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Analysis of Flow Variation in the Kelani River due to The Impact of the Laxapana Hydropower System in Sri Lanka

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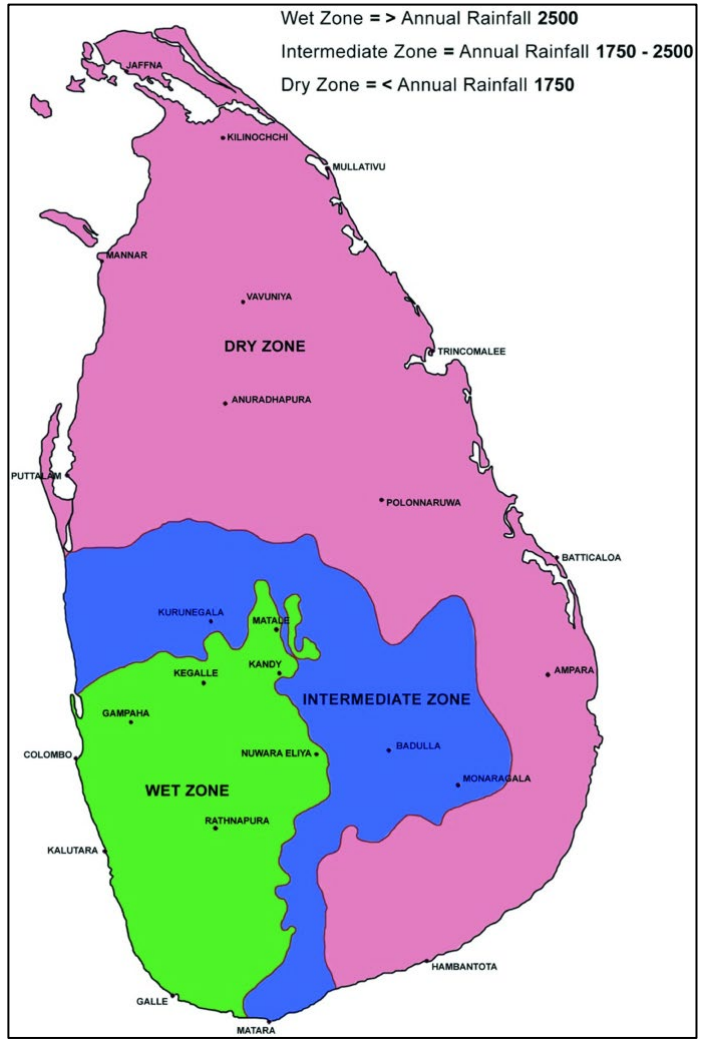
Background

- Sri Lanka is a tropical country that affected by 2 monsoon rainfall seasons
- Frequent occurrence of high-intensity rainfall cause floods in the wet zone
- Extreme wet weather conditions cause significant flooding issues in the wet zone
- Reservoirs were constructed to store excess water to cater for hydropower & water supply in wet zone
- Proper utilization of excess water is important to minimize the frequent occurrence of floods.



