

# RGS-IBG Field Research Programmes

Royal  
Geographical  
Society

with IBG

Advancing geography  
and geographical learning

- Middle Hills Project
- Central & Western Nepal
- 1991-1999

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The sensible and sustainable use of land, water and soil resources is essential to the future development of Nepal. This joint project aims to aid soil and water resource management at the catchment and hillslope scale by providing a greater understanding in Phase 1 (1991-1995) of soil erosion, land failure, hydrological changes and regimes, and water quality. Emphasis was on quantitative assessment of environmental parameters. The basis of this phase was an integrated analysis of the hydrological, geomorphological, sedimentological, biological and agricultural systems operating in selected river basins. Phase 2 (1996-1999) concentrates specifically on understanding nutrient losses from erosion and leaching on rainfed agricultural land, on which the poorest farmers depend for their livelihoods.

Organised by the Royal Geographical Society (with the Institute of British Geographers) in participation with the Lumle Agricultural Research Centre and the Soil Science Division of the National Agricultural Research Institute, Nepal.

**Phase 1:** Jointly organised in the UK by the Institute of Hydrology and Queen Mary and Westfield College, London University)

*Directors:* Dr Rita Gardner, RGS-IBG & Dr Alan Jenkins, Institute of Hydrology

*Scientific Programme Directors:*

*Socio-economics:* Prof. Piers Blaikie, UEA

*Landslides:* Dr John Gerrard, University of Birmingham

*Catchment Hydrology:* Dr Keith Richard, University of Cambridge

*Subsurface hydrology:* Prof. John Thornes, KCL

*Water pollution:* Dr Alan Jenkins, IH

*Aquatic ecology:* Dr Steve Ormerod

*Soil erosion:* Dr Rita Gardner

Number of members: 25 Duration: April 1991- April 1995.

**Phase 2:** *Directors:* Dr Rita Gardner, RGS-IBG & Dr Paul Harding, LARC, Nepal

*Field programme co-ordinators:* Kevin Mawdesley, QMW, London

Dr B Tripathi, LARC, Nepal and R.B. Maskey, NARC, Nepal

Number of members, including field staff: 16

Duration: May 1996 - April 1999

The Nepal project was established as a long term monitoring programme within an area vulnerable

to environmental degradation. Increasing population pressures within the Himalayas has led

to the expansion of its agricultural area. The resulting pressure on already delicate hillslope environments disrupts natural systems operating within the region and makes the area vulnerable to accelerated environmental damage, such as soil erosion and reduction in water quality.

Increasing land clearance and deforestation had been assumed in the 1980's to lead to a rapid loss of topsoil, causing productivity to fall and furthering the need for agricultural expansion. Damaging knock-on effects potentially include: increased flood risk during monsoons; reduction in winter stream flows for irrigation; greater erosion and gullying; increased suspended sediment within rivers; declining water quality; changes within aquatic biology. Further disruption and degradation can be caused through the human response to the situation, with widespread and heavy applications of soil dressings causing the leaching out of minerals and a further decline in water quality. The project was initially designed to provide a scientific assessment of the existence and seriousness of these supposed problems.

In Phase 1 the Likhu Khola catchment, Nepal, (in the Middle Hills region in the north of the Kathmandu Valley), was chosen as an example of a watershed within the southern Himalayas in which these processes could be examined and quantified by an interdisciplinary project team. Based on the data collected the team also hoped to gain greater insights into human/environment interaction and to develop models of the environment that could be used not only to assess future management strategies within the Likhu Khola but also more widely in the region. Such understanding is necessary to underpin future sustainable development. The primary objectives were:

- to compare the hydrological response of catchments with different land uses.
- to characterise the quality of surface waters and to determine the effects of agricultural land use on water quality.

- to initiate long term biological and water quality monitoring stations for the detection of changes in environmental quality and ecosystem change, and to establish relationships between land use, biological indicators and water quality.
- to examine processes and rates of soil erosion and gully development under different land uses.
- to examine subsurface hydrology and its association with land failure.
- to examine distribution causes and consequences of landslides.
- to assess local farmers perception of, and interaction with, their local environment, and its degradation.

