

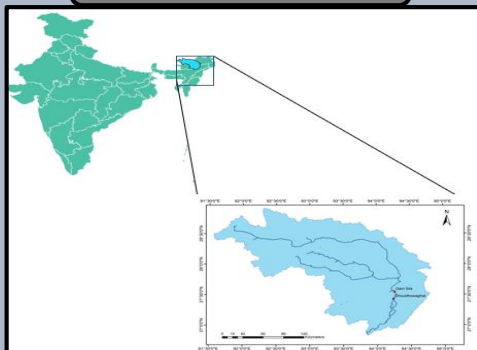
Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma
Indian Institute of Technology Guwahati
Assam, India

Introduction and Methods

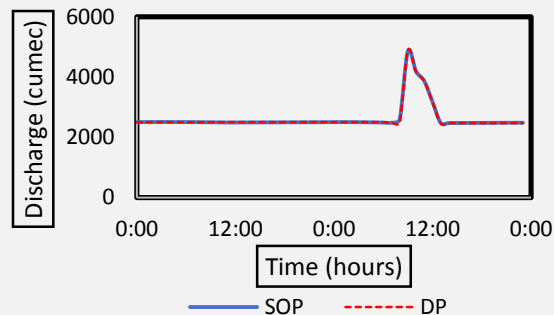
- ❑ Flooding at downstream can be disastrous due to sudden release from dam.
- ❑ Proper operating policy with a routing model can be used to check the flooding at downstream.
- ❑ Two operating policies; i) Standard Operating Policy (SOP) and ii) Dynamic Programming (DP) generated operating policy have been tested.
- ❑ The release from the reservoir as well as inflow without dam is used to route to downstream using a hydrodynamic model.

Case Study Area

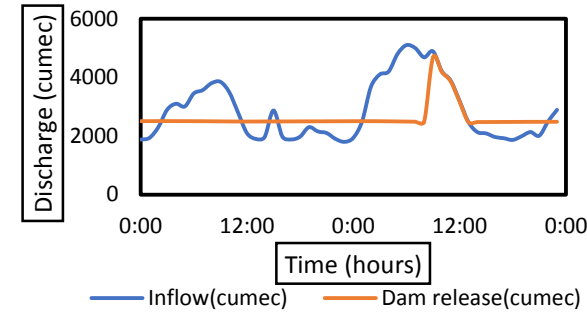


Results

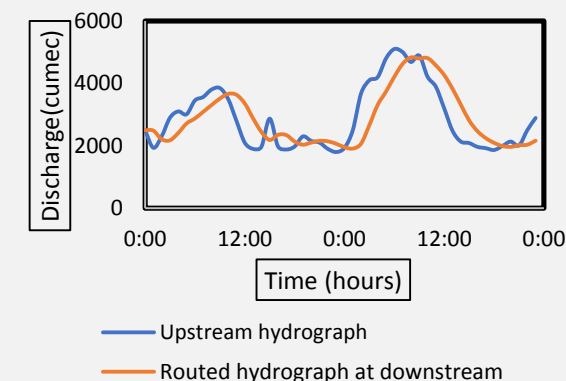
Comparison of Dam Release from SOP and DP



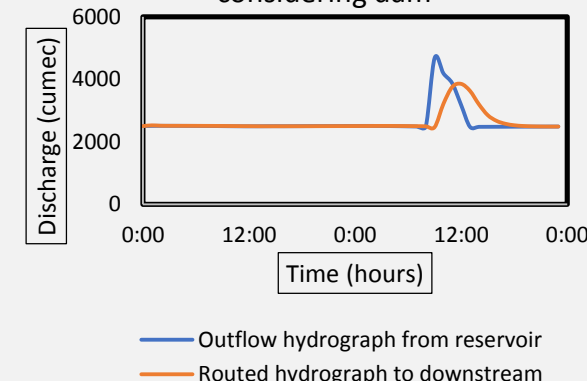
Initial Storage at 1315 MCM (DP)



Routed hydrograph to downstream without considering dam



Routed hydrograph to downstream considering dam



Conclusions

- ❑ In natural condition without dam, flood rises gradually providing prior information and sufficient time for completing pre-disaster actions based on experience.
- ❑ With inclusion of dam, peak flow rises vary rapidly from a very low flow without showing any indication of flood beforehand and thus flood becomes more disastrous.
- ❑ Sudden fluctuations of water level can also cause failure of river bank eventually leading to failure of embankments.
- ❑ The sudden release from the dam is also dependent on the initial storage of the reservoir.



Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma
Indian Institute of Technology Guwahati
Assam, India



EGU21-8757

Introduction

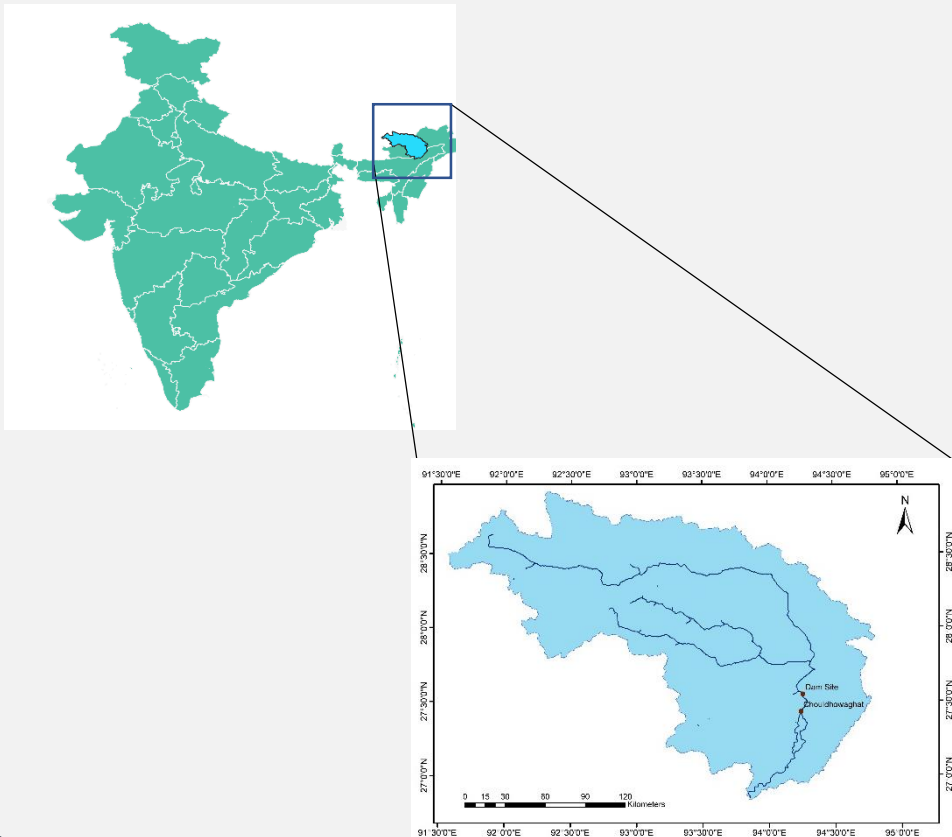
- ☐ Flooding due to sudden release from a hydropower dam during monsoon is becoming a serious concern for downstream locality, especially when there is lack of coordination between the dam authority and the Disaster Management Authority (DMA) at downstream.
- ☐ For hilly river, a disastrous flash flood is generally caused by short duration high intensity precipitation and a pondage hydropower project cannot attenuate such flood.
- ☐ Generally, reservoir simulation/optimization for a hydropower project is carried out on monthly, ten-daily or at best on daily basis to determine the best operating policy.
- ☐ Such flood event goes unnoticed so a detailed investigation of the downstream flooding is required before the construction of any hydropower project with at least on hourly basis to get insight into the impact of such inflow at downstream.

Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma
Indian Institute of Technology Guwahati
Assam, India

EGU21-8757

Case Study Area



- ☐ The Lower Subansiri Hydroelectric Project (LSHP) located in the Subansiri River, the largest tributary of Brahmaputra River.
- ☐ The river Subansiri originates from the western part of Mount Pararu in the Tibetan Himalaya.
- ☐ The dam site is located at Gerukamukh which is on Assam-Arunachal Pradesh border.
- ☐ The downstream flood prone area named Chouldhowaghat has been considered in this analysis which is 13 km downstream of dam site.

Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma

Indian Institute of Technology Guwahati
Assam, India

EGU21-8757

Methodology

- ❑ Two operating policies; (i) Standard Operating Policy (SOP) and (ii) Dynamic Programming (DP) generated operating policy have been tested.
- ❑ Two scenarios; (i) With dam and (iii) Without dam have been considered to check the downstream flooding.
- ❑ The release from reservoir as well as the inflow without the reservoir is routed to the downstream using a 1D hydrodynamic model.

Standard Operating Policy (SOP)

$$S_{t+1} = S_t + I_t - E_t - R_t - S_{pt}$$

$$E_t = \left(\frac{A_t + A_{t+1}}{2} \right) \times ev_t$$

$$h = el_t - TWL$$

$$S_a = S_t + I_t - E_t - S_d$$

$$P_t = \gamma Q h \eta$$

$$S_t = K; \text{ if } (S_a - R_t + S_d) > K$$

$$S_t = (S_a - R_t + S_d); \text{ if } (S_a - R_t + S_d) < K$$

$$S_{pt} = S_t - K; \text{ if } (S_t > K)$$

$$S_{pt} = 0; \text{ if } (S_t < K)$$

$$O_t = R_t + S_{pt}$$

Dynamic Programming (DP)

$$f_t^n(S_t) = \max[B_t(S_t, R_t) + f_{t+1}^{n-1}(S_{t+1})]$$

$$B_t(S_t, R_t) = \rho g h Q \eta$$

$$S_d < S_{t+1} < K$$

$$R_{t \min} < R_t < R_{t \max}$$

$$R_{t \min} = \max[5, S_t + I_t - E_t - K]$$

$$R_{t \max} = S_t + I_t - E_t - S_d$$

Hydrodynamic Model

- ❑ The 1-D HEC-RAS unsteady flow model is employed in the analysis as a routing model.

$$\frac{dA}{dT} + \frac{dQ}{dX} - q_l = 0$$

$$\frac{dQ}{dT} + \frac{d(QV)}{dx} + gA \left(\frac{dz}{dX} + S_f \right) = 0$$

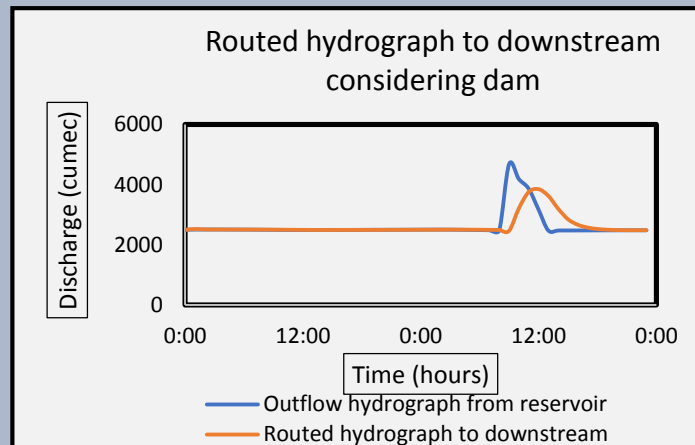
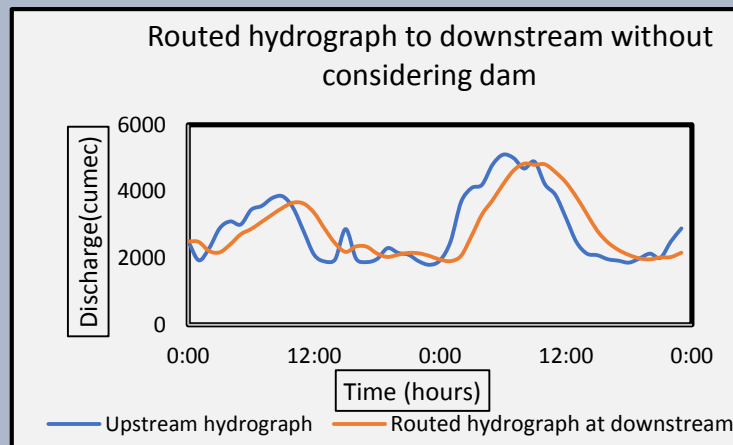
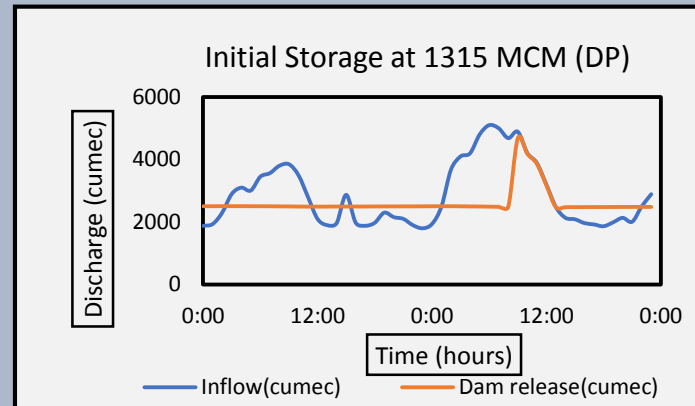
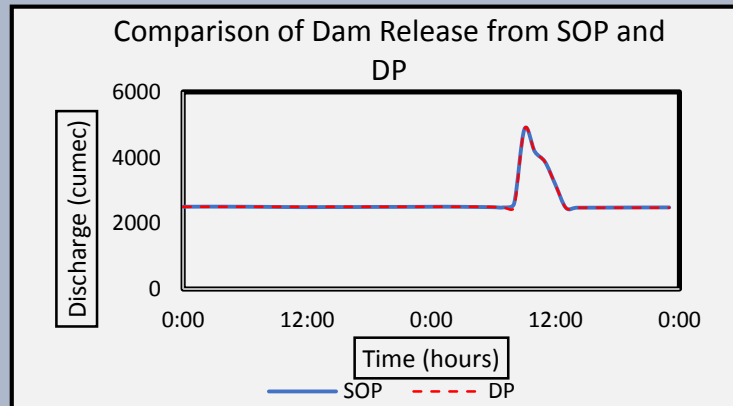
Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma

Indian Institute of Technology Guwahati
Assam, India

EGU21-8757

Results



- ❑ A typical hydrograph of 48 hours with two flood events has been used as inflow to the reservoir.
- ❑ Both the policies have generated similar hourly flow time series of total reservoir outflow
- ❑ Considering 1315MCM as the initial storage, the operating policy from the DP model has been employed to calculate the dam release.

Characterizing Dam Induced Flood at Downstream of a Hydel Project

Dipsikha Devi, Anupal Baruah, Arup Kr Sarma

Indian Institute of Technology Guwahati
Assam, India

EGU21-8757

Conclusions

- ☐ In natural condition without dam, flood rises gradually providing prior information and sufficient time for completing. pre-disaster actions based on experience.
- ☐ With inclusion of dam, peak flow rises vary rapidly from a very low flow without showing any indication of flood beforehand and thus flood becomes more disastrous.
- ☐ Sudden fluctuation of water level can also cause failure of river bank eventually leading to failure of embankments.
- ☐ The sudden release from the dam is also dependent on the initial storage of the reservoir.

Thank you for your attention