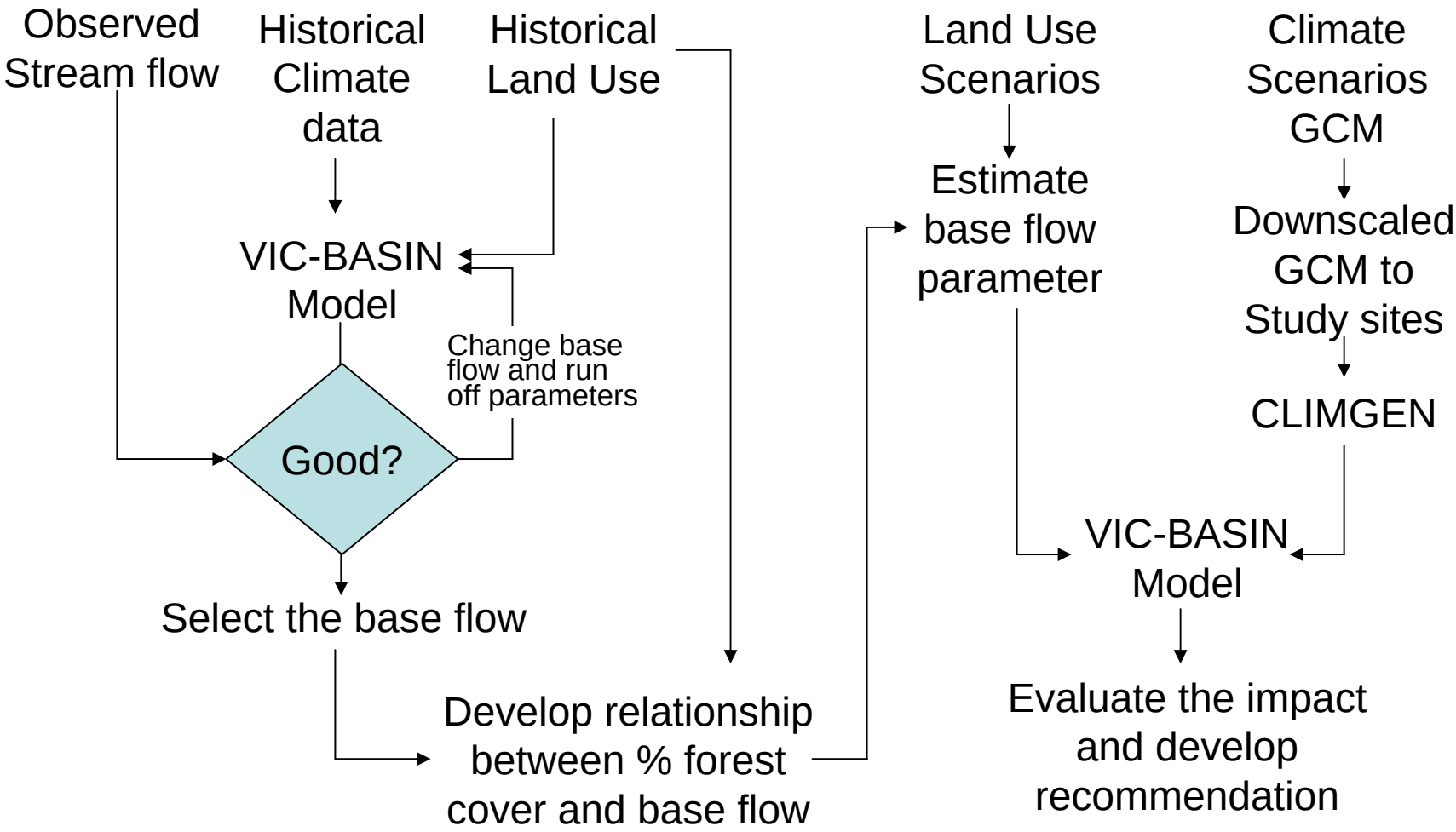
- In 2010, government targeted to increase forest cover up to 48% of the total areas

