Deforestation or Climate Change:
What is changing the flow regime of the Way Besai?

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Correspondence:
Bruno Verbist (b.verbist@cgiar.org)**, Rudy Harto Widodo**

Introduction

'Deforestation' is often perceived to be the cause of loss of watershed functions. The strong association of 'forest' and 'water' in public perception has very frequently led to conflicts when forest areas were converted to other productive systems. The Way Besai watershed (Sumberjaya) is an example of this, where conversion of forest to coffee gardens on slopes was considered to have led to a reduction of discharge of the Way Besai river, a reducing functionality of the Hydropower plant. This reduced discharge is, in public discourse, attributed to past deforestation and catchment degradation. While the earlier policies of evictions by the Department of Forestry were based on this perception, environmental activists still claim that under-performance of the hydropower schemes of Batutegi (2 X 14 MW) and Way Besai (2 X 45 MW) are due to deforestation of catchment areas, causing shortfalls in the electric power crisis in Lampung province (Oyos Saroso, 2004).

By analysis of the long term data records of flow of the Way Besai and rainfall in the area, we explored the possible role of land use change in the catchment versus the alternative explanation of variability (and/or trends) in rainfall as cause of changes in flow.

Methods

The IHACRES model is a parsimonious ('few-parameter') model that has been fitted to data sets derived in various climatic conditions (Croke et al., 2004). Model fits were obtained on the basis of the daily rainfall and discharge data for the1975 – 2007 period. Model parameter sets were derived for each consecutive 3-year period to expose the model to some inter-seasonal variability. All these models were then used on the rainfall data for the whole period 1975-2007. Model parameters for 1975-8 reflect a time that the catchment had 63% forest cover, the model parameters for the last few years a condition with only 13% forest.

