NATIONAL SEMINAR ON
PERSPECTIVES OF HIMALAYAN ENVIRONMENT

OCTOBER 30, 2010

Souvenir with Abstracts

ORGANISED BY

HIMALAYA SAMIKSHA PARISHAD

IN COLLABORATION WITH

DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF CALCUTTA; NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION; NETAJI INSTITUTE FOR ASIAN STUDIES, KOLKATA; DEPARTMENT OF FOREST, GOVT. OF WEST BENGAL

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S. P. Chatterjee Memorial Hall
Department of Geography, University of Calcutta
35, Ballygunj Circular Road
Kolkata 700019

IN COLLABORATION WITH

Department of Geography, University of Calcutta
National Atlas and Thematic Mapping Organisation
Netaji Institute for Asian Studies, Kolkata
Department of Forest, Government of West Bengal

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Contact:
Himalaya Samiksha Parishad
Room # 527 : Department of Geography
Ballygunj Science College
35 Ballygunj Circular Road
Kolkata 700019
e-mail: himparishad@gmail.com

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Preamble

The *Himalaya Samiksha Parishad* is an academic organisation playing a significant role as a resource centre for disseminating information about the Himalayas.

The *Parishad* was set up in 1976. At present the organisation has a wide base with members from different walks of life. Scholars from disciplines like anthropology, geography, botany and zoology take active part in its activities.

The National Seminar on Perspectives of Himalayan Environment aims to provide a stimulative platform to discuss and exchange ideas on various aspects of the Himalaya.

The Himalaya is a unique environment. The majesty and splendour of the Himalaya have captivated people from all over the world. Its impact on the physical, political and socio-cultural environment of the Indian sub-continent is immense. The fragile and unstable environment of the Himalaya is prone to natural hazards. It has also not been exempted from the influence of developmental activities, which has seriously affected its environs.

The *Himalaya Samiksha Parishad* feels that a better understanding of the Himalaya—its geographical and geo-political influence as well as man-nature relationship—would go a long way in understanding the present problems of the region.

~ Seminar Organising Committee

KEYNOTE ADDRESS

RESOURCE APPRAISAL AND ENVIRONMENTAL CHALLENGES IN HIMALAYA: POSSIBLE ROLE OF GEOINFORMATICS

Prithvish Nag

Director, National Atlas and Thematic Mapping Organisation, Kolkata

Himalayan mountain region harbours unique ecosystems. Many varieties of plants and animals have originated in the mountains. Mountain people cultivate many lesser-known crops and medicinal plants. This biodiversity is of immense value for the future. The mountains also provide scenic beauty and recreation. Mountain areas are considered to be the abode of Gods and Goddesses and have an important place in religion and mythology. A healthy mountain environment, besides being prosperous themselves, also keep the rivers originating from it, healthy.

A healthy watershed upstream helps to regulate the hydrological regime downstream. The benefits of fresh water and clean energy that mountains can provide downstream, requires good management of the catchment. Therefore, maintaining the health of mountain area is important for the economy, ecology and environment, locally and globally. Mountain ecosystems are fragile. They are susceptible to soil erosion, landslides and loss of genetic diversity.

Indian Himalayan region

The Indian Himalayan Region has an area of 5, 31,250 km square, which is about 16% of India's total geographical area. It is spread over the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, and the seven sister states of the NE region i.e. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Himalaya in Indian territory extends all along the northern border of the country from the eastern border of Pakistan on the west to frontiers of Myanmar in the east having a total length of about 2,500 km.

Glaciers cover a large portion of the Himalaya. Glaciers play an important role in the hydrology of the rivers.

The Himalayas are known for their tremendous biodiversity. The variety of vegetation found in the region, from tropical rainforests to alpine and sub-alpine forests, is truly breathtaking.

The Himalayas are also indispensable to India for providing assured fresh water supplies. The two largest Himalayan rivers, the Ganges and the Brahmaputra, along with their tributaries, comprise the third largest water resource in the world

after the Amazon and the Congo-Zaire river systems.

Hydro-electric power potential is rich in Himalayan region. The need is to harness through ecologically sound methods and supply to local population to reduce their dependence on fuel-wood for cooking and heating.

Tourism is increasingly recogni sed as one of the most important sectors of the global economy. Tourism sector can help us preserve our natural and cultural environments, leading to sustainable development at many levels.

Besides tourism, mountaineering and trekking have become increasingly popular as mountain sports. A large number of peaks for climbers and trails for trekkers have been opened up for such expeditions. These adventure expeditions provide a boost to the local socio-economic scenario and help to populari se the sport. Often, these are sources of valuable foreign exchange.