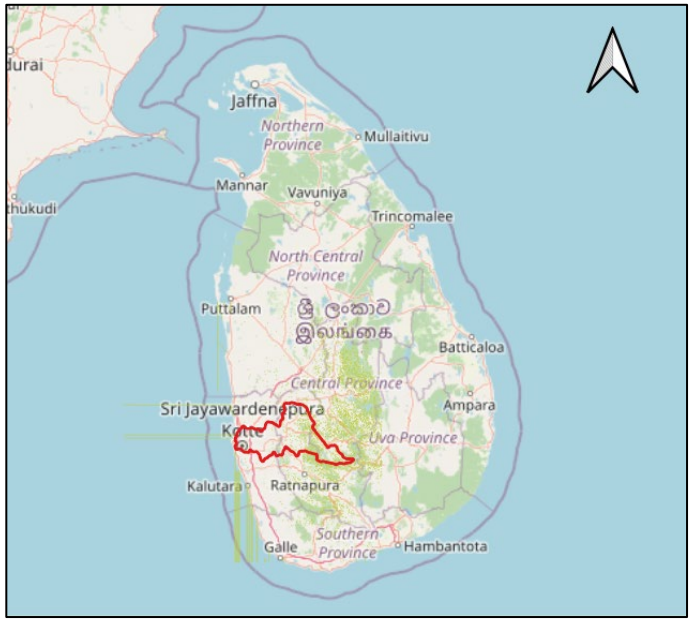
Problem Statement

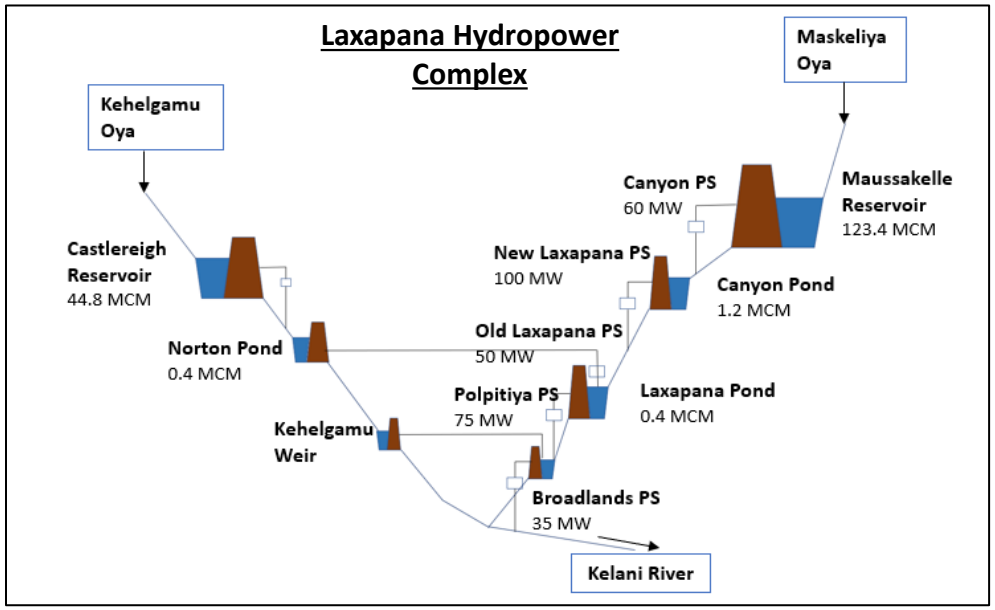
- Sri Lanka suffers annual flood damages of around 32 LKR billion (economynext, 2020)
- Main sources of power production are thermal and hydropower
- Significant alterations occurred in the flow of the river due to regulatory reservoirs
- Vital to quantify the variation of flow in order to maximize the power generation and reduction of flood damages

Source: www.ceb.gov.lk

Study area

- Kelani river is the fourth largest river in Sri Lanka
- The upper catchment comprises of the Laxapana Hydropower Complex with a total capacity of 346.3 MW (more than 20% of current national capacity)
- Two main river tributaries in the upper reaches; Kehelgamu Oya and the Maskeliya Oya
- Castlereigh reservoir fed by Kehelgamu Oya whilst Maussakelle reservoir fed by Maskeliya Oya
- Canyon and Laxapana reservoirs located downstream of Maussekelle reservoir
- Norton reservoir located in the downstream of Castlereigh reservoir