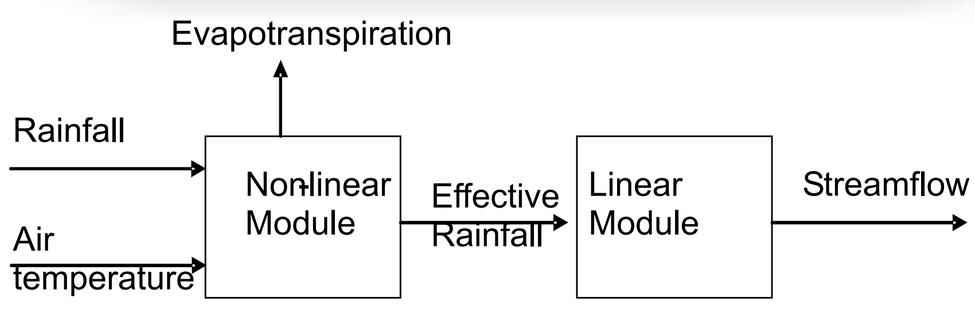

Figure 1. Generic structure of the IHACRES model

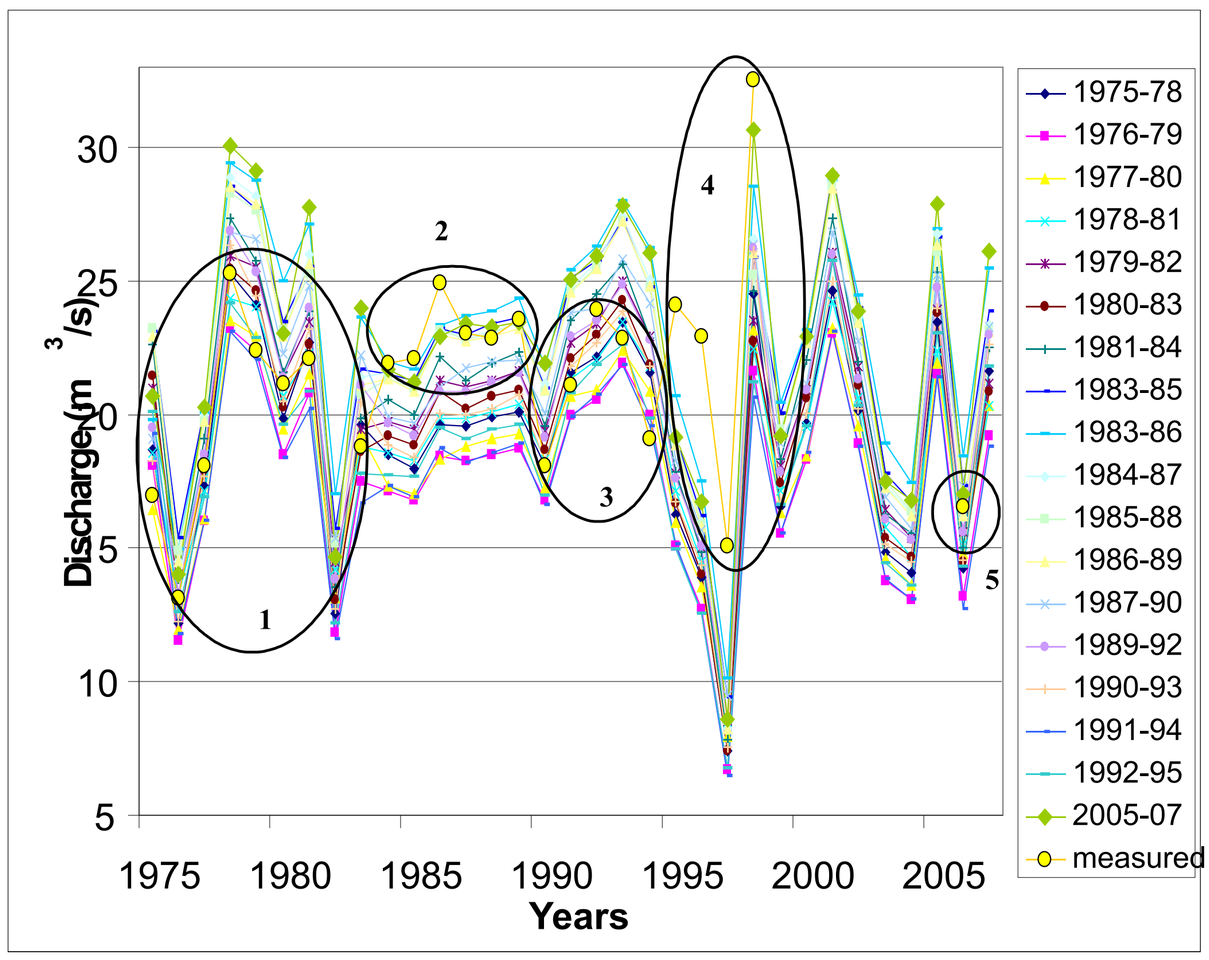

Fig. 2 Modelled and measured average discharge (m3/s) of the Way Besai for 18 models, each optimized for the catchment condition in a 3-year period

Results

Figure 2 Predicted average discharge for the 1975-2007 rainfall data with models that reflect the hydrological behaviour of largely forested (early years) and deforested (later years) conditions.

For the same model e.g. 2005-2007 average annual discharge can vary between 8 m^3/s (in 1997) and 32 (in 1998) m^3/s. The variation per year between models is never more than 9 m^3/s. So the first conclusion is that the variability due to differences to rainfall (wet vs. dry years) is much larger than the possible land use effect given by the envelope of models.

The results show a (hydro)logical trend in a sense that per amount rainfall the discharge increased over time, Taking a closer look at the models and the data 5 distinct periods can be Distinguished:

1. 1975-1984 with a relatively low discharge per unit rainfall
2. 1984-1989 with a steep increase of discharge per unit rainfall
3. 1989-1994 whereby the discharge per unit rainfall is lower again, but still higher than the 1975-1984 period
4. 1995-1998 whereby measured discharge is much higher than the modelled one
5. 2005-2007 whereby discharge per unit rainfall is the highest

Conclusion

The modelling results of IHACRES showed that the impact of annual variation in rainfall on discharge is a factor 4 larger than the possible effects of land use change. The changes in overall catchment hydrology are non-linear with time and may reflect a recovery of vegetation other than 'forest'. In the public debate, variation and changes in rainfall pattern are insufficiently recognised as major driver of changes in discharge patterns.

Reference

Croke, B.F.W., Merritt, W.S., Jakeman, A.J., 2004. A dynamic model for predicting hydrologic response to land cover changes in gauged and ungauged catchments. Journal of Hydrology 291 (1-2), 115-131.