

Identifying spatial priority areas of ecosystem services in the Western Himalayan Urban Landscapes



Co-funded by the
Erasmus+ Programme
of the European Union

Abstract

The Himalayas provide multiple Ecosystem Services (ESs) to support human well-being. The relatively new, yet proportionally extensive urban growth in fragile landscapes of Himalaya is affecting crucial ecological processes and their subsequent ecosystem functions-services. To guide future urban land-use decisions, we have adopted ESs framework for identifying ESs bundles in two rapidly urbanizing landscapes, Dharamsala and Pithoragarh, of western Himalaya. We mapped four key physical regulating ESs (flood regulation, soil erosion control, carbon sequestration, and local climate regulation) for year 2019 and identified spatial priority areas for all four services through cluster analysis.

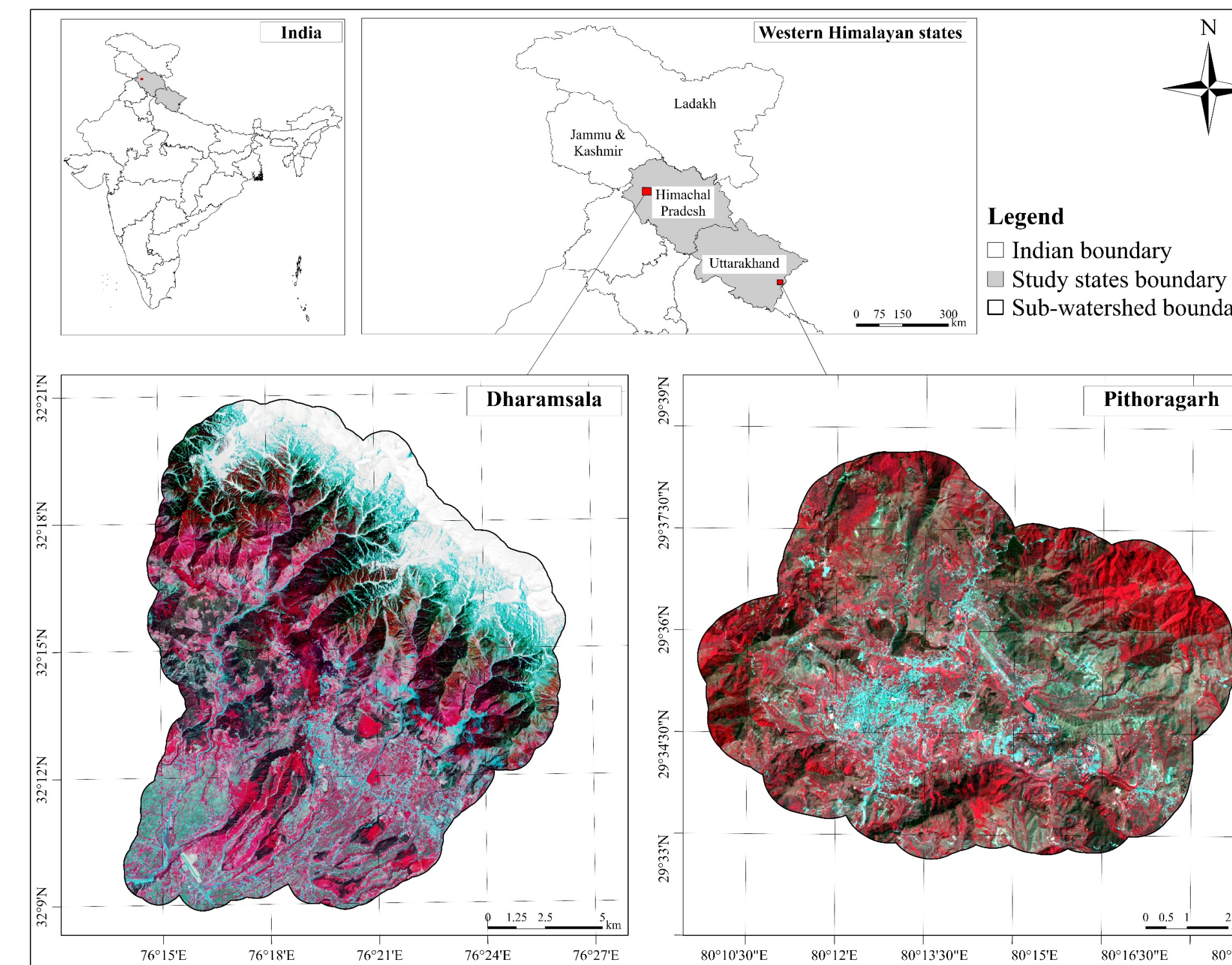
Introduction

- The unplanned and unregulated urban developments keep key ecological processes of natural and semi-natural land units under constant pressure and irreversible threats of loss.
- For designing any sustainable and resilient urban landscape under the umbrella of Nature-based Solutions (NbS), ESs play foundational and crucial roles.
- ESs bundles represent the multi-functional units of any landscape, a feature that is often referred as distinctive and preferred trait of NbS, and are priority conservation sites for sustainable functioning of that landscape.