Himalayas are tectonically active and structurally unstable due to which earthquakes pose the greatest threat to the Himalayan region. Almost the entire Himalayan region is prone to high seismic activity.

Geospatial information, including maps and images, are vital to support decision making and management of earth's resources at various levels and implementation of action plans. With the availability of space borne imagery, GPS data and GIS technology, users are now able to process maps – both individually and along with tabular data, crunch them together to provide a new perception – the spatial visualisation of information.

Survey of India (SOI) provides national level maps and Geographical Information System to support various activities related to expeditious and integrated development so that all resources contribute their full measure to the progress, prosperity and security of the country. The geodetic and geophysical measurements are made for entire country, which forms the basis for ongoing global research to predict earthquakes and other natural / man-made disasters. Maps on various scales are being prepared in the department, which show natural and manmade features and also elevations through detailed contours. These maps could be of immense help in post disaster recovery and rescue operations.

Technological trends: **Surveying & mapping – Tools for management planning**

In the modern scientific term, Geomatic is referring to the integrated approach of measurement, analyses, management, storage and display of the description and location of earth based data, often termed spatial data. These data came from many sources including satellites, air and sea borne sensors and ground based instruments: It is processed and manipulated with state-of-the-art information

technology using computer software and hardware. It has applications in all disciplines which depend on spatial data, including environmental studies, planning, engineering, navigation, geology, geophysics, oceanography, land development, land ownership and forest management. It is fundamental to all the geoscience disciplines, which use spatially related data.

At present we are in the midst of an information explosion, particularly from our surrounding physical environment. Remote Sensing now can obtain spatial information in high-resolution imageries (less than 1 metre). Analysis and processing of large volume of information have been made possible by the rapid advancement in the computer-aided technology. Users of topographical map data as base map have reali sed the potential of digital topographical databases to improve the production of various themes and management of environmental data etc. The geoinformatics i.e. cartographic data can be visuali sed as an information science performing a service function to a wide range of other disciplines like geology, meteorology, ecology, demography, geography, oceanography etc.

The growing demand for economic well being and for better quality of life has put stress on the management of resources. Therefore, the resource management has to be supported by an effective decision support system, which in turn requires timely and high quality spatial information.

The science of surveying and mapping encompasses a broad range of disciplines including surveying and mapping, remote sensing, Geographic Information System (GIS) and the Global Positioning System (GPS). GIS is powerful system for decision-making tool is now in the hand of cartographers. Beginning with a computeri sed topographic map as its base, a GIS overlays and integrate graphic and textual information from separate database. The end result is a customi sed and reliable tool that can support decision making and problem solving and provides almost instantaneous answers to complex questions.

Cartography for water management

Cartographic data in the form of maps, charts, atlases, digital data, GIS and other form of geospatial data for designing and construction of various hydro electric and irrigation schemes are the prime requirements for effective management of water resources.

Management of water resources is critical in Indian agriculture because more than 70 per cent of cultivated area needs rainfall. Excess of water or lack of water during critical crop growth stages severely affects crop yield. Therefore, management of water resources requires regular monitoring and inventory of surface and ground water potential.

Survey of India (SOI) provides national level maps and Geographical Information System (GIS) to support various activities. Maps on various scales are being prepared in the department which show feature like natural, manmade and elevation in the form of contours etc. These maps could be of immense help in water management and developmental activities.

Flood and drainage can best be managed by drawing block level plans through large-scale maps. Survey of India provides special maps on scale 1:15,000 in some selected areas. Indo Ganga plains in U.P. and Bihar and Brahmaputra Basin in Assam Valley have been mapped with CI ranging from 0.5 to 5 m for flood control management. Surveys were also carried out on demand of CWC and various other agencies, spread over several years between 1970 and 1990. These maps represent all types of features such as rivers, lakes, glaciers, canals etc. by specific symbols that help in managing the water related parameters. In addition to graphic representation, detail reports are prepared by the field surveyors which include sub soil information like water table, forest type, landslides, fauna and flora in the area. Although all these information are not depicted in the graphical form, but this information is available in the form of reports, which could be of immense, use while generating GIS for the use of managing and planning activities.

Glaciers play a most significant role on the hydrology of the Rivers. Scientific studies of glaciers assume foremost importance as they contribute to the development of water resource and understanding the ecological system. In the event of disturbances in the glacier regime, there can be droughts, floods and changes in ecological system. SOI has been contributing to the glacier study for monitoring the extent variation, movement in horizontal & vertical directions and depth of glaciers through geodetic & geophysical measurements. These studies contribute to the development of water resources, climate and weather predictions and understanding the ecological system. The department has carried out glacier studies in various major glaciers in the country including Dokriani Bamak and Gangotri glacier during the recent past.

