Headwater streamflow regime in the Garhwal Himalaya (India) severely disturbed after advanced forest degradation

Background

Springs and dry-season stream discharges in the Indian Lesser Himalaya have been declining for decades and both forest degradation/removal and tree planting have been blamed. About 80% of annual rainfall in the area falls during the main monsoon (June-September) rendering ecosystem water retention of paramount importance. This work compares the streamflow regime and stormflow response (2008–2011) for two headwater areas near Mussoorie (Uttarakhand) having equal geology (phyllites/dolomites) but contrasting land cover, viz. largely undisturbed (Arnigad, 286 ha) vs. heavily degraded (Bansigad, 191 ha) banj oak forest. Baseflow recession analysis suggested no deep leakage losses, thus allowing meaningful comparisons to be made between the two nearly adjacent catchments.

Dense oak forest in Arnigad catchment

Degraded oak forest in Bansigad catchment

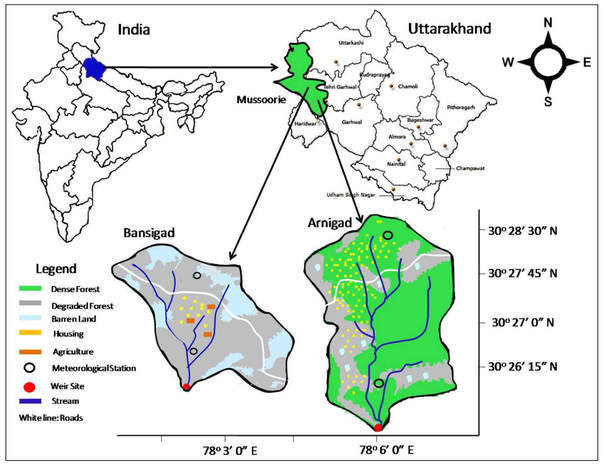

Figure 1: Study catchments

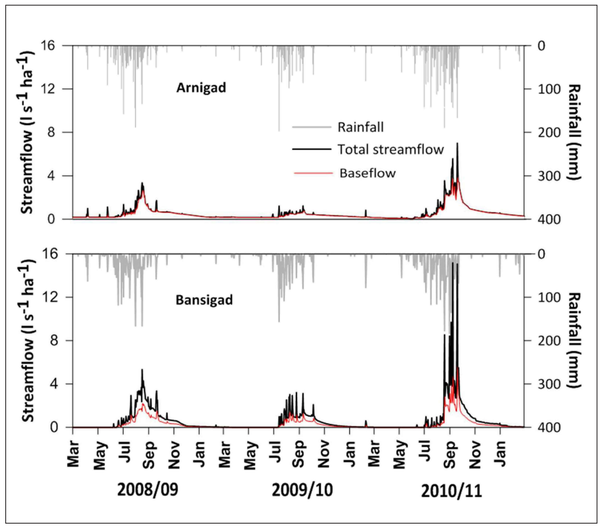

Figure 2: Seasonal flow regimes

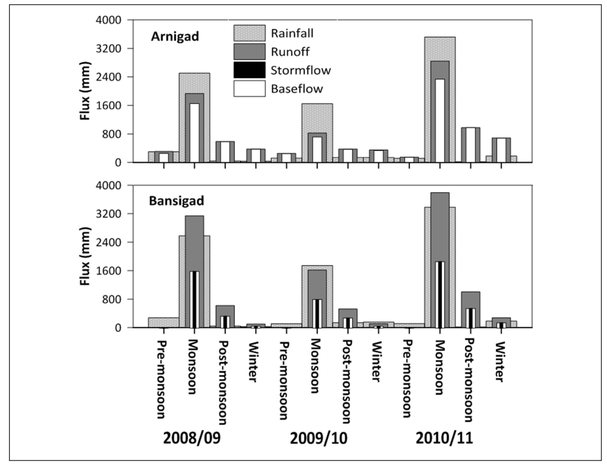

Figure 3: Seasonal runoff component totals

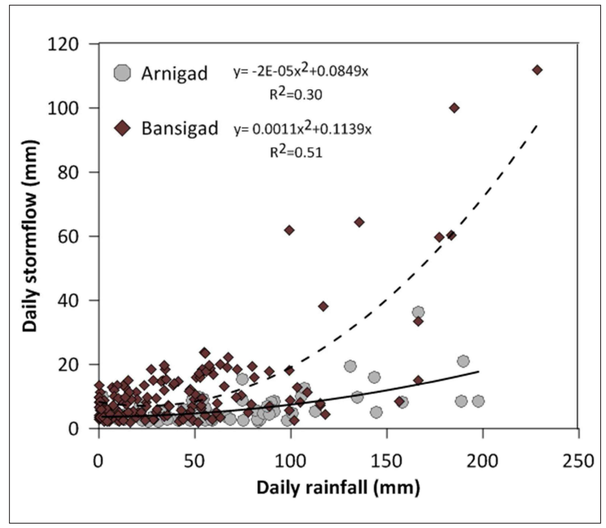

Figure 4: Contrasting stormflow response

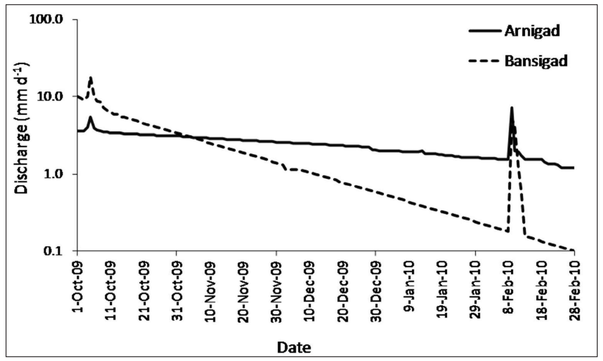

Figure 5: Contrasting baseflow recession

Conclusions

- Mean annual runoff coefficient for Arnigad forest = 54% (44–61%) vs. 62% (53–69%) for the degraded Bansigad forest.
- Stormflows were modest (8–11% of total runoff) and occurred mostly during the monsoon (78–98%) in the forested basin.
- Bansigad's stormflows were elevated (~49%) and occurred also during the post-monsoon season.
- Flow at Bansigad ceased in March but was perennial at Arnigad. Thus, maintaining infiltration after forest removal is key to sustained groundwater recharge.

Authors

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