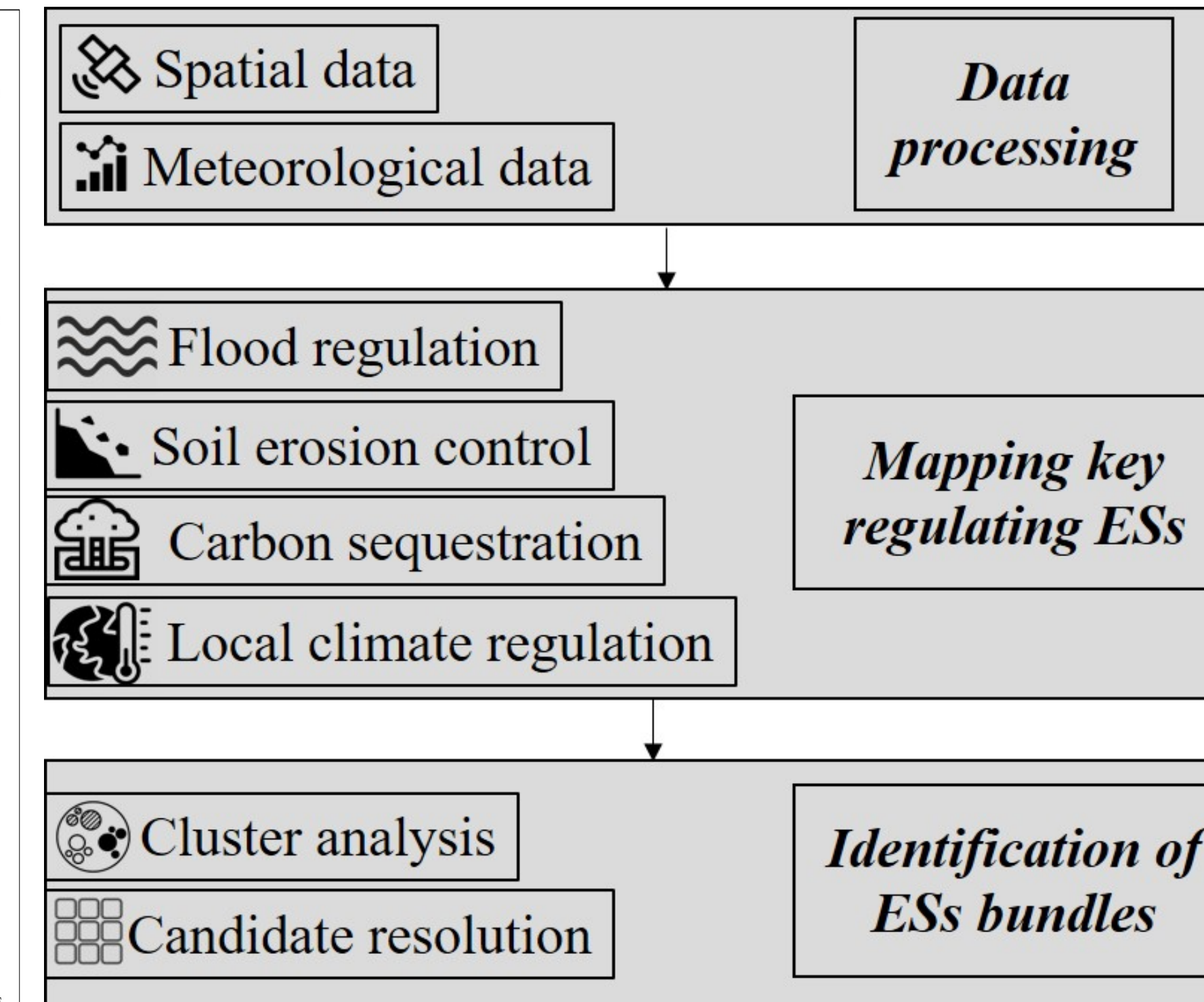
Aims

- Identification over-performing and under-performing multiple-ESs supply areas.
- Identifying the ESs supply bundles for evidently guiding future losses of key physical regulating ESs in two rapidly urbanizing landscapes of western Himalayan.