Objectives

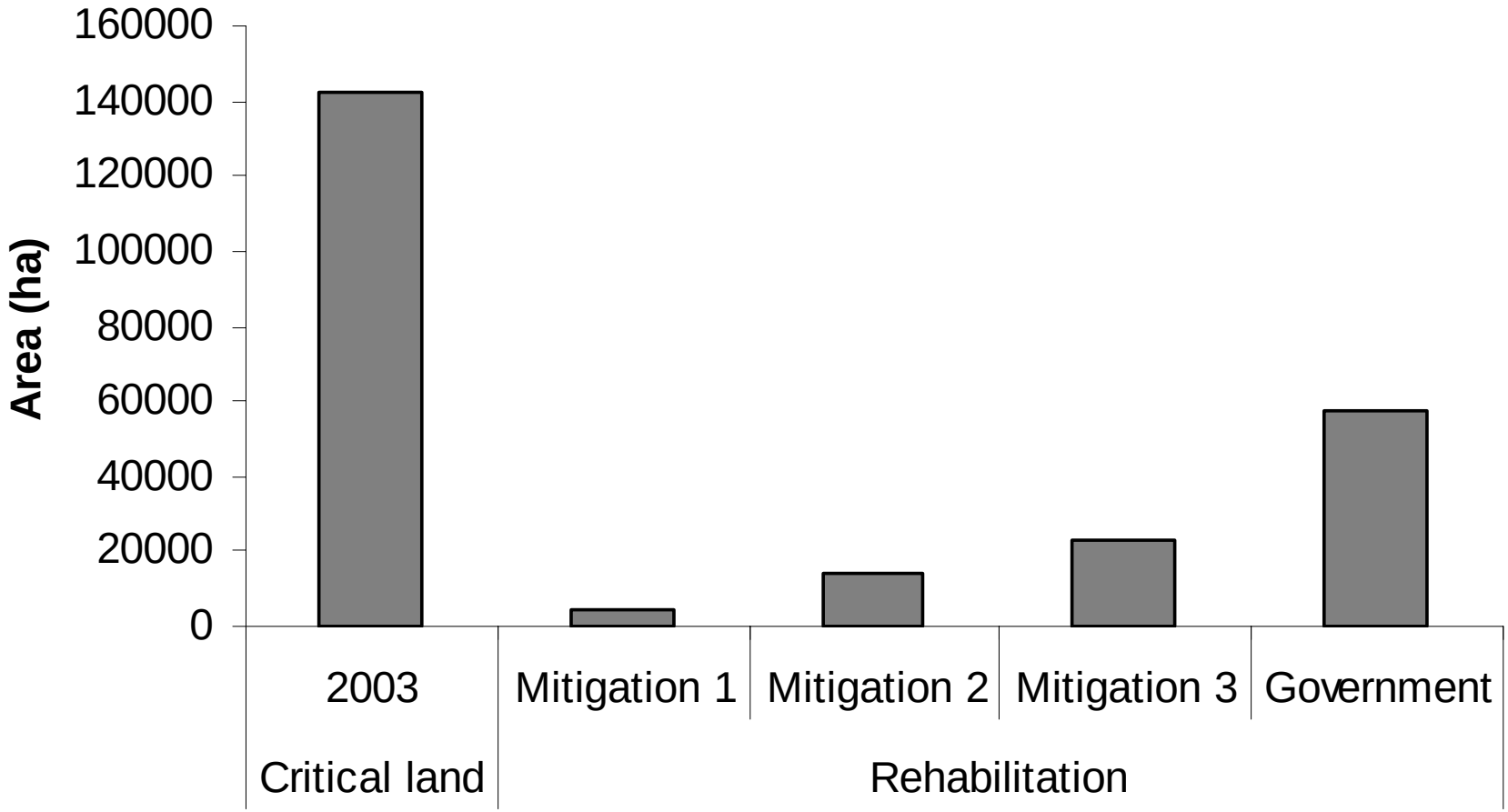
- To evaluate impact of land use and climate changes scenarios on river flow at Nanjung (Upper watershed) and on electricity generation



Step of Analysis



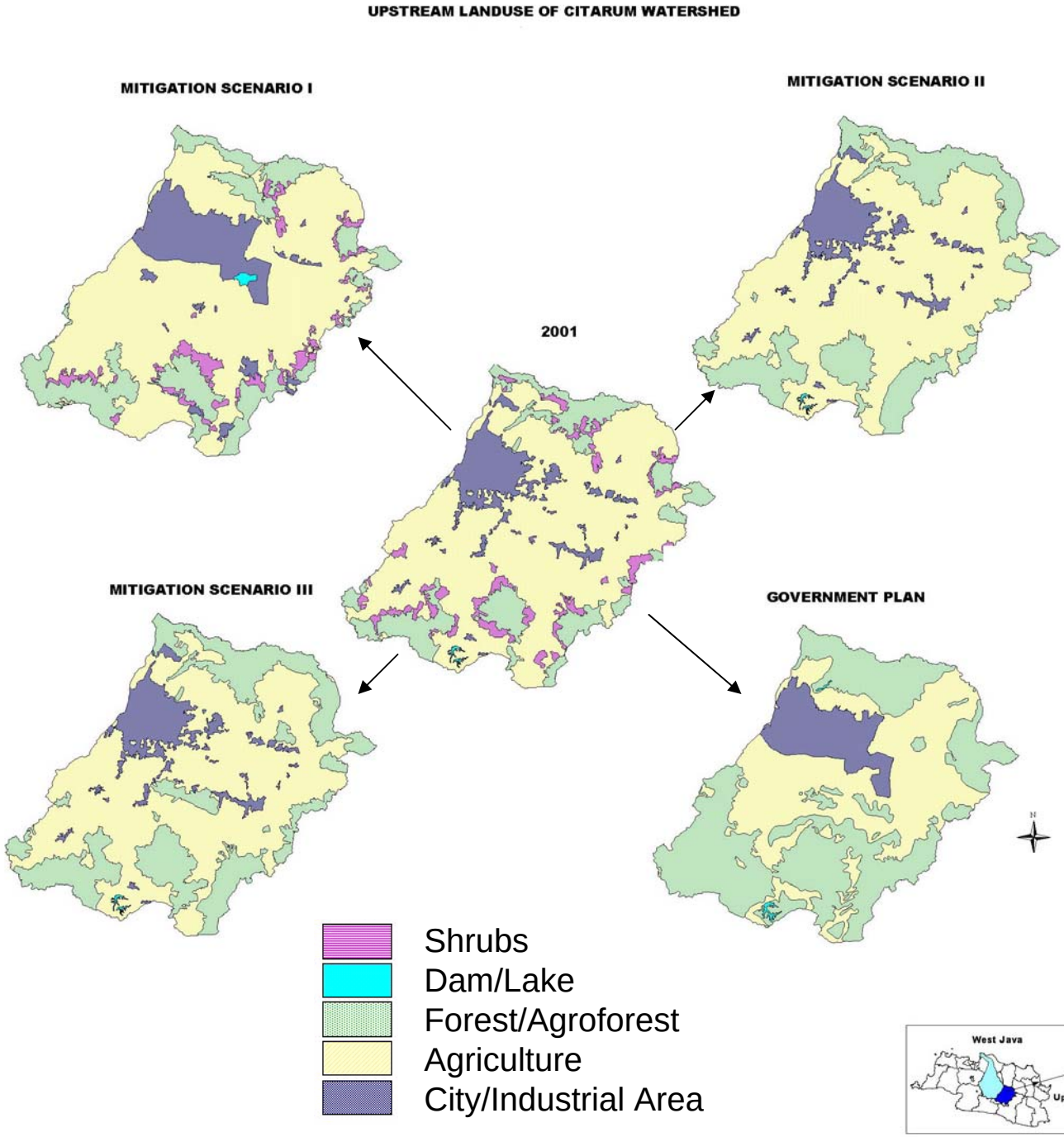
Critical Land and Rehabilitation Plan for the Four Land Use Scenario for Upper Citarum Watershed