The methodology was based on five subcatchments, with areas from 2-4 km sq., that differed in terms of aspect (north and south facing slopes) and land uses. A control site was largely forested. At each site water levels were recorded and converted to flows using stage-discharge relationships based on spot gauging. In addition to flow measurements, rainfall, pH, conductivity and temperature were also monitored. Weekly samples of rainfall and stream water were collected at the same sites for chemical analysis. At another two sites automatic weather stations were installed, at which a variety of meteorological data were measured; raingauges were located at a further four sites in association with erosion studies. Twenty four erosion plots on all major landuse, five gully sites and four subsurface hydrology plots were established and over 1400 storms monitored. The incidence of landsliding was monitored throughout the study.

At the end of Phase 1 the conclusion reached was that despite the potential for damaging side effects from increased agricultural activity, the threats were largely controlled by environmentally intelligent practices already established by local farmers. However, some areas were found to be

under serious threat of degradation; particularly in the most agriculturally marginal areas inhabited by the poorest of farmers. Through working with these communities in the Likhu Khola catchment area and on the basis of the data sets, a series of management recommendations were suggested which sought to complement present practices and limit further degradation.

**Participating Organisations:** Birmingham University, Institute of Hydrology, Kings College, London, Queen Mary and Westfield College, London, Royal Geographical Society, University of Wales, University of East Anglia, University of Cambridge, Soil Science Division NARI, Groundwater Project, Dept. of Hydrology and Meteorology, Nepal Agricultural Research Council.

**Major funders included:**

UK Government's Overseas Development Administration, with sponsorship from Land Rover.

Leading on from Phase 1 which identified the most susceptible areas in terms of soil loss within the limited Likhu catchment, Phase 2 is specifically designed to gain further understanding of the nutrient losses from susceptible rainfed agricultural lands. This includes nutrient loss associated with surface runoff, particulate erosion, and subsurface leaching. The studies are being undertaken in 8 farming systems within the Central and Western Middle Hills that are thought to be representative of the range of different terrace-based farming systems in this densely populated and cultivated area. The scientific base of the project is Lumle Agricultural Research Centre close to Pokhara. The ultimate aim of the programme is to improve the livelihoods of those farming rainfed lands by working with farmers to reduce soil nutrient losses on highly susceptible land.

The first part of this is to understand which combinations of physical, land systems and farmer socio-economic characteristics lead to high nutrient losses and by which routes, and to assess

the seriousness of the losses for medium term sustainability of the rainfed agricultural land. The project will also define a farmer-based methodology that can be used more widely to assess susceptibility. These will enable the identification of priority areas with high nutrient losses that are in need of improved soil conservation and fertility management.

A detailed programme of field monitoring in each location is based around both semi-quantitative recording of changes in soil surface topography and surface soil physical properties on over 330 different terraces, supplemented by quantitative daily monitoring of runoff, erosion, infiltration and nutrient losses at each of 24 erosion plots. Longer term patterns of erosion loss of topsoil at the hillslope scale are being assessed using <sup>137</sup>Cs methods.

**Participating Organisations:** RGS-IBG; Queen Mary & Westfield College, University of London; Lumle Agricultural Research Centre, Nepal; Soil Science Division of the National Agricultural Research Council, Nepal.

**Major funders include:**

UK Government's Department for International Development (DfID); Kadoorie Foundation; Leverhulme Trust; and sponsorship from Land Rover.

**Further reading:**

Gardner, R. & Jenkins, A. (1995) **Land use, soil conservation and water resource management in the Nepal Middle Hills**. Final Report for the Soil Science Division, Institute of Hydrology and Royal Geographical Society joint research programme. 650pp.

Institute of Hydrology/Royal Geographical Society (1995) **Land use, soil conservation and water resource management in the Nepal Middle Hills**. 13pp. colour illustrations and maps. ISBN 0 9458540 72 9.

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*Himalayan crisis - a re-evaluation*.  
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### PhD Theses

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- Brasington, James, (1995) Hydrological modelling in the Likhu Khola basin, Nepal. University of Cambridge.
- Curtis, Adam, (1996) Quaternary geochronology and environmental history in the Kathmandu basin, Nepal. University of London.

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Gerrard, J. & Gardner, R. Landslides in the Likhu Khola Basin.

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Wu, K. Measurement of soil moisture in weathered soils using a capacitance probe (to be submitted to Hydrological Processes)

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#### **Other Reports**

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