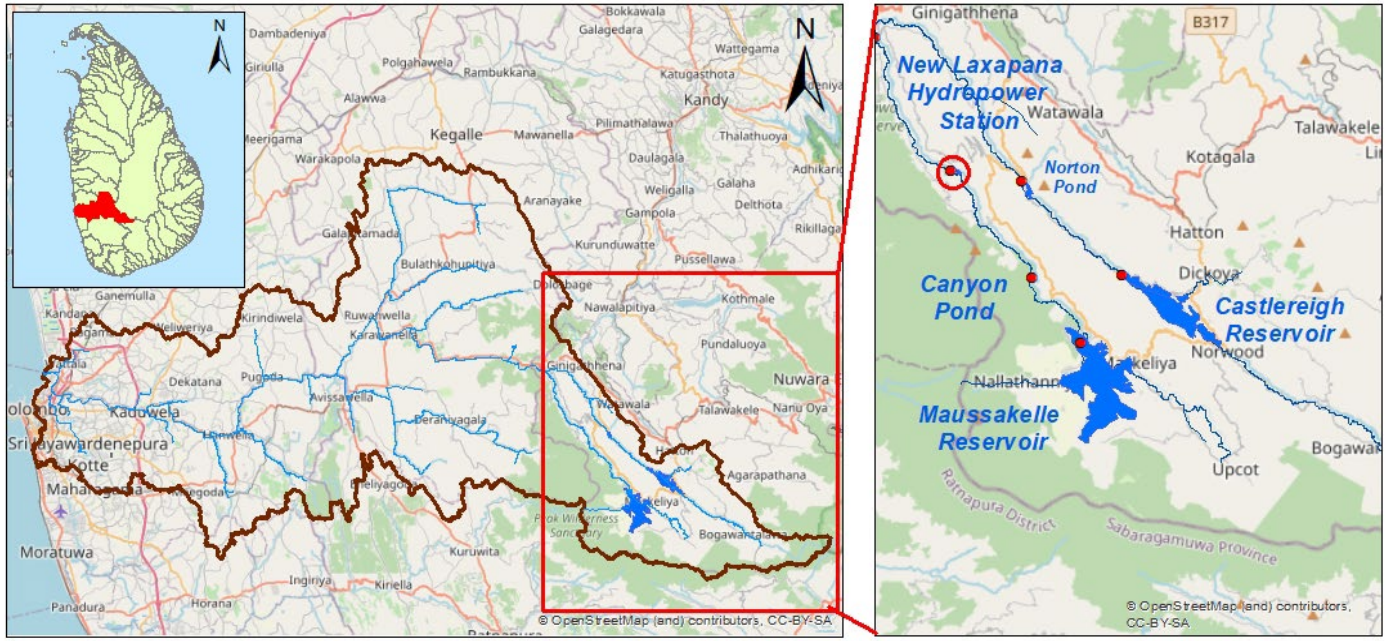


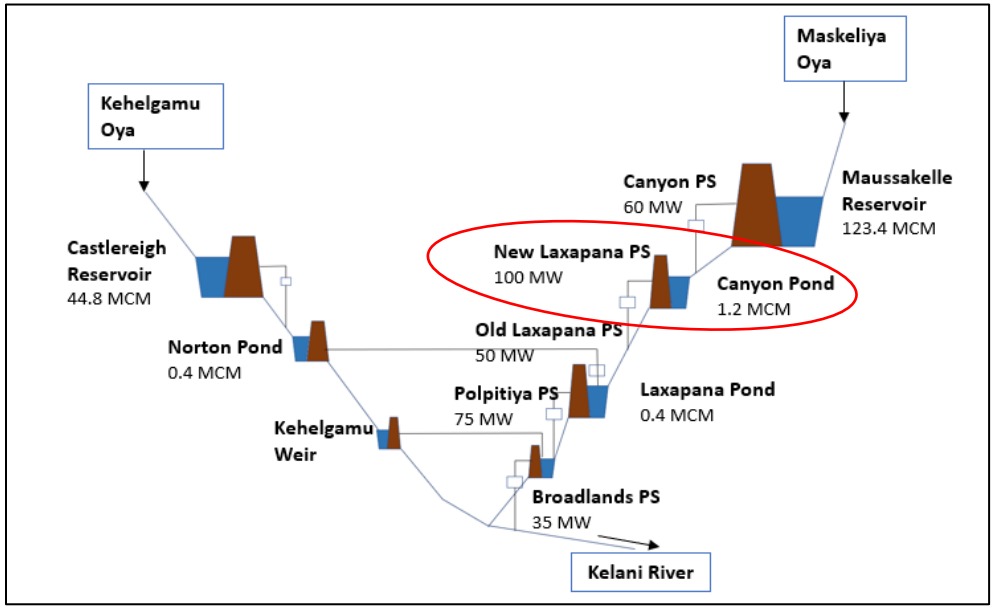


Study area

- New Laxapana power station of capacity 100 MW, fed by the Canyon reservoir

- Laxapana pond, located downstream of Canyon Pond, also receives power flow from Norton Pond