Land Use Scenarios

Land use category	Area (ha)				
	LU-2001	MIT-1	MIT-2	MIT-3	RUTR
Shrubs	11862	9578	5	0	0
Agriculture	126494	118465	124167	115736	77426
Forest/Agroforest	31825	35921	45990	54445	89426
City/Industrial areas	16912	22849	16931	16912	20016
Dam/Lakes	223	503	223	223	448
TOTAL	187316	187316	187316	187316	187316
Percent forest cover (%)	17	19	25	29	48

1989



Land Use Scenarios

17%: Baseline

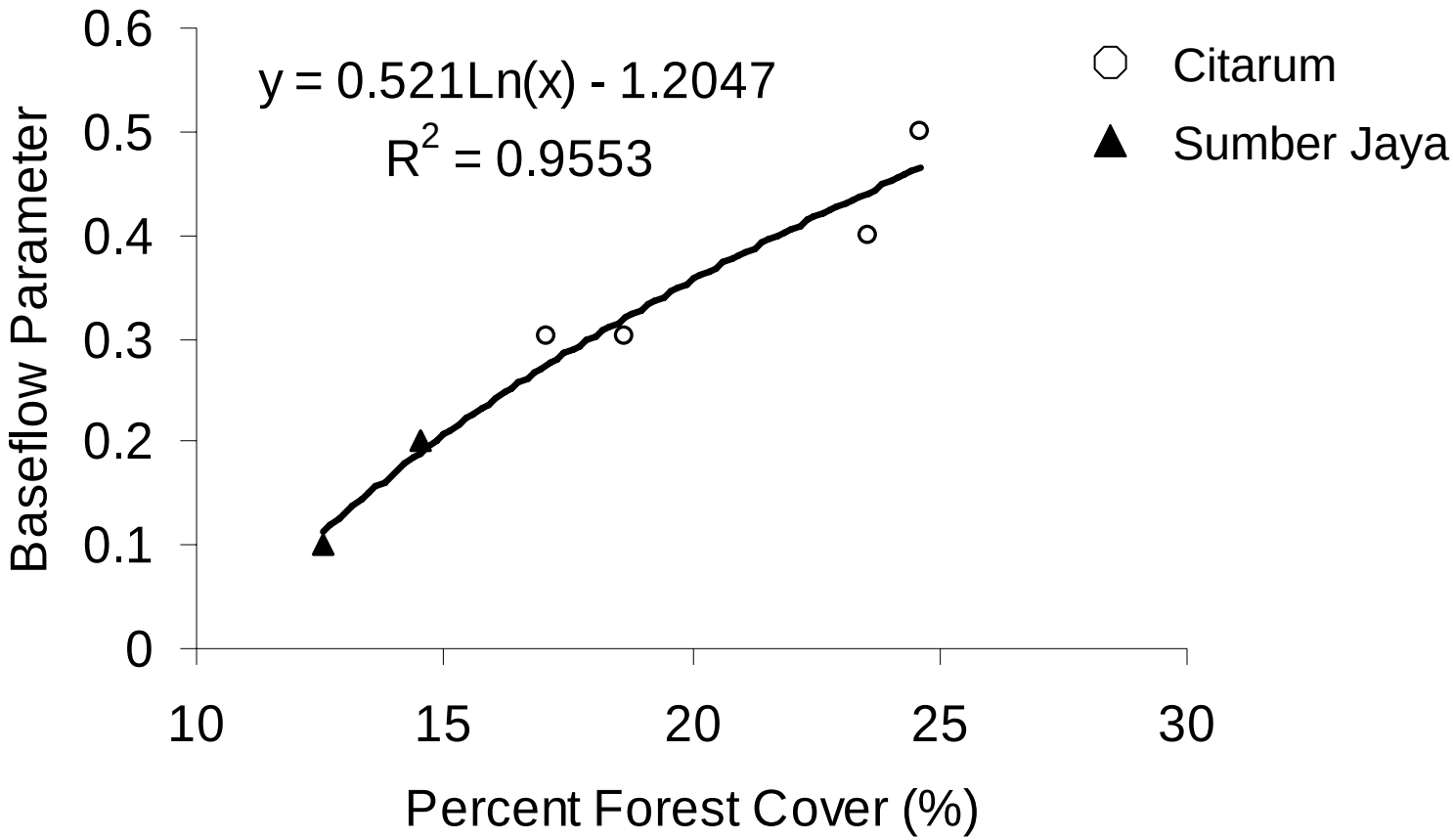
19%: MIT-1

25%: MIT-2