Water constitutes a major source of power generation without affecting the atmospheric parameters. This source of energy is in abundance in the Himalayan Rivers. Engineering design of hydroelectric projects based on topographical information to channelise the river water through various civil structures like head race, diversion tunnels, pressure shafts, penstocks and power houses and open channels etc are being monitored. SOI is playing an important role in execution of major hydroelectric power projects in India and abroad. The alignment of tunnels in desired direction is the critical aspect as the tunnels are excavated from two or more ends and finally they meet each other. The department has successfully

completed alignment and survey work including mapping the extent of reservoirs for various major hydroelectric projects in the country and abroad. Survey for Chukha hydel and Tala hydel projects in Bhutan and Pancheshwar in Nepal are some of the examples of the geodetic survey by the department in the neighbouring countries. In India, almost all major hydroelectric and irrigation projects are being taken up by the department for fixing the alignments of structures and mapping.

Geospatial data: A tool for natural disaster management

It is well known that natural disaster strikes countries, both developed and developing, causing enormous destruction of property and lives, resulting negative impact on national economy. Natural disasters like droughts, landslides, earthquakes, cyclones, floods and volcanic eruption are caused due to diverse physical and climatic conditions prevalent in different parts of the globe. India is a vast country and prone to number of natural disasters. The country most frequently faces river floods, droughts, earthquakes and landslides that cause widespread damage to life and property. The country has a coast line of about 75,000 km long and a mountain stretch extents for about 2,500 km in the north. The major problems in mountainous region are landslides and avalanches. India has faced 14 major earthquakes in the past having magnitude greater than 6 on Richter scale.

Understanding natural hazards such as earthquakes, volcanic eruptions, landslides, floods, hurricanes, subsidence and naturally occurring toxic materials are critical public issues, which our country is facing. Geology and hydrology are also crucial for infrastructure development and protection of the environment of the country. However, planning, design and construction of large structures often pose serious challenges, as the structures frequently become vulnerable to failures. Similarly, hydrology has become increasingly important in water resource management such as drinking water and for irrigation purposes. Water is going to be the most precious commodity of any country.

There are several aspects, which need to be addressed in connection to natural hazards. Demographic trends have been found to strongly correlate with rates of deforestation, expansion of agricultural land and increasing water scarcity. The impact of industry on the environment has become increasingly evident, causing resource depletion, contamination of water, air and land, health hazards and degradation of ecosystems.

Landslides are common in hilly regions like Uttarakhand state. This state also falls in active seismic zone, which causes frequent earthquakes. During the last decade it has experienced two major earthquakes, one at Uttarkashi region during

October 1991 of 7.5 magnitudes on Richter scale and second in Chamoli region during March 1999 of 6.8 magnitudes.

In order to emphasise on prevention and mitigation by the government and non-government organisations, there is a need to develop an integrated and coordinated system of disaster management. Specific working groups for each type of disasters shall be needed. When defining the activities, there is a need to focus on vulnerability, specifically the focus should be on preparedness and prevention.

There is a need to increase the capability of organisations and individuals for geospatial information for disaster preparedness, response, and recovery. Technology in general has a role to expand access to information, while geographic information system can improve access to information for planning, logistics and other purposes. Disaster prevention and mitigation requires as a first step, efficient and functional wide area monitoring system that provides accurate near real-time information from multiple sources which could be easily integrated to produce appropriate products that are easily and freely accessible to all relevant role players. In order to make feasible planning for disaster management, geospatial data play an important role as this is an essential requirement for any geographical information system (GIS). Though, it is not possible to completely avoid natural disasters, but the sufferings can be minimi sed by creating proper management through application of GIS tools. Geospatial data with GIS provides a tool for effective and efficient storage and manipulation of remotely sensed data and other non-spatial data types for both scientific management and policy-oriented information. This can be used to facilitate measurement, mapping, monitoring and modelling of variety of data types related to natural phenomenon.

GIS system for analysing biodiversity

In an era of digital information, GIS is best defined as a decision support system involving the integration of spatially referenced data in a problem-solving environment. The spatial interaction of many abiotic and biotic factors that occur in ecosystems at various scales, are very important. GIS tool has been, and being used in a variety of disciplines where special planning and decisions are involved.

One basic thematic map or layer in GIS terms is land cover. Land cover is all of the vegetation and man-made structures covering the surface of land. Land use differs from land cover in that land use can be thought as a sub class of land cover. Land cover data are vital to many applications including basic habitat assessments, constructing state-wide wild life distribution model, delineating specific vegetative communities, calculating soil loss, evaluating water quality within and between watersheds and monitoring wilderness management.