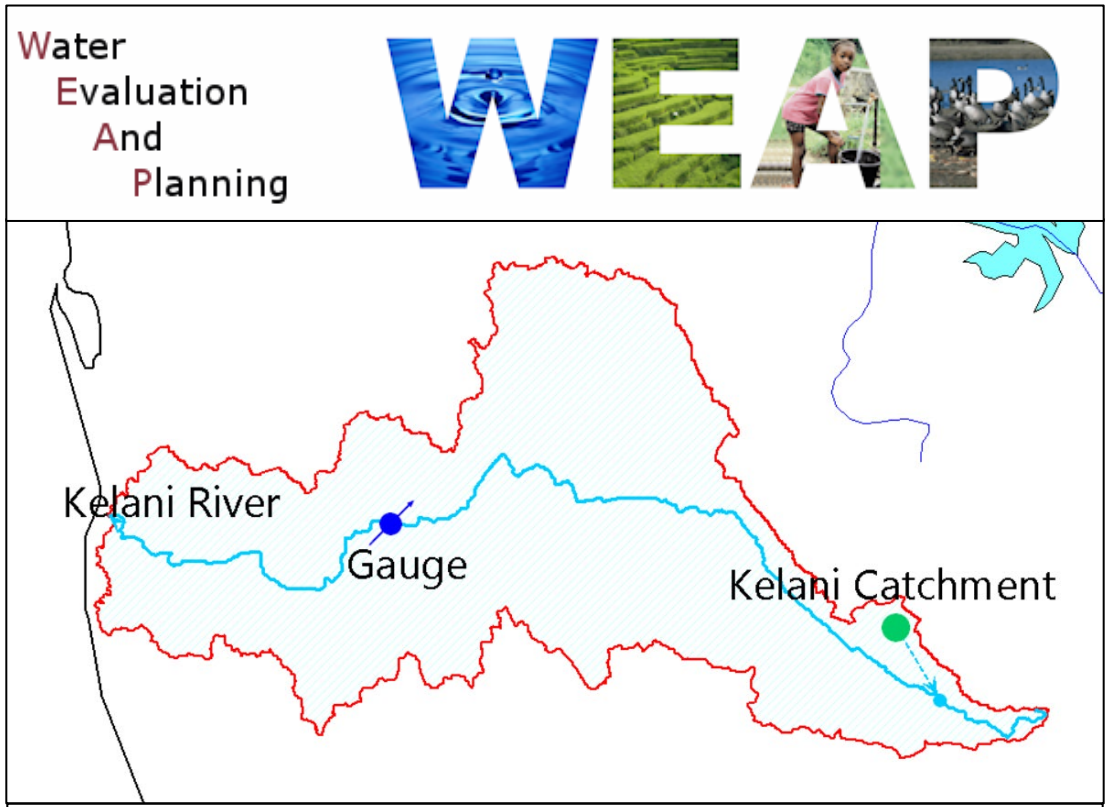


Significance of the research

- Natural flow regime is mostly affected by the monsoonal rainfalls in Sri Lanka
- Influence of hydropower regulations in the upper Kelani basin affects the river flows
- Analysis of flow variation due to the Laxapana hydropower scheme in the upper Kelani basin is important to further ensure the implications to be faced in the lower part of the catchment.
- Investigation of flow variations due to hydropower regulations with regard to monsoonal rainfall patterns is vital for regulated river basins in Sri Lanka.

Methodology

- Development of a hydrological model in WEAP software for Kelani River basin in unregulated state.
- Calibration of the model for the unregulated condition
- Comparison of the simulated flow (unregulated) with the observed discharge downstream of Canyon reservoir
  - Annual Variations
  - Seasonal Variations