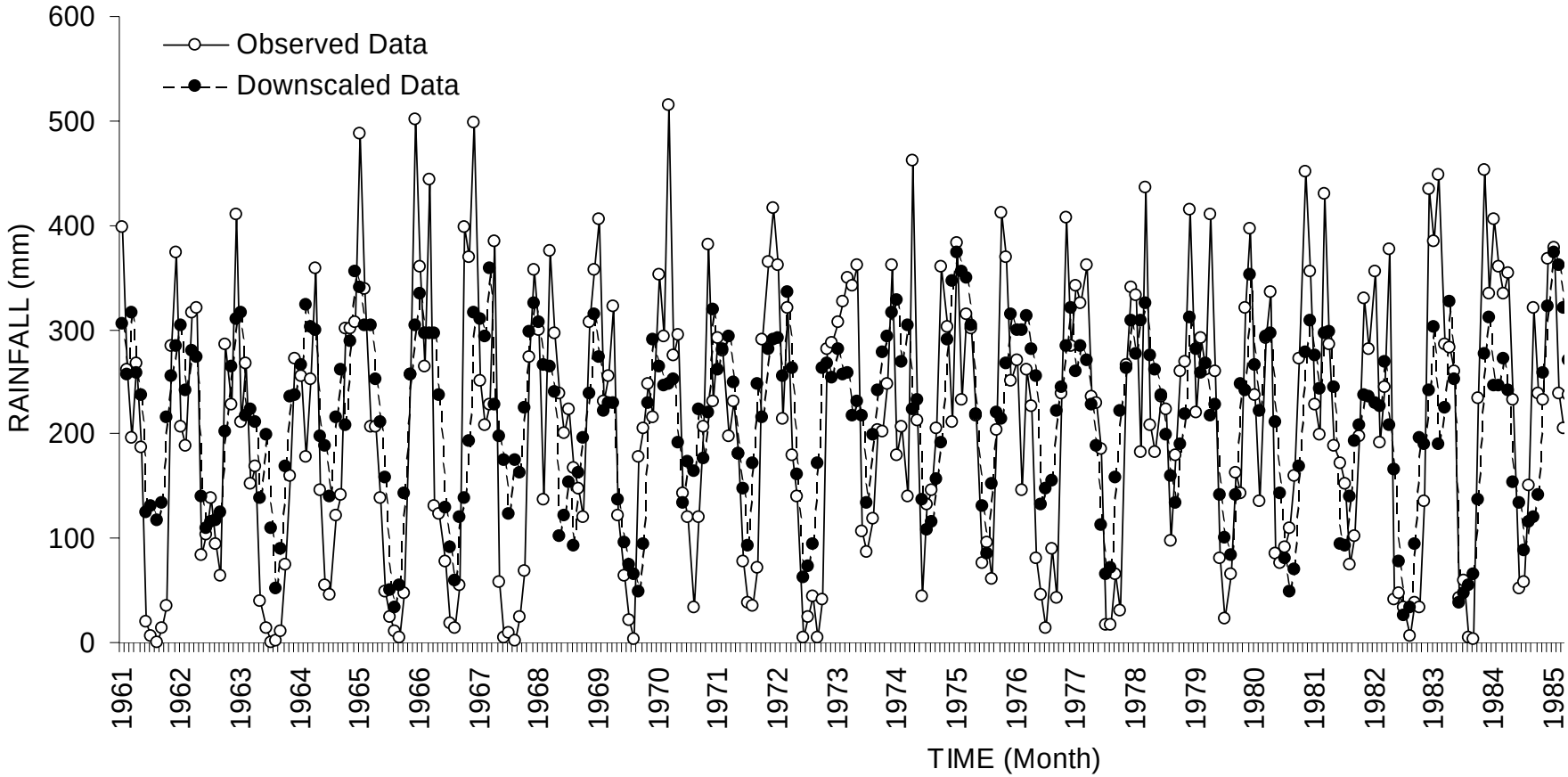
29%: MIT-3

48%: RTRW

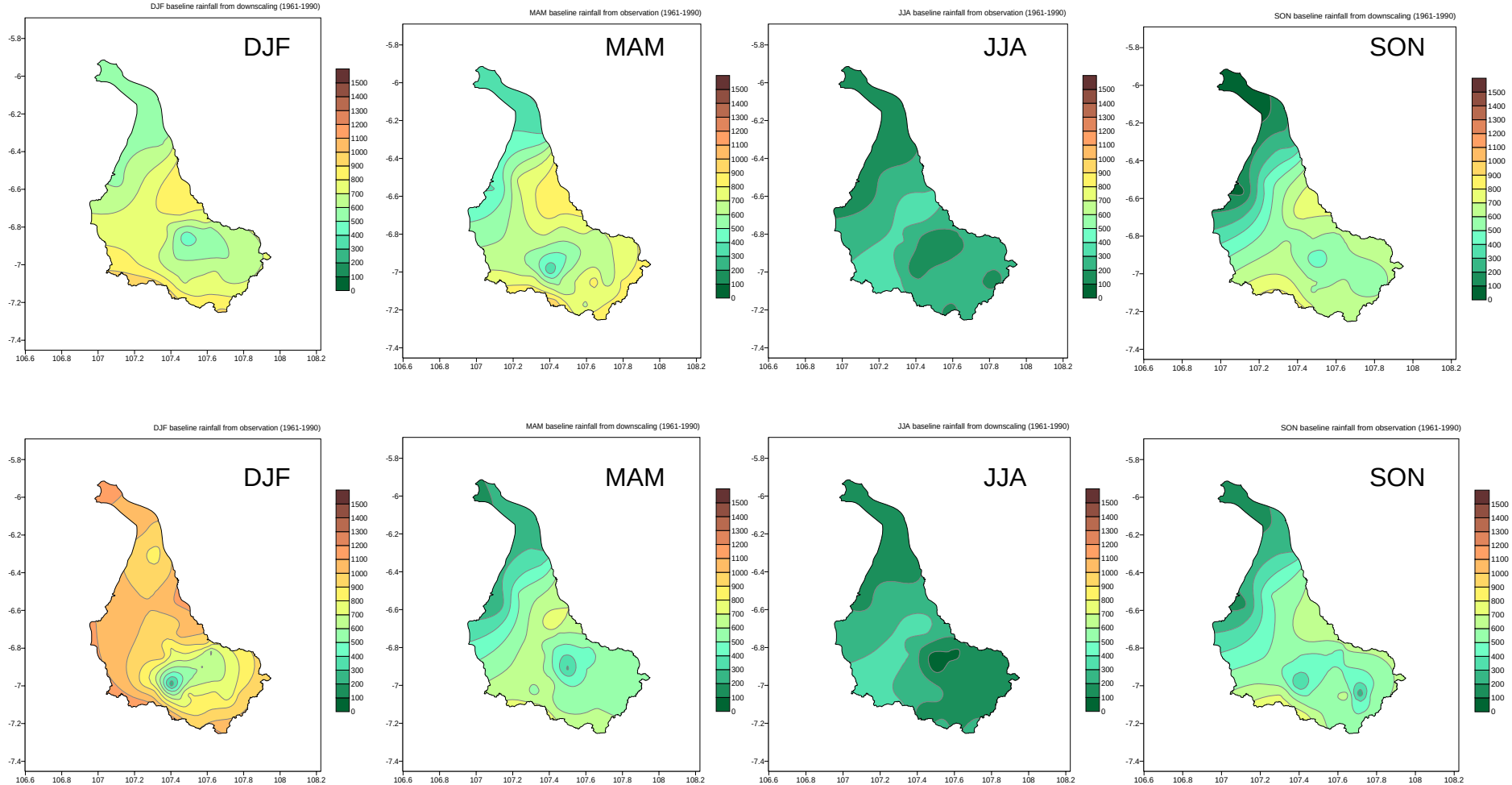
Relationship between base flow parameter and forest cover



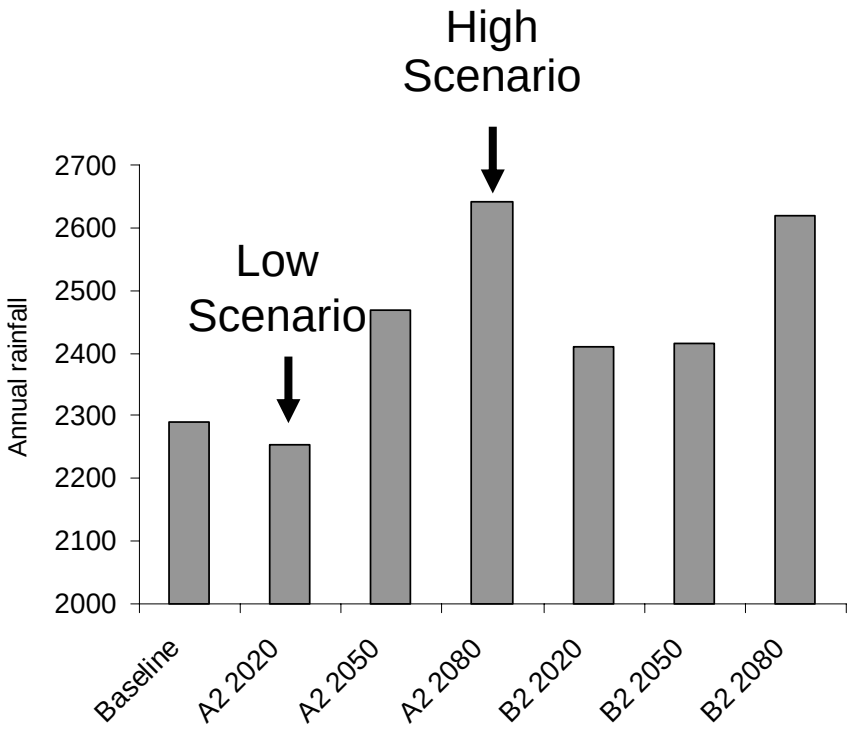
Comparison between observed and Downscaled