Knowing the spatial area, amount and arrangement of forests, water, wetlands, shrubs, agriculture and development can be invaluable in a variety of wildlife and natural resource applications. These applications range from managing individual species to accessing the quality and quantity of watersheds and to assess biodiversity.

The worst disaster of present day is the loss of genetic and species diversity via habitat destruction. There is a need of large scale habitat inventories. Inventories can provide information about each cover type, including relative type abundance, average or range of area of consideration.

A map showing the spatial arrangement of all above is crucial. Accurate land cover maps that concentrate on vegetation in all areas are desperately needed to protect the rich natural heritage of the nation. The maps produced through this effort could be a piece of information needed for variety of management activities including the promotion of faunal diversity.

Remote sensing analyses of the land cover is likely to fulfil the needs of various users like land owners for knowing accurate information about quantity, quality and spatial distribution of natural resource base.

Conclusion

Thus, cartography plays an important role in natural resource management for their optimum utilisation. The importance of timely collecting, analysing and updating the geospatial information on water resources covering areas of interest has been emphasised from time to time. Cartographical products like maps, atlases, charts, RS data and GIS are being used frequently to indicate, how and where the resources are located in an area and how the various resources are spatially interrelated. GIS can help in managing and making developmental plans for effective water management system.

PHYSICAL LANDSCAPE OF PITHORAGARH DISTRICT, UTTARAKHAND: A STUDY OF REGIONAL GEOMORPHOLOGY

Arindam Sarkar and [1] **Somnath Ghosh** [2]

[1] *Department of Geography, P. K. H. N. Mahavidyalaya, Purashkanpur*

[2] *Mukundabag High School, Jangipur*

Located in the outer Himalayan region, Pithorgarh is one of the hilly districts of Uttarakhand. The district has an area of 7242 sq km, which is bounded by Tibet on the north, Nepal on the east, Almora district on the south and part of Almora and Chamoli districts on the west. The district includes eight CD Blocks, namely – Munsyari, Dharchula, Berinag, Didhat, Konalichina, Moonakat, Pithorgarh, and Gangalihat.

Elevation of this district ranges from 500 m above the sea level on the valleys of the south to over 7000 m on the ridges of snow-clad Himalaya in the north and north-west. The climate largely depends on altitude and varies according to slope aspect and elevation. The district is situated on the southern slope of the Himalayas, and it is dominated by monsoon climate. The northern part of the district comprising the larger portion of the tahsils (CD Blocks) Munsiary and Dharchula with the high mountain ridges is rocky and much of the area is covered with perpetual snow. The forests are confined to the river valleys of the southern part of the district. Taking into consideration the differences in the altitude and the climatic condition, its flora may be divided into four main groups, viz. sal forest, chir forest, oak forest and coniferous forest. The district abounds in rivers, some of which originate within the fold of the district and taking a peripheral course along the border line, enters the Garwal region and eventually merges with the Ganges.

Besides fluvial landforms, evidences of glacial action in shaping the landscape of the district are also prominent in many locations. The physical landscape is, to a great extent, responsible for controlling land cover/ land use of the district, both at macro and micro levels. A field study conducted during 2009 in and around Pithoragarh town shows significant socio-economic response to the physical landscape of the area.

VALLEY FORMATION OF MANDAKINI BASIN, UTTRAKHAND

Mery Biswas

Department of Geography, Baruipur College, Baruipur

The paper bespeak about the detailed study of the valley formation of Mandakini Basin, Uttarakhand. It is a study on the aspects of valley formations, both by the action of glacier and river together with litho-tectonic and climatic influences. Morphological characteristics of a valley are a result of the interaction between hydraulics of flow and factors like velocity, discharge, roughness, shear and channel configuration. In the paper special emphasis has been given on the detailed analysis of glacial as well as fluvial valley formations processes through time and space.

The name 'Mandakini' in Sanskrit signifies a river which flows calmly. Mandakini is a tributary of the Alaknanda River, originating from the Charabari Glacier near Kedarnath in Uttarakhand. Mandakini is fed by Vasukiganga River at Sonprayag. The main tributary Madameshwar Ganga originating from Gundar glacier meets together and flow as Mandkini covering the Greater and Middle Himalayan ranges. Mandakini joins Alakananda at Rudraprayag. Alaknanda then proceeds towards Devaprayag where it joins with Bhagirathi River to form the Ganges. The morphology of the valley is controlled by some endogenetic and exogenetic factors as well as some variables like discharge, load, geology and climate. There are a number of perennial and non-perennial rivers which have joined the river Mandakini like Bashuki Ganga, Kali Ganga, Madhu Ganga, Laster Gad etc. The river has a magnificent journey from Kedernath to Rudraprayag with a wide range of landform assemblage of glacial, periglacial, fluvio-glacial and fluvial origin.

