Potential impact of precipitation and land-cover changes on stream flow in Srepok River Basin in Vietnam and Cambodia: An analysis process for local level water resources adaptation

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Introduction

- Although climate change impact on global and regional water have been intensively studied, practical analyses on local scales are not always well studied. To make a suitable water resources adaptation at local level, decision makers need to understand the extent of potential impact of changes in both climate and human activity on local water flow. However, few studies have assessed the magnitude of these impacts although it is very important to compare these factors based on practical analysis with local data and to respond impending climate change and expanding human activity, particularly in developing countries.

- This paper aims to respond to these needs by a practical analysis process: to evaluate the potential impact of two driving forces of change in local stream flow over the next several decades, 'precipitation' and 'land-cover', Magnitude of the changes due to each driving forces is demonstrated with different likely scenarios.

Study area

- The Srepok River basin, a cross-boundary sub-basin in the Lower Mekong are selected as a study area (Fig. 1).

- The basin covers an area of 30,000km². The Cambodian side remains largely covered in thick forests. The Vietnam side features a small, concentrated urban population of 390,660 in less than 10km². There is also significant agricultural development (approximately 6000km²) and a hydropower dam (Dray Linh Old) and reservoir systems that control flow and collect hydrological data.

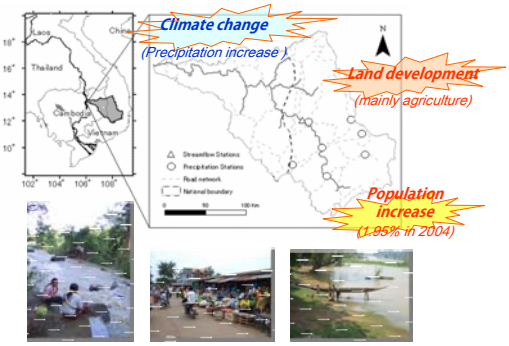

Fig. 1 Study area

Methodology

- Fig. 2 shows the overall structure of this project involves integration of two software programs – a hydrological simulation tool, Hydrologic Modeling System (HEC-HMS), developed by the US Army Corps of Engineers Hydrologic Engineering Center, and a GIS environment (ArcGIS). The integration better reflects effects of changes in climate and land use over time in a local scale.

- Arc Hydro data model, a geospatial and temporal data model specifically developed for water resources, and the Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) were used to model the water flow from upstream to downstream and to process climate and rainfall data into one integrated model of the hydrological processes in the basin.

- Hydrological model development and calibration using HEC-HMS were conducted with available local precipitation and stream flow data in Vietnam. Then, stream flows in 2025 and 2050, was estimated by considering the potential impacts of climate change and socio-economic development on water supply and demand from domestic and agricultural uses (Fig. 2 and 3).

- **Scenarios** such as "**Precipitation change only (Sc 1)**","**Land cover change only (Sc 2)**" and "**Both precipitation and land cover change (Sc 3)**" was incorporated for building future models.

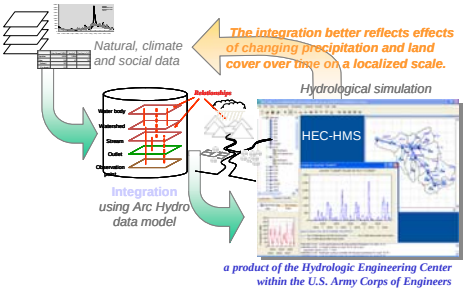

Fig. 2 Image of software integration

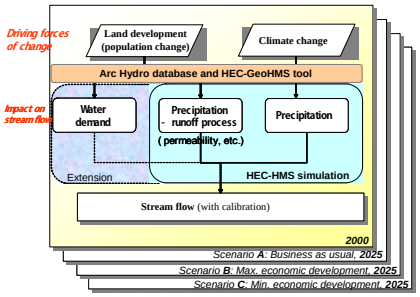

Fig. 3 Outline of analysis process

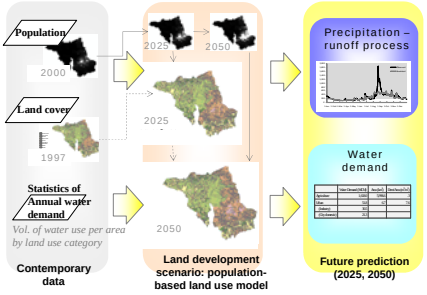

Fig. 4 Process of future land-cover model

Results and discussion

-Based on the scenario analysis, flow rate will decrease by about 80% in 2025 and by about 50% in 2050 in the dry season as comparing to the 2000 level, with moderate decrease in the wet season. The human water demand would be the greatest factor in reducing stream flow by about 20% in 2025 and by about 60% in 2050, while the effect of precipitation changes by 2025 and 2050 would be 2% and 3%, respectively (Fig 5).

- Fig. 6 shows how the total stream water flow would be changed by scenario in 2025 and 2050 comparing to 2000 level.

Fig. 7demonsrates the contribution ratio of stream flow changes among precipitation, land cover and water use.

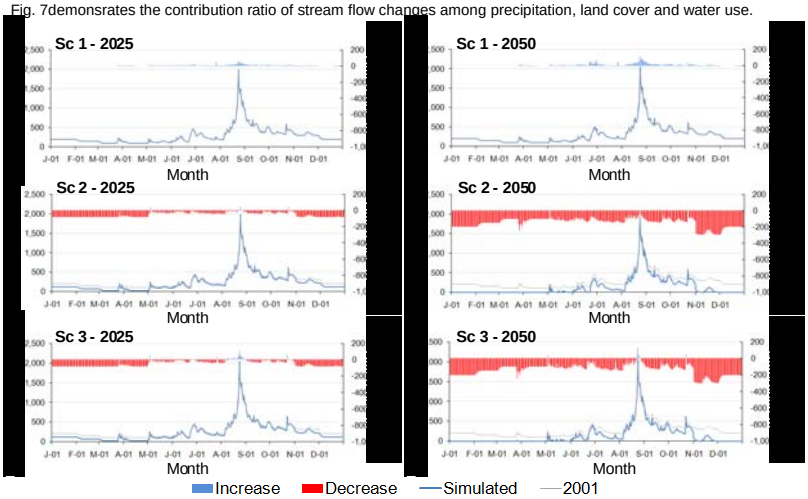

Fig. 5 Stream flows in Ban Don in 2025 and 2050 (lines), and the difference of stream flow as compared to 2001 (bas) by scenarios (Sc 1, Sc 2, Sc 3)

- Our result shows that, if anything, the most extreme expected climate change would ameliorate reduced stream flow from increased water demand, but the effect is very small.

- This study's practical methodology can be a basis for local policy decision-making and research for climate adaptation and urban and regional planning in the Srepok River basin and beyond. This paper has been a modest step in that direction.

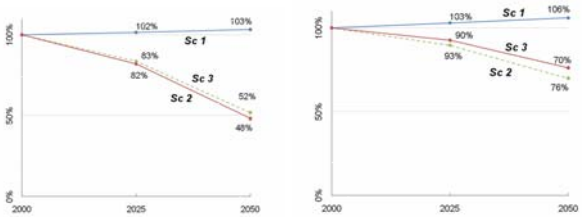

Fig. 6 Change s of total water flow by scenarios in Ban Don, Vietnam (left), and at the basin outlet in Cambodia (right)

Fig. 7 Contribution ratio of individual driving forces of change to stream flow change in Ban Don (left) and the basin outlet (right) in 2025 and 2050 in Sc3.