Study sites and methodology

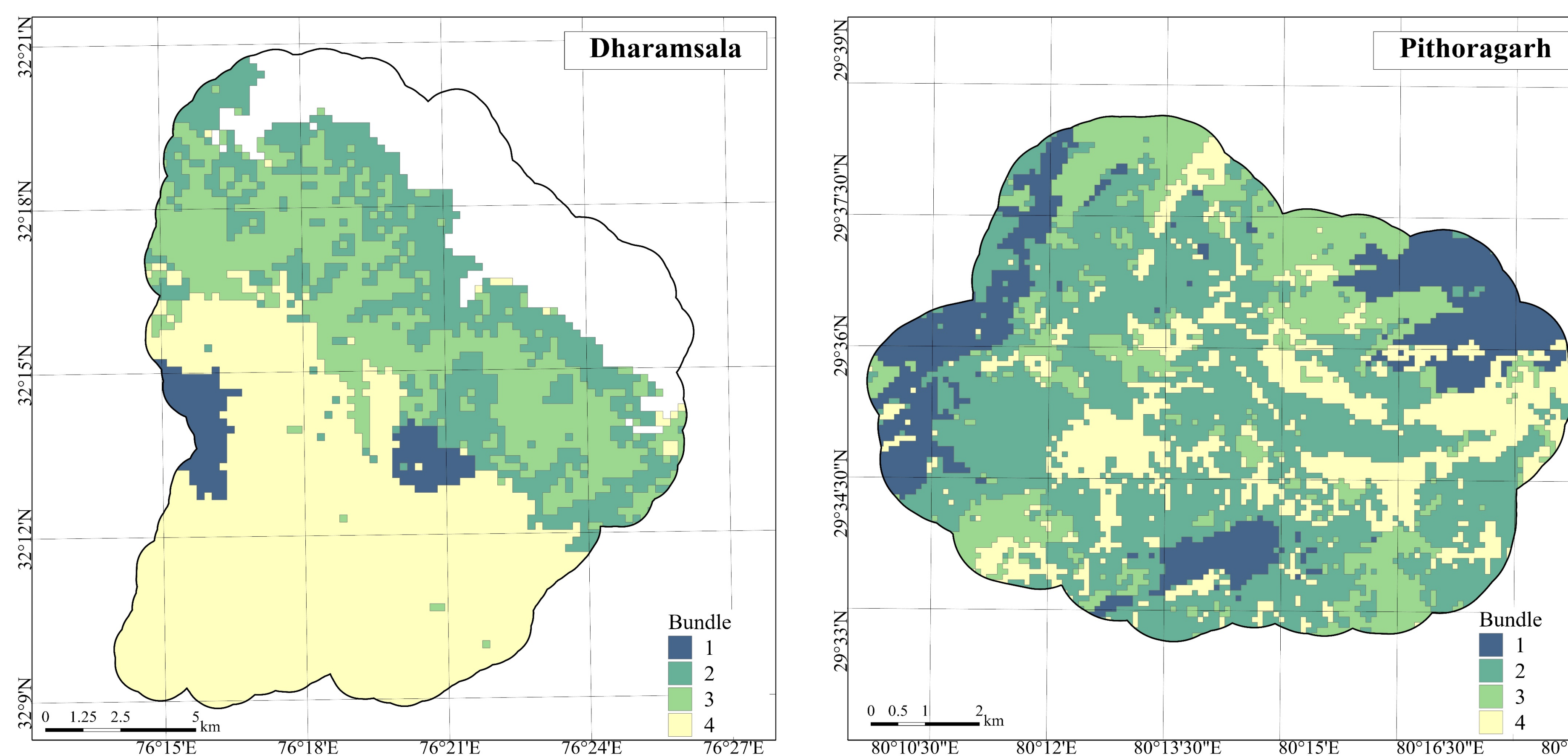


Location of selected urban landscapes in Indian western Himalayan states (row 1) and Sentinel 2a satellite image of study sites- Dharamsala and Pithoragarh (row 2).



Flowchart of methodology followed for the present study.

Results



Spatial distribution of ESs bundles in Dharamsala and Pithoragarh for year 2019.

- Bundle 2 (dominated by cropland and forest) covers majority of study site and have highest value for all four ESs in Pithoragarh.
- Similarly, bundle 1 (dominated by forest) is minor component of study site but is highly relevant for three ESs: flood regulation, soil erosion control and carbon sequestration.
- For global scale ES (*carbon sequestration*) bundle 2 in Pithoragarh while bundle 3 (dominated by oak forest) in Dharamsala gives most of the contribution.
- For local scale ESs, bundle 2 & 3 play highly important role in Pithoragarh while for Dharamsala bundle 1 & 3 are playing crucial roles.

On-going PhD

Conclusion

- Amount and type of ESs varies considerably in each bundle.
- Multi-functionally bundles (bundle 1 in Dharamsala and bundle 2 in Pithoragarh) are exceptionally crucial for sustainable functioning of respective landscape.
- Future land use decisions need to design NbS based on these nature based indicators for prolonged functional and sustainable development of landscape.
- For e.g., In Pithoragarh the most probable neighbourhood for future urban growth is bundle 1, therefore, future urban land use decisions should be informed for implementing NbS along with development.

References

- Almenar, J. B., Elliot, T., Rugani, B., Philippe, B., Gutierrez, T. N., Sonnemann, G., & Geneletti, D. (2021). Nexus between nature-based solutions, ecosystem services and urban challenges. *Land use policy*, **100**, 104898.
- Meacham, M., Norström, A. V., Peterson, G. D., Andersson, E., Bennett, E. M., Biggs, R., Crouzat, E., Cord, A.F., Enfors, E., Felipe-Lucia, M., Fischer, J., Hamann, M., Jacobs, S., Lavorel, S., Locatelli, B., Martín-López, B., Plieninger, T & Queiroz, C. (2022). Advancing research on ecosystem service bundles for comparative assessments and synthesis. *Ecosystems and People*, **18**(1), 99-111.
- Pan, H., Page, J., Cong, C., Barthel, S., & Kalantari, Z. (2021). How ecosystems services drive urban growth: Integrating nature-based solutions. *Anthropocene*, **35**, 100297.