CHANGING COURSES OF WESTERN HIMALAYAN RIVERS FROM LATE QUATERNARY TO THE PRESENT: A PALAEOGEOGRAPHIC OBSERVATION

Ritendu Mukhopadhyay [1], **Sujay Bandyopadhyay** [2] and **Debasis Ghosh** [3]

[1] *Department of Geography, Burdwan Raj College, Bardhaman*

[2] *Department of Geography, Guskara Mahavidyalaya, Guskara*

[3] *Department of Geography, Kandra R.K.K. Mahavidyalaya, Kandra*

Observations show that the major western Himalayan rivers like Indus, Saraswati, Sutlej, Yamuna etc. were flowing from the Himalaya towards south-west during Quarternary period (3 MyBP). Among these rivers, the combined water of Sutlej and Yamuna fed river Saraswati which emptied itself into the Gulf of Kachchh, like the Indus (7000-3000 BP). But from the geoarchaeological studies over the

last several decades, one can conjure up the findings that gradual change occurred in the courses of the existing rivers, either eastward or westward. The legendary river Saraswati has vanished and what we see today are some disproportionately wide and astonishingly water-less sand-filled channels of Ghaggar in Haryana and Marwar (26°18′0″N, 79°55′0″E), Hakra in adjoining Bahawalpur (29°23′44″N, 71°41′1″E), and Nara in Sindh (24.87°N, 67.05°E). Not only that, the confluence points of all these rivers also shifted from their previous locations.

The evidences from ancient Indian literature; geology and sedimentology established the fact that neotectonic movements in western India caused the slow rise of Aravalli mountain. The upheaval resulted in steepening of the western flank and gradual flattening of the eastern flank of the Aravallis. The river Yamuna and Sutlej separated from Saraswati as a consequence of continuous upliftment of the region. This phenomenon changed the river morphology like formation of beheaded streams and virtual dissipation of Saraswati in the Rajasthan desert.

The Sutlej shifted westward abandoning its older dry channels successively through Wah, Naiwal and Sarhind. Finally it got deflected further possibly as a result of uplift of the Aravalli as well as concomitant subsidence of the land to the west and ultimately joined with the river Indus. The paroxysmal uplift also formed the spectacular U-turn of the Sutlej at Ropar. On the otherhand, Yamuna migrated progressively eastward because of river piracy and joined Ganges near Allahabad. The Indus also shifted towards west which finally veered its confluence point to the Arabian Sea from Rann of Kachchh.

The present work is concerned with the causes of diversion of the above mentioned rivers and their impact on the fluvio-geomorphological set up of the western Himalayan region. The disorganised state of these rivers in the western Himalaya helps to build up our hypothesis about rapid channel diversion and river dissipation. A combination of tectonics and geomorphic process might have caused the disappearance of Vedic Saraswati and also shifting of confluence points.

Temporal analysis of different thematic maps collected from valuable works on geoarchaeology indicates the presence of a number of lineaments across the plains, which might have some influence on the shifting of the river courses. The study also reveals the relationship between the change in the nature of channel morphology and the process of desertification in this fluvial regime.

GLOBAL WARMING AND HIMALAYAN LAKES

Amit Kumar Pandit

Department of Geography, Kanchrapara College, Kanchrapara

Human activities in general and industrialisation in particular have significantly altered the atmospheric composition, leading to climatic change in an unprecedented manner. The global mean temperature is expected to increase between 1.4 to 5.8º C over the next hundred years. The consequences of this change in global climate are already being witnessed by the Himalayan glaciers and glacial lakes. The Himalayan glaciers area retreating at rates ranging from 10 to 60 metres per year and many small glaciers (<0.2 km^2) have already disappeared. Together with glacial retreat, the lakes are growing in number and as well as size in the Himalayas. A remarkable example is Lake Imja Tsho near the Everest. This lake was virtually non-existent in 1960, but now it covers nearly 1 km^2 area. Similar observations were made in the Pho Chu basin of the Bhutan Himalaya, where the size of some glacial lakes has increased over the past 40 years. At present, several supraglacial ponds on the Thorthormi glacier have merged together forming a larger lake. These lakes pose a threat to glacial lake outburst flood (GLOF). These floods are often catastrophic in nature, especially for the people living downstream. At least 32 GLOF events have been recorded in Himalaya that resulted in heavy loss of human lives and property. Global Warming in the coming decades will amplify the GLOF events with accelerated rate of glacial retreat and formation of many potential glacial lakes. Hence, monitoring of glaciers and glacial lakes is of utmost importance for sustainable development in the mountains.