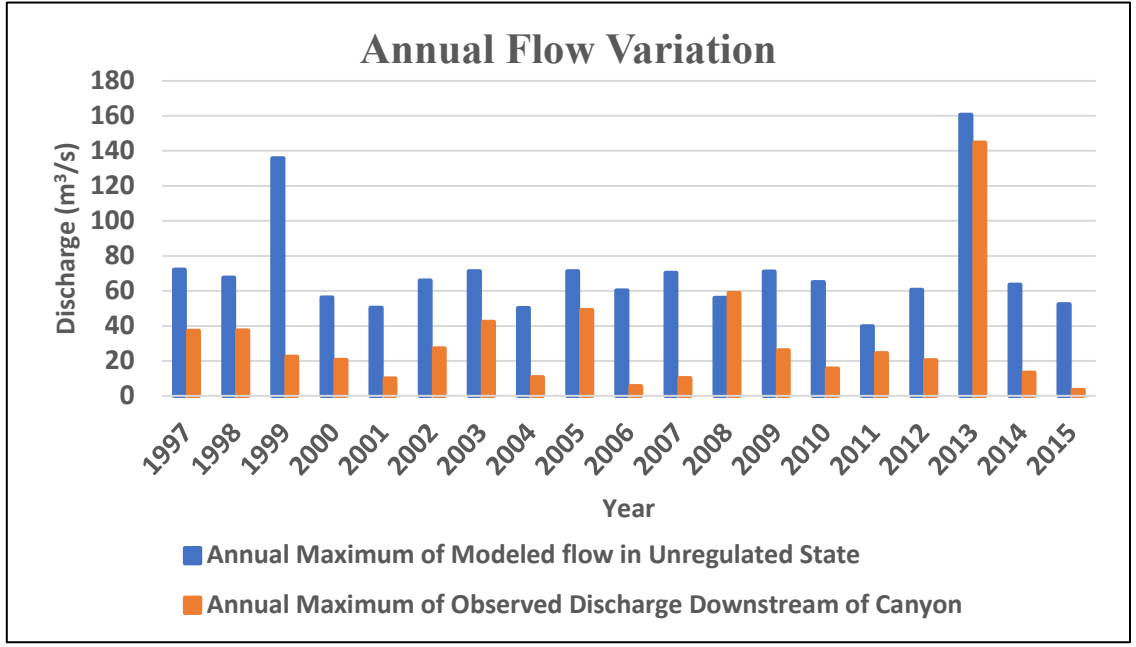


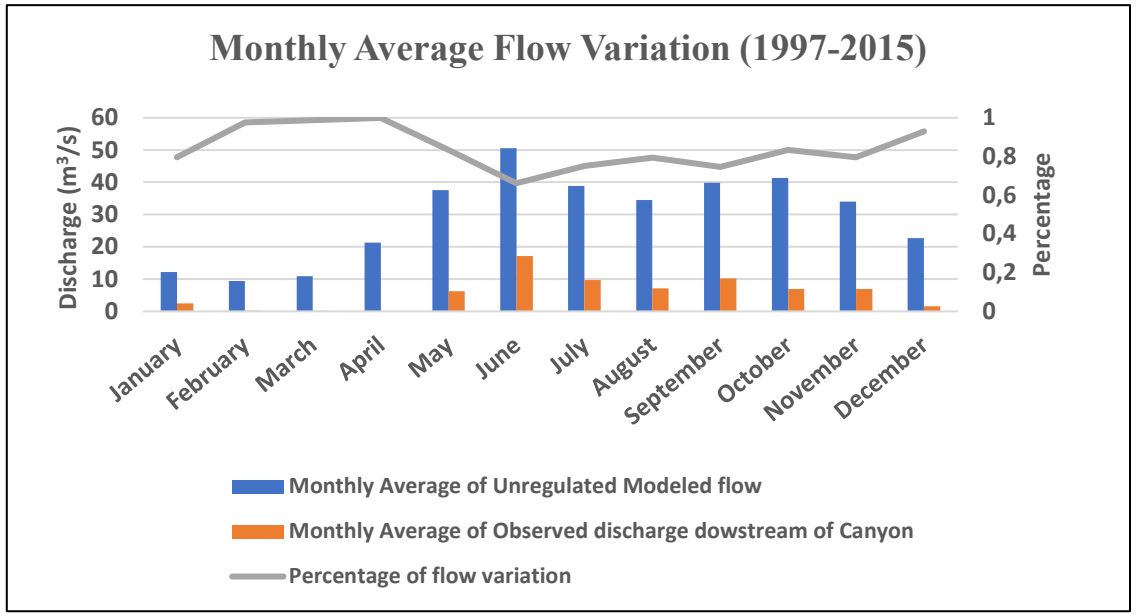
WEAP schematization for Kelani river basin

Results

- Highest annual flow variations were observed in the years; 2015 (93%), 2006 (91%) and 1999 (84%).

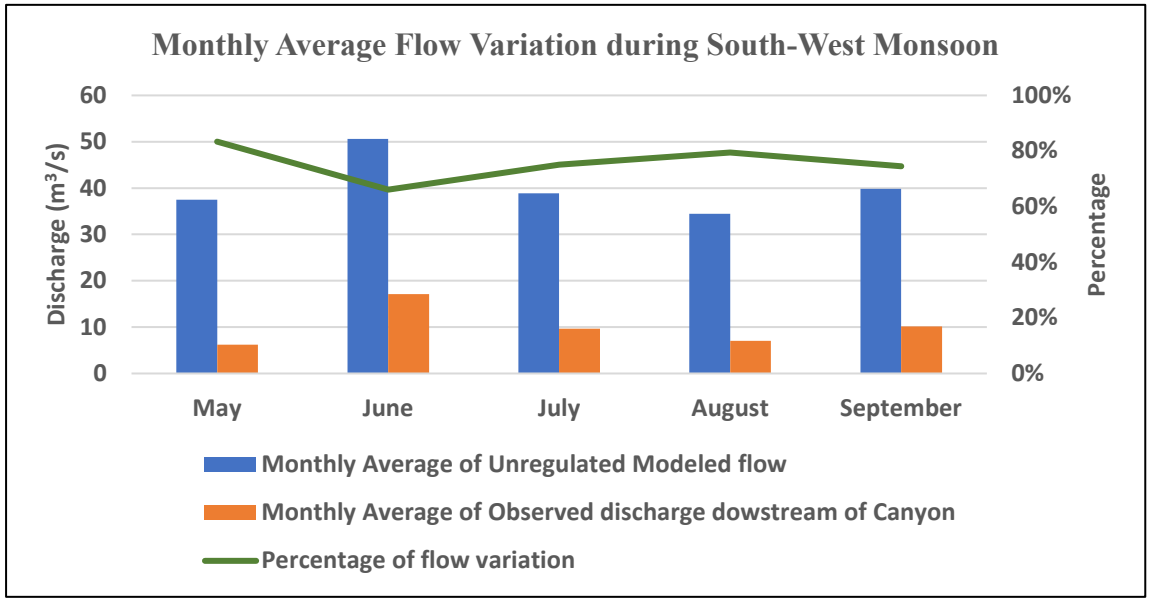
- The monthly average flow alterations highest in the months of February-April and lowest in June.

