Linking sustainable land management with biodiversity conservation in Nepal

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Land degradation and biodiversity loss are important environmental challenges that directly affect human livelihoods and development (ELD Initiative 2015; IPBES 2018). Despite both being mentioned in the Sustainable Development Goals under goal 15 'Life on Land' (UNGA, 2015), in practice they are often dealt with separately (Akhtar-Schuster *et al.*, 2017). Little research has considered how efforts to move towards sustainable land management and restore degraded areas impact upon biodiversity. Similarly sparse consideration has been given to how biodiversity conservation could affect the ways in which land is managed and the implications it has for livelihoods and human development (Stringer *et al.*, 2009). The broad assumption is that making progress towards SDG 15 can deliver multiple environmental and development benefits, contributing to climate change mitigation and adaptation, biodiversity conservation, ecosystem restoration, food and water security, disaster risk reduction and poverty alleviation. Empirical data that tests this assumption is nevertheless lacking.

Countries around the world are currently identifying land degradation hotspots in which they aim to avoid, reduce and reverse degradation. Yet, whether these areas align with high biodiversity areas is not known, and whether the kinds of agronomic, vegetative, structural and management measures being used to tackle degradation can deliver co-benefits for biodiversity conservation has not been assessed. The reverse is also in need of research attention: in-situ methods of biodiversity conservation that tackle specific threats such as e.g. invasive species, species loss and habitat loss may present routes to improve land quality. Such assumed co-benefits need rigorous scientific assessment.

Figure 1: Nepal is home to a number of threatened species source: http://www.wwfnepal.org/what_we_do/wildlife/

For example, measures to avoid, reduce and reverse land degradation in agricultural areas often involve taking land out of direct agricultural production through agro-forestry, vegetative strips, terracing etc. Understanding about the socio-economic benefits of such sustainable land management practices is growing (e.g. Dallimer *et al.*, 2018). However, whether there are similar gains for biodiversity (either within the farmed landscape, or through sparing the conversion of non-farmed habitats) is unclear. Similarly, we understand little of how the intended benefits of sustainable land management approaches, such as erosion control,

improved water retention or enhanced soil fertility increase, might co-occur with other benefits, such as more biodiverse landscapes or improved ecosystem functions and ecosystem service provision.

Pressures on land and biodiversity are particularly acute in South Asia. This region hosts a quarter of the world's population (1.6 billion people) on just 3% of the planet's land area. The region is home to around 40% of the world's poor, with approximately 51% of the population living without sufficient food and energy (Ahmed *et al*., 2007). Much of South Asia is mountainous, with its population highly dependent on the natural resource base for their livelihood.

Against this backdrop, this project focuses specifically on Nepal, where considerable land degradation and biodiversity loss is driven by changing land use patterns, land cover changes, and inappropriate human behaviours (e.g. poaching and illegal trade of species). Such challenges further endanger globally threatened wildlife species including mammals such as the Bengal tiger, greater one-horned rhinoceros, Asian elephant, snow leopard, red panda and musk deer.

Nepal has a wide range of climatic conditions across its five main physiographic zones. The country is located in a biodiversity hotspot transition area comprising six floristic regions, and presents extreme variations in altitude within a very short lateral distance (Figure 1). As populations grow and land use changes continue (especially as urban areas grow in their extent), understanding how the problems of land degradation and biodiversity loss can be tackled in ways that are synergistic and support livelihoods and development becomes paramount.

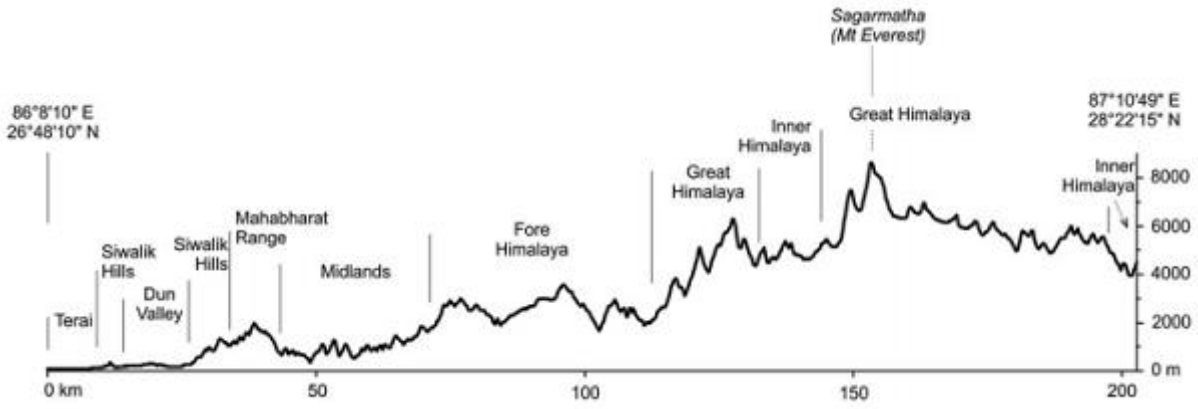

Figure 2: profile of the Himalaya through east Nepal and position of physiographic regions (generated from the SRTM DEM; Source: Dhital, 2015: p26)

Analyses in the literature identify several drivers of land degradation and biodiversity loss. Forests have been converted for inappropriate agricultural use leading to fragmentation and encroachment; rangelands are experiencing excessive livestock grazing, reducing the abundance of palatable species; and biomass is being lost leaving soils open to erosion. Impacts of this degradation and subsequent changes to biodiversity are experienced both in the degradation sites themselves and more widely, affecting people's abilities to meet basic food, water and energy needs (Rasul, 2016). Measures to tackle some of these pressures are nevertheless being taken and include e.g. establishment of local forest user groups to strengthen local governance of natural resource management; revival of traditional rangeland

management systems involving rotational grazing and fines for those grazing outside their designated village grazing areas; establishment of biological corridors and refugia to link protected areas; enhanced anti-poaching operations; and livelihood improvement interventions particularly in natural resource dependent communities. The co-benefits of these interventions are nevertheless poorly understood.

Aim

This project takes a systems approach and aims to deepen understanding of the ways in which efforts to tackle land degradation and biodiversity loss can be mutually supportive.

Focus could be placed on land degradation hotspots identified by the Nepal Government as target areas in which they seek to prevent, reduce and reverse degradation under voluntary commitments to the United Nations Convention to Combat Desertification and efforts to address SDG 15, or areas designated for biodiversity conservation. The student will explore the trade-offs between biodiversity conservation and sustainable land management/restoration, considering the on- and off-site implications for livelihoods.

Depending on the interests of the student, the project could contribute to debates around resilience/vulnerability, specific conservation approaches such as land sharing/sparing or sustainable use, and could inform understanding of conservation and development relationships. Taxonomic groups of focus can match the student's interests. The project offers the chance for the student to make an important empirical contribution to the research literature, while also shedding light on the key variables that should be assessed to monitor relationships between sustainable land management and biodiversity conservation. A methodological contribution to knowledge is therefore also envisaged.

According to the interests and expertise of the student the project could combine approaches such as:

1. Carrying out an integrated land-use change assessment (e.g. Dallimer et al. 2009; Stringer and Harris 2014) over time using satellite imagery.
2. Mapping and analysing livelihoods and ecosystem service relations and vulnerabilities in areas of different degradation and biodiversity status, with different kinds of interventions;
3. Establishing links between sustainable land management practices, the provision of food, water and energy, the abundance and resilience of those ecosystem services and the role of biodiversity therein;
4. Ecosystem service valuation (including biodiversity values), potentially using both monetary and non-monetary approaches both for the present day, and through time (e.g. Favretto et al. 2016);
5. Quantifying and modelling feedbacks between land management and conservation decision making in different agro-ecological zones (e.g. Fleskens et al., 2014);
6. Participatory scenario development and environmental management decision-making exercises (e.g. Reed et al., 2011; Stringer et al., 2014) identifying what affects the adoption and disadoption of particular land management practices that can contribute positively towards biodiversity conservation.

Potential for high impact outcome

Tackling land degradation and biodiversity loss in ways that are mutually supportive and coherent is a critical challenge, particularly for poor communities in developing countries who depend heavily on the natural resource base. The research topic has relevance for both environmental management and poverty alleviation/development policy audiences in Nepal and the wider South Asia region, as well as for donor countries such as the UK. We expect the student to generate several research papers for submission to high impact, interdisciplinary journals and to deliver other outputs as appropriate in formats relevant to non-academic audiences (briefing notes, blog posts) that can enhance the policy uptake and societal impact of the findings.

Training

The student will work primarily under the supervision of Prof. Lindsay Stringer and Dr. Martin Dallimer within the Sustainability Research Institute's Environment and Development research group. Co-supervision and field support in Nepal will be provided by Dr Moti Rijal at Tribhuvan University. We anticipate that the student would spend 6-9 months undertaking primary data collection in Nepal following a successful transfer viva.

This project provides interdisciplinary training in: (i) environmental systems and livelihoods approaches; (ii) use and application of GIS and remote sensing; (iii) qualitative social science methods; and (iv) ecosystem service assessment. The PhD student will have access to a range of different Faculty training opportunities, including workshops on participatory research methods, GIS, SPSS and the use of other research methods and analysis methods, as well as non-technical training sessions on 'managing your supervisors', and 'preparing for your viva'. A training needs assessment undertaken at the start of the PhD will ensure that opportunities are tailored to the student's specific requirements.

Student profile

The student should have a strong interest in systems approaches, sustainability and interdisciplinarity, a solid background in an environmental discipline (environmental sciences, geography, conservation, ecology, sustainability science), experience in applying both qualitative and quantitative research and analysis methods and ideally some familiarity with GIS and remote sensing. The student must be prepared to travel to remote mountainous locations and spend time collecting primary data in Nepal.

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Related undergraduate subjects:

- Ecology
- Environmental conservation
- Environmental management
- Environmental policy
- Environmental science
- Geography
- Natural resource management
- Remote sensing
- Sustainability
- Sustainability and environmental management