MECHANICS, CAUSES AND POSSIBLE MITIGATION OF THE LANDSLIDES: A CASE STUDY OF KASHMIR HIMALAYA

Anju Gupta

Department of Geography, University of Jammu, Jammu

In the modern world, there is an increasing paradox between the outstanding achievements in science and medicine, which makes life safer and healthier and the continuing death and destruction associated with so-called ‘natural hazards’. The paradox is complicated by the fact that science itself is not without hazard

and has led to the comparatively recent emergence of man made threats which arise from the failure of technological systems. People are now at risk not only from extreme geophysical events, such as earthquakes, landslides and floods but also from industrial explosions, releases of toxic substances and major transport accidents. A growing awareness of hazard is further encouraged because all disasters make news.

Throughout the twentieth century, mountains all over the world have been experiencing an increasing intensity of man-nature interaction with devastating consequences. This interaction is expressed through the spread of settlements, elaboration of transport arteries, conversion of forests into cultivated lands and construction of vast reservoirs for irrigation and hydroelectricity in the mountainous areas. All these so-called developmental activities disregard the dynamic stability of the ecological balance existing in nature. Knowledge about recognizing and understanding landslide processes has been shared with several countries. Although landslides occur in many parts of the Indian sub continent both in the Himalayas and the peninsular realms, their affinity with the Himalayan setting have drawn wide notice.

Kashmir Himalayas have experienced landslides due to rapid explorations. Widening of the roads and clearance of the forests aim at the development of the area. Due to the impact of these activities the stability of the area has been greatly affected. This instability further deteriorates due to widening of roads, excessive flow of traffic and torrential rainfalls. All these factors have played the important roles in de-stabilising of the mountains. Since the Himalayas represent one of the most fragile structural and morphological units, instability at any point leads to failure of the landmass material. When our understanding of crustal formation is receiving a wider global perspective, the tectonic processes and the mechanics of slope failure in the Himalayas should gain more prominence. The present study is an attempt to discuss the morphostratigraphy and morphogenesis of the landslides and suggest possible mitigation measures.

CLOUDBURST AND FLASH FLOOD IN LADAKH

Baishakhi Modak

Department of Geography, Kanchrapara College, Kanchrapara

Climate change can influence the environmental factors of an area, leading to prolonged winter or highly moist environment or extended summer which sometimes causes natural hazards. Ladakh of Western Himalayan region is a cold desert which generally experiences low precipitation, a prolonged winter and humidity of about 50%. On 6th August, 2010 very high humidity of about 72% led to a cloudburst. The cloudbursts resulted in sudden and copious rainfall over a

small area that lasted only for a short time but triggered floods and engulfed the area in no time, taking several hundreds of people's life. The determination of risk factor i.e. mechanism of formation and the cause of the cloudburst and what type of management should be taken, are a matter of concern. The causes of the cloudburst can be analysed from different points of view. Firstly, an intense convective cloud band extending from South-East to North-West developed ever Nepal in the afternoon of 5th August. It gradually intensified and moved West and North-West towards Jammu and Kashmir. Moving along the slope of mountain it gradually gained height. Later this intense convective cloud cluster developed to the east of Leh. Night time cooling led to condensation in upper layers of the cloud that set off a chain reaction rapidly releasing all accumulated water. Secondly, some experts assume that a thunderstorm might produce more than 1 inch of rain in a minute. However, it would require a a very moist and warm environment for the thunderstorm to occur. The freezing layer on the upper part of the cloud should extend very high, so that there would be a deep layer of accumulated water droplets. The thunderstorm would need to have strong updraft to accumulate a lot of water droplets suspended aloft. Then somehow the updraft should stop and be replaced by a strong downdraft that would drive an intense rain toward the ground much faster than it would fall normally. Thirdly, scientists at Indian Institute of Tropical Meteorology (IITM) Pune, think that due to global warming temperature has now gone up 15.7^{o} C from 15^{o} C. As a result low pressure areas shifted to North-West which helped monsoon winds reach Leh, and a tropical cyclone that forms over the Bay of Bengal or the Arabian Sea may evolve over three to six days during which it travelled thousands of kilometres and could result in a cloudburst. The cloudburst triggered floods in arid Ladakh with at least 112 dead, some 375 people injured and thousands left homeless.

