

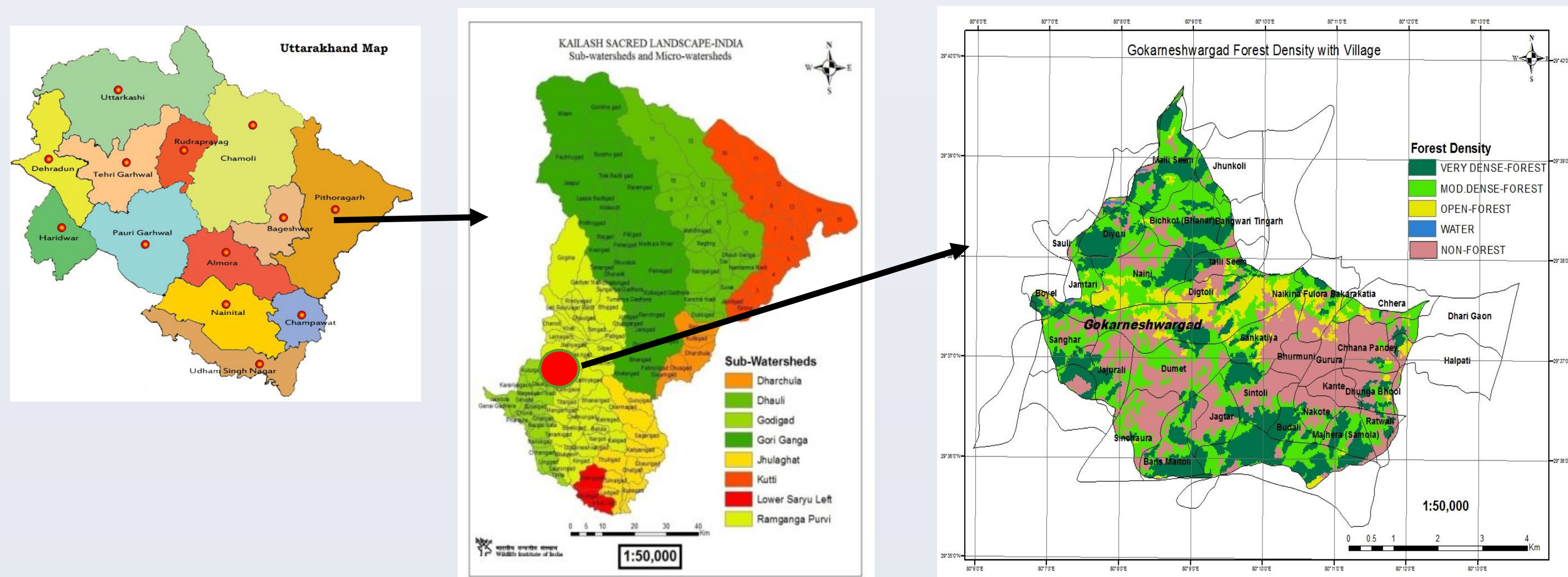
Plant invasion in the Himalaya: A case study of *Ageratina adenophora* in Kailash Sacred Landscape-India

Alka Chaudhary, B.S. Adhikari and G.S. Rawat



Introduction: Alien invasive plant species (AIPs) are those which become established in natural or semi-natural ecosystems or habitats, an agent of change, and threaten native biological diversity (IUCN, 2000). The plant diversity around the world is facing various threats and is reducing very rapidly (Dogra *et al.*, 2009). Biological invasion has become one of the major causes of economic and environmental damage. The Himalayan region, (biodiversity hotspot) is rapidly getting invaded by alien invasive species. The present study aims to understand the patterns of invasion by *Ageratina adenophora* in Pithoragarh district, Western Himalaya.

Location: Gokarneshwar Gad Micro-watershed (32 Km²) is located in Ramganga catchment of Pithoragarh district of Uttarakhand state, a part of Kailash Sacred Landscape.



Study Objectives:

- To model spatial distribution of selected plant invasive species using distribution modelling technique,
- To identify the patterns of invasion by *Ageratina adenophora* in Gokarneshwar Gad Micro-watershed- KSL and prediction of future spread for better management, and
- Experimental trials on eco-restoration of habitats.

Methodology:

- Intensive field surveys were conducted during January to April 2016 to record the cover and abundance of *Ageratina adenophora* covering forests, fallow lands, agricultural lands and grasslands.
- Participatory mapping of species specific, a rapid ecological assessment was carried out in 41 different patches 229 random quadrats (1x1m²) were laid in the identified patches and the density was calculated following Misra (1968).
- GLM, Maxent and Mahalanobis were used separately and their combined averaged model to predict potential distribution of the species in GIS domain. The environmental matrix variables considered were slope, distance from village, distance from road, distance from drainage, altitude, LULC and Aspect.

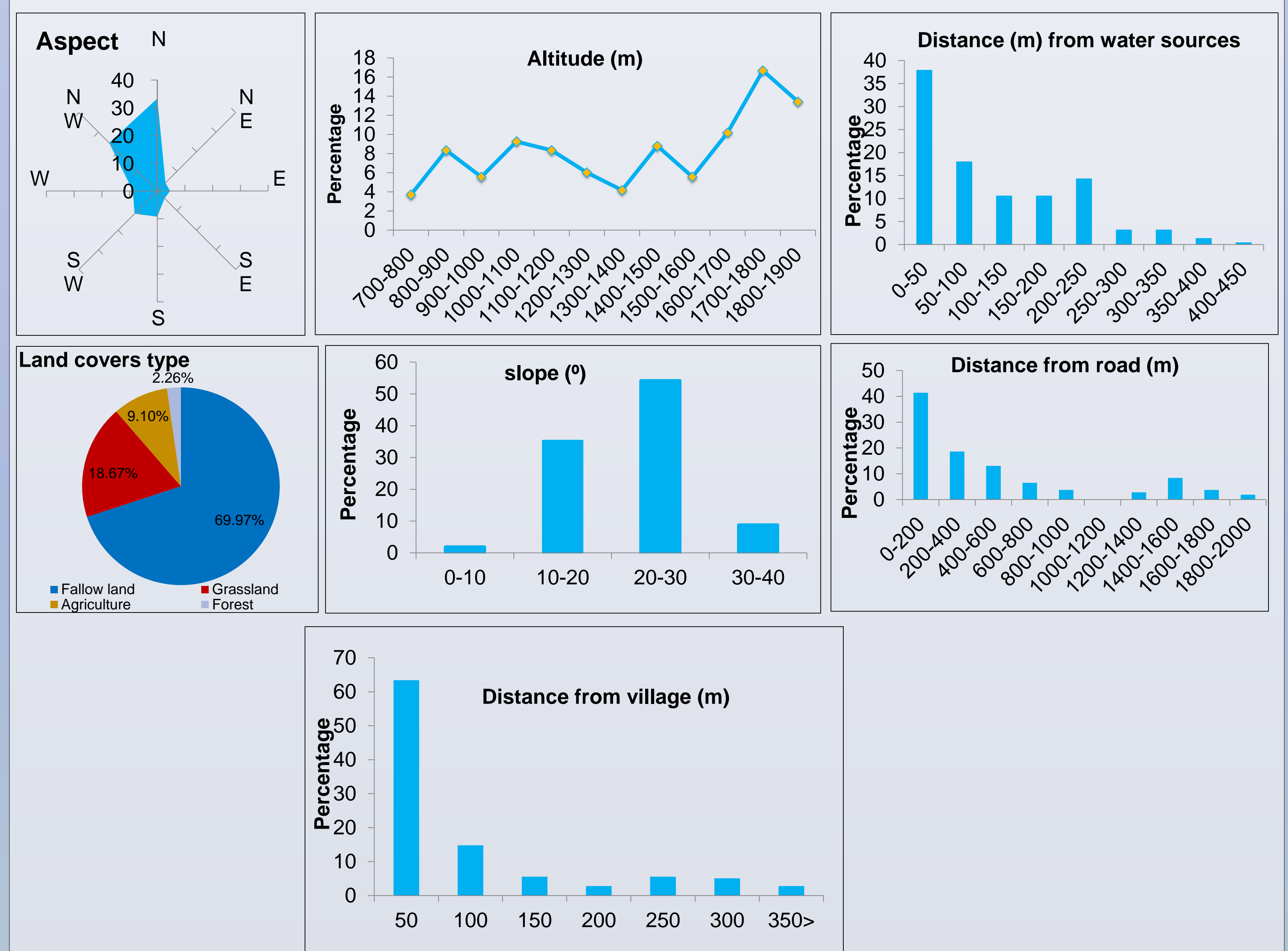


Awareness and restoration activity

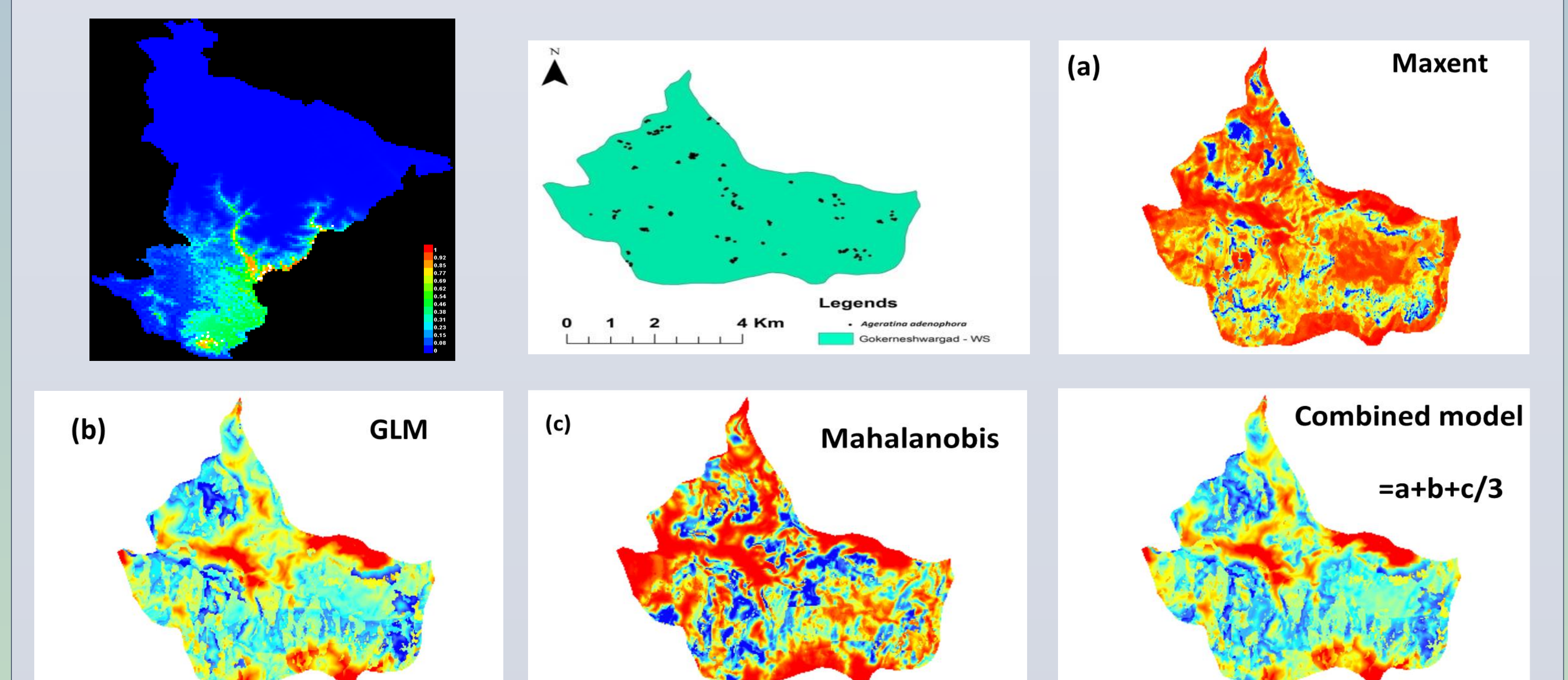
Results:

- The maximum density of *Ageratina adenophora* was 248 individuals m⁻² and minimum 96 individuals m⁻² in fallow land. In agriculture land the maximum density was 197 individuals m⁻² and minimum 71 individuals m⁻²
- The density was maximum (201 individuals m⁻²) and minimum (63 individuals m⁻²) in forest and the maximum area of invasion was recorded in fallow land (29950 m²) followed by agriculture (7993 m²), grassland (3895 m²) and forest (968 m²).
- The maximum presence of *Ageratina adenophora* was observed between 20° and 30° slope positions, whereas the highest invasion was in between 1700 – 1800m elevation in North (33%) facing slopes.
- Invasive plants have a major impact on catchment hydrology as *Ageratina adenophora* presence (82%) was recorded near most of the water bodies (secondary and tertiary tributaries) and abundance and occurrence of *Ageratina adenophora* was inversely proportional to the distance from village.

A. *adenophora* distribution with respect to different parameters



Distribution of *Ageratina adenophora* and probability distribution models



Probability of invasion is maximum (red areas) and minimum (blue areas)

Conclusion: Open areas were more vulnerable to invasion of Gokarneshwar gad watershed. The average model performance may not lose any place where there is high probability of invasion; therefore, the map can be used for risk mitigation enforcement by field managers

References:

- Adhikari, D., Tiwary R. and Barik, S.K. (2015). Modelling Hotspots for Invasive Alien Plants in India. PLoS ONE 10(7):1-20, e0134665. Doi: 10.1371/journal.pone.0134665.
- Dogra, K.S., Kohli, R.K. and Sood, S.K. (2009). An assessment and impact of three invasive species in the Shivalik hills of Himachal Pradesh, India. *International Journal of Biodiversity and Conservation*, 1(1): 4-10.
- IUCN Report (2013). Impact Assessment of Invasive Plant Species in Selected Ecosystems of Bhadaure Tamagi VDC, Kaski. An Ecosystem-based Adaptation in Mountain Ecosystem in Nepal. Pp 1-66. Retrieved on: 01/01/2016