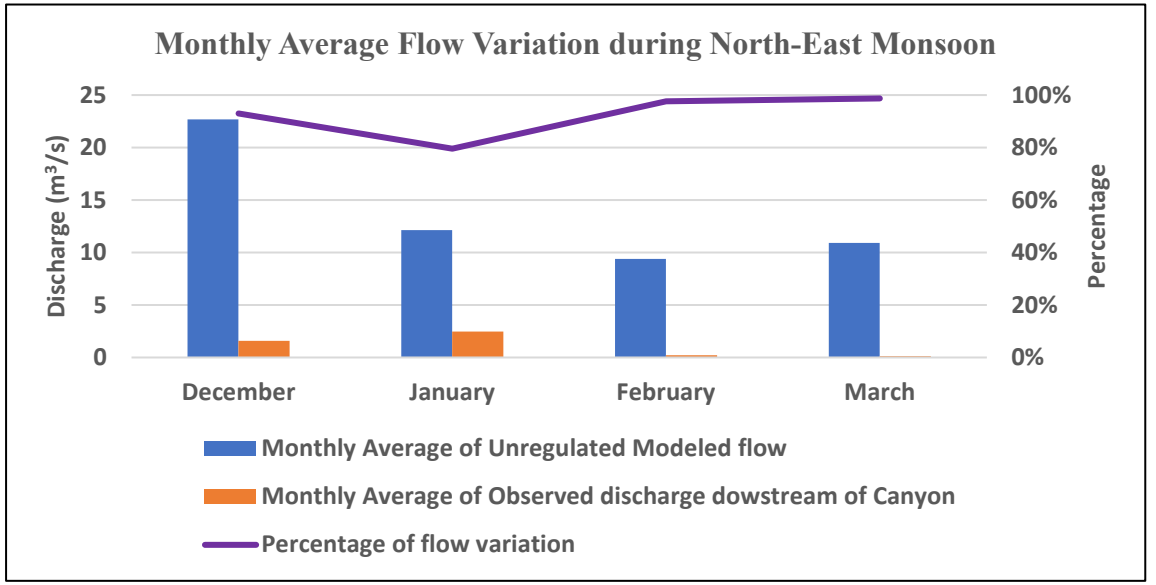




Results

- The percentage of flow variation ranged from 66% to 83% during the period of southwest monsoon.
- The percentage of discharge alterations due to regulations during northeast monsoon times were over 90% except in January (80%).
- Although higher flows experience throughout the southwest monsoon, percentages of flow reductions are still lower than that in northeast monsoon.





Conclusions

- The difference between the maxima of unregulated modeled flow and the regulated observed discharge represents the magnitude of flood peak reduced during the regulations in Maskeliya Oya in Kelani river basin.
- It is understandable that the regulatory reservoirs Maussekelle and Canyon have a definite flood dampening effect in the river basin.
- The flow variations were higher in the period of northeast monsoon than that of the southwest monsoon as the reservoir filling was less during this period.

Recommendations

- This same approach can be performed to the other river tributary (Kehelgamu Oya) to evaluate the flow variations occurred due to upstream regulatory reservoirs.

- Water allocation model can be developed for Kelani River basin in WEAP software and analyze how much significant that the regulations of Laxapana Hydropower System towards the demands in lower Kelani river basin.


Thank You.!