LANDSLIDE HAZARD IN SIKKIM HIMALAYAS: GEOLOGICAL CONTROL AND HUMAN ACTION

Biswajit Bera

Department of Geography, Rabindrabharati University, Kolkata

Sikkim is situated on a part of the inner and the axial belt of Eastern Himalaya receives heavy and intense rainfall during the monsoon period and snowfall during winter months. Thus, the area suffers repeated slope failures during the rains as well as during the thawing of winter snow. Over the last two decades, a number of slides and subsidence have occurred and some of these have aggravated due to unscientific buildings construction over the vulnerable geological structure. These slides affect the roads, buildings and many other properties in different parts of Sikkim. Through geotechnical investigations several control measures have been suggested by Geologists and

Geomorphologists from time to time. However, landslide has continued to pose problems to the communication lines along the NSH, NH31A, Rongyek road and State Highway over the Gangtok town. A detailed study has been carried out in the recent past on the major slides in Sikkim Himalayas. The objective of this study was to highlight the present status of landslide in Sikkim, to carry out mapping through RS & GIS techniques, to find out the causative factors and the mechanism of landslides and finally to suggest remedial measures.

HYDROLOGICAL DISASTERS IN HIMACHAL PRADESH: A GEOGRAPHICAL ANALYSIS

Dev Dutta Sharma

Department of Geography, Himachal Pradesh University, Shimla

The occurrence of water related natural disasters especially floods, flash floods and cloudbursts are common in most of the hilly states including Himachal Pradesh. A flood can be defined as excess flow or overflowing of water, especially over land which is not normally submerged. The flow is markedly higher than the usual and this also cause inundation of low land. The flood can be of caused by various reasons, but in a hilly area like Himachal these are the result of some typical situations. They include cloudburst in the catchment region, intense and prolonged rainfall, downstream blocking of river channels by landslides or avalanches or the sudden breach or burst of artificial /natural lakes. In Himachal, riverine flooding is mostly associated with the snow fed rivers because in summer snowmelt coupled with heavy rains often triggers a flood. The river Satluj and river Beas, which are flooded almost every year, are of this type. Another form of flooding in this hilly state is flash flooding which is principally associated with hydrologically small regions. The duration of this phenomenon is short but can cause extensive damage. Like floods, cloudbursts are also water related disasters which may be defined as a sudden aggressive rainstorm falling for a short period of time over a small geographical area but may have intensity of more than 100 mm per hour.

The state of Himachal Pradesh has experienced a large number of incidences of flood and cloudburst since its inception. Though the state has faced severe flood disasters in 1975 and 1988 but the last decade (1997-2007) has proved one of the worst decades as both the magnitude and frequency of water related disasters have gone up. There were several incidences of floods / flashfloods and cloudbursts during 1997-2007 of which some were of really large scale. These disastrous events have brought heavy toll on the state as the loss was estimated in several thousand millions of rupees and also killed several hundreds of people besides large number of cattle heads.

The present paper is based on the primary as well as secondary data and aims at giving an account of various incidences of water related disasters and their multi-faceted impacts on the state. The paper also tries to analyse the spatial similarities and differences in these disastrous events to find out the policy imperatives for sustainable development.

KINEMATICS AND MORPHOLOGY OF LANDSLIDES IN EASTERN HIMALAYAN FOOT SLOPES ALONG DOOARS.

Kaustubh Lahiri

Department of Geography, Surendranath College for Women, Kolkata

Kinematics explains the propulsion variables associated to the motion of a particle or body in a system. In contrast to analytical dynamics it does not take the factors triggering the motion into account. Kinematics of landslides tries to discern the movement mechanism of the displaced mass and the International Association of Engineering Geologists has standardised two typical dimensional variables for slope failure: width of displaced mass (W_d) and width of rupture surface (W_r). The following kinematics slope stability relationships are based on the concept of limit equilibrium.

Shear strength (T) along the assumed failure surface can be expressed as $T = S/FOS$ [where S = shear strength of soil; FOS = Factor of Safety]. This works in terms of effective strength.

On the other hand, $S = C' + (<\sigma_n - u) \tan \varphi$ [where C′ = effective cohesion, σ_n = normal stress, u = pore water pressure; φ = angle of internal friction in terms of effective shear]. Generally φ is defined as H/L_n [where H = difference in elevation between the crest and tip of landslides; L_n = horizontal length of the landslides]. The φ is related to the mobility and volume of the landslides.

The ratio between depth and length of surface rupture (D_r/L_r) is an important index and Skempton and Hutchinson's calculation indicates that rotational soil slides generally show values ranging between 0.15 –0.33.