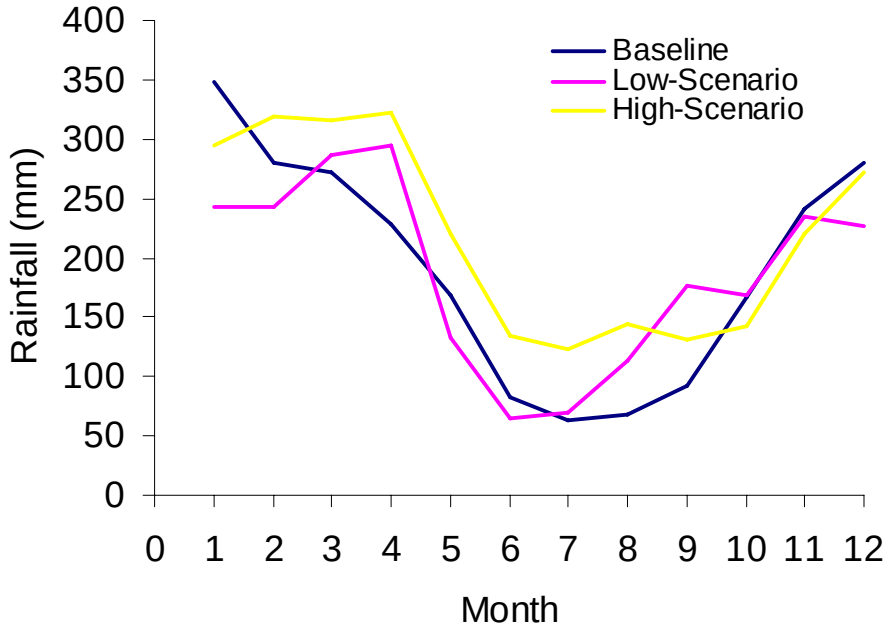
Comparison between Observed (Above) and Downscaled Rainfall (Below)



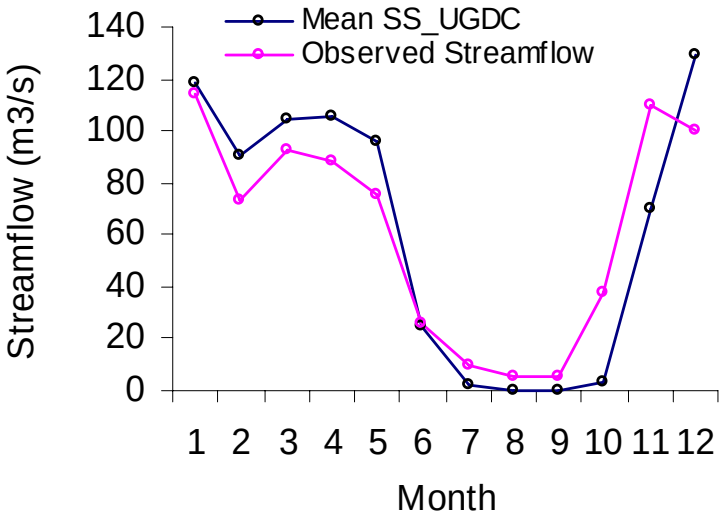
Projected Annual Rainfall at Citarum Watershed

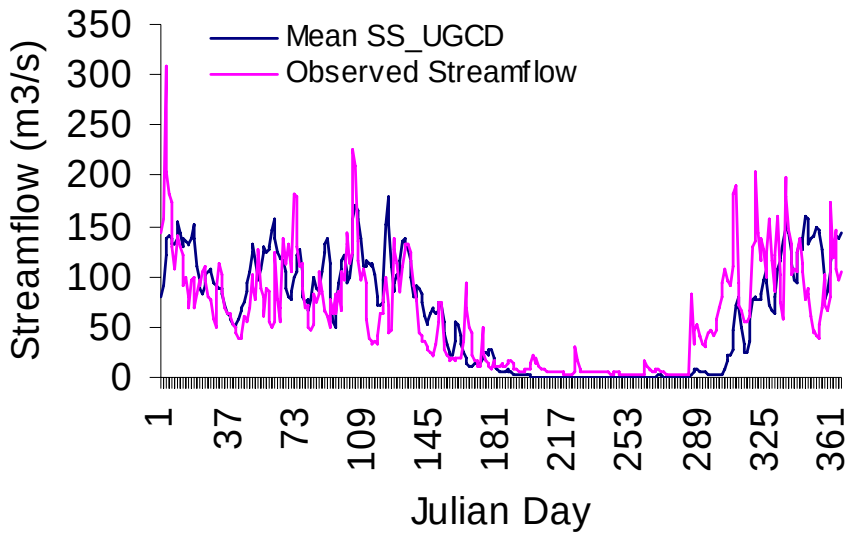


GCM outputs from ECHAM model downloaded from Data Distribution Centre



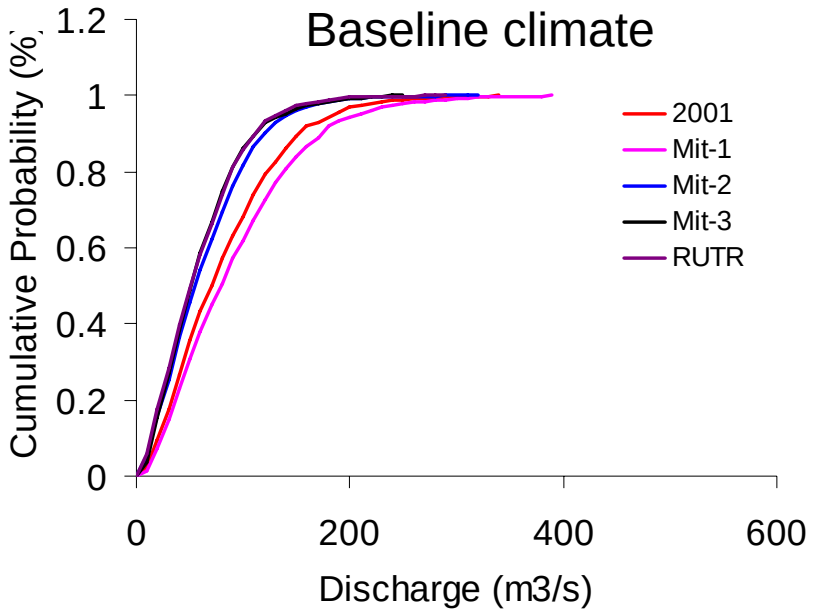
Result of Validation Using CLIMGEN

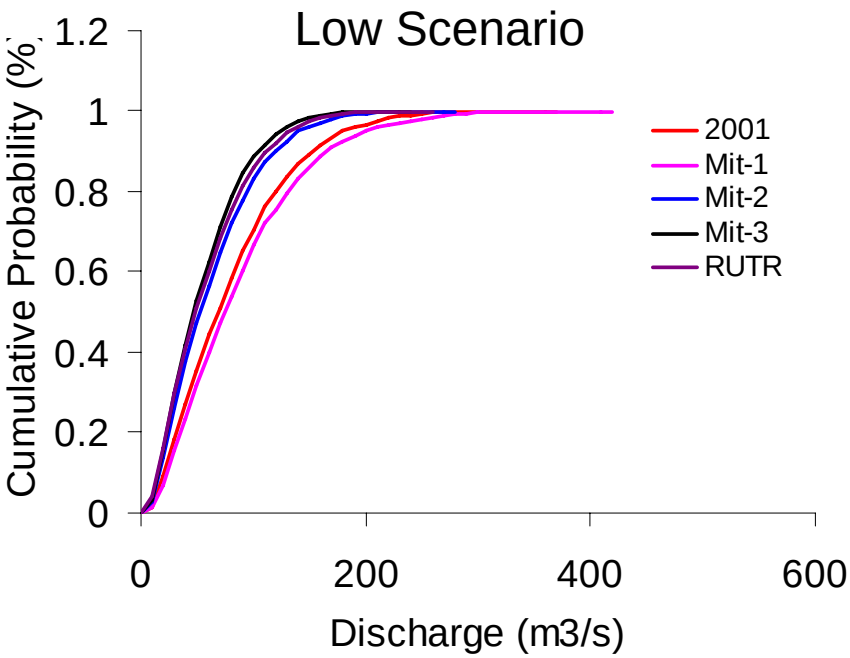


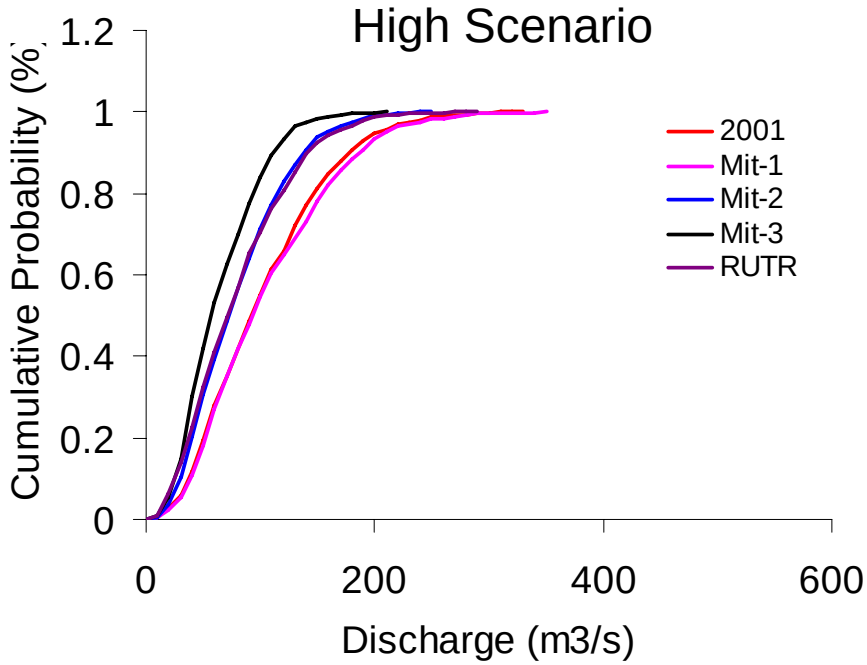


Distribution of stream flow under different land use and climate scenarios

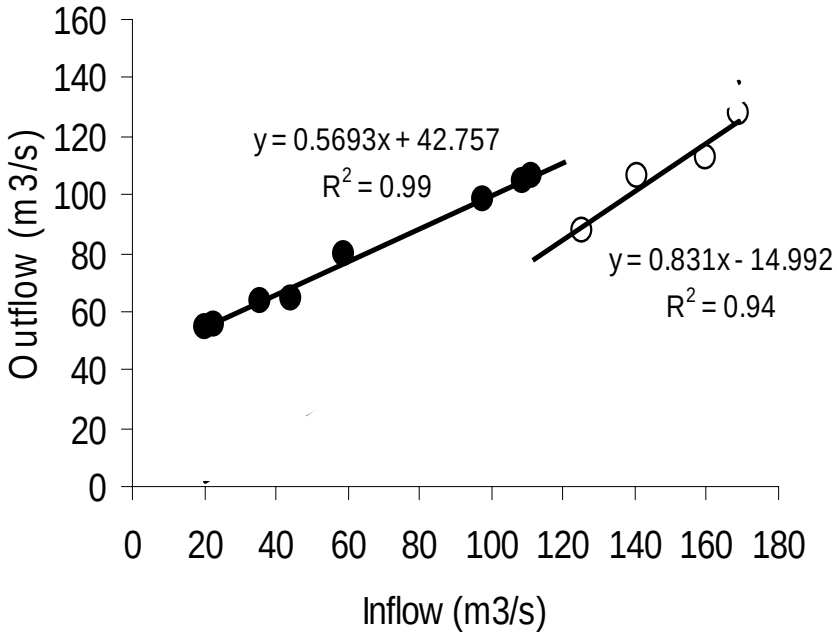
Under baseline and low climate scenarios, increasing forest cover more than 20% and up to 47% of the total land areas would not change the distribution of stream flow
Under high climate scenario, the distribution of stream flow under baseline and mitigation 1 land use scenario (percent land use cover is between 17% and 19%) was different from those under Mitigation 2 and 3 scenarios (percent forest cover is between 25% and 29%) and under RTRW (percent forest cover is 48%).

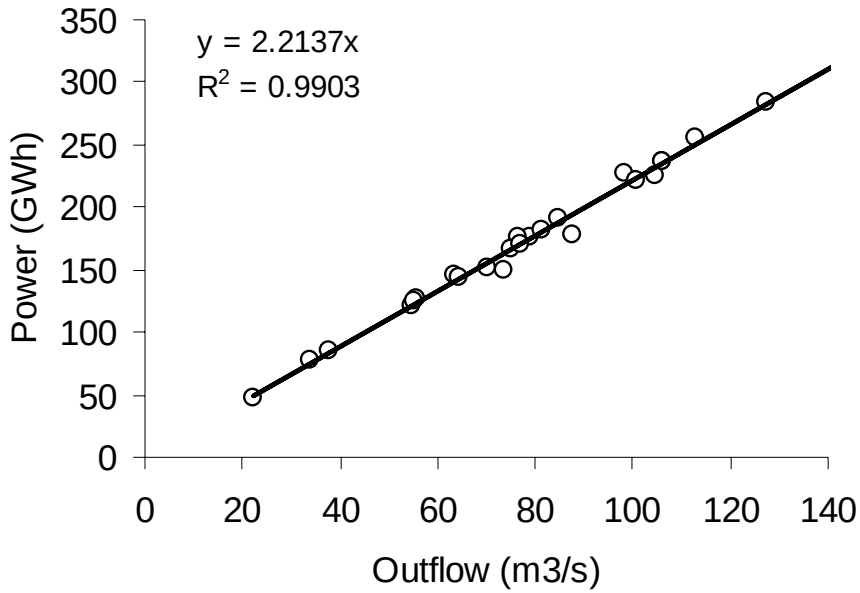






Relationship between Inflow, Outflow and Electricity Generation





The result of analysis suggested that If the forest cover were not increased to more than 25%, the frequency of producing electricity power of less than 100 GWh during dry season will increase under the three climate scenarios. The operation of this HEP in the dry season in critical to meet electricity demand during peak load


THANK YOU