According to Crudes and Vernes, the initial volume of materials before the landslide moved (Vol_r)= $l/6 \pi D_r \times W_r \times L_r$ [where Vol_r, D_r ,W_r , L_r = volume, depth, width and length of rupture surface].Calculation of the post-motion volume would be comparatively inaccurate because depth of the displaced mass (D_d) remains unknown. So it can only be assumed that $Dd = D_r$ and that $Vol_d = l/6 \pi D_d \times W_d \times L_d$. [where Vol_d D_d ,W_d , L_d = volume, depth, width, and length of displaced mass]

The transport corridors in the eastern Himalayan foothills north of Dooars are greatly affected by landslides. Kinematic study of selected landslide sites can help in their prediction and proper disaster management planning for the region.

SUSTAINABLE APPROACHES TO DISASTER MANAGEMENT IN THE HILL AREAS

Mamata Desai

Netaji Institute for Asian Studies, Kolkata

The decade of nineties was declared as International Decade for Natural Disaster Reduction. The term Disaster means the loss of life and property due to severe natural or man made hazards, like, severe earthquake, cyclone, massive landslide, fire breakout etc. Disaster Management is a system or process to mitigate any type of disaster, whether man made or natural.

Steep slopes, heavy rainfall and high altitude characterise the Darjeeling Hill area. Here natural vegetation plays an important role in protecting the hill slopes from erosion. The forest lands in the hilly areas are encroached upon for different purposes, as is done in almost all hilly areas of the country. But, in the Darjeeling hill area, this has created some vulnerable patches, which have become susceptible to frequent landslide hazards.

The region is geologically vulnerable, ecologically fragile and under pressure due to the demands made on environmental resources by growing tourist traffic and rapid urbanisation. Various types of environmental stresses are evident from degrading forest resources, air pollution, insufficient urban infrastructures like water supply, sanitation, solid waste management etc. In this region, landslide hazard is a frequent and recurring incidence due to excessive human interferences in the form of unscientific land use pattern, deforestation, illegal and unauthori sed construction on the vulnerable hill slopes.

For the sustainable approaches for landslide disaster mitigation in the Darjeeling hill Areas, several systems should be developed which include development of proper scientific forecasting system, evaluation of pre-disaster situation, identification and evaluation of the type of disaster, development of strategies as preventative measures, planning for community preparedness, formation of technical groups, relief operation programmes and arrangement for shelter points. Finally, proper planning should be made to develop a data base of the total scenario for future planning, awareness programme, warning system and other management options for prediction of the disaster and moving towards sustainable approaches.

কেদারনাথ ও বদ্রীনাথ অঞ্চলের ভূপ্রকৃতি এবং সাম্প্রতিক পরিবেশগত কিছু আলোচনা

পাপড়ি বসু

দমদম দেশবন্ধু হাই স্কুল, দমদম

এই আলোচনায় কেদারনাথ ও বদ্রীনাথ অঞ্চলের বিশেষ কতকগুলি ভূমিরূপ এবং তাদের উৎপত্তি এবং সাম্প্রতিক পরিবেশগত কয়েকটি বিষয় তলে ধরা হয়েছে।

এই অঞ্চলের ভূমিরূপ গঠনের ক্ষেত্রে তুষার এবং জলপ্রবাহ - এই উভয় ক্রিয়াই লক্ষ্য করা যায়। বিগত হিমযুগগুলিতে হিমবাহের ক্রিয়ায় যেমন "U" আকৃতির উপত্যকা, ঝুলন্ত উপত্যকা, গ্রাবরেখা ভূমিরূপ গড়ে উঠেছে, তেমনি নদীর কাজের ফলে জলপ্রপাত, বতু´লাকার গর্ত, গিরিখাত, শৃঙ্খলিত শৈলশিরা ভূমিরূপ গঠিত হয়েছে। এই ভূমিরূপগুলির গঠনে যেমন ওই অঞ্চলের ভূতাত্ত্বিক গঠন এবং শিলার প্রকৃতি গুরুত্বপূর্ণ, তেমনি জলবায়ুর প্রভাবও বিশেষ উল্লেখযোগ্য। বিশেষ করে শিলার আবহবিকারে ঐ অঞ্চলের আবহাওয়ার গুরুত্বের কথা বোঝা যায়।

সাম্প্রতিক কালে এই অঞ্চলে তীর্থযাত্রীর সংখ্যাধিক্য, যান চলাচল বৃদ্ধি পাওয়া, দোকানপাটের সংখ্যা বৃদ্ধি, ফাটা থেকে কেদারনাথ বিমান পরিষেবা এবং হিমালয়ের পরিবেশের উপর এগুলির প্রভাব বিষয়েও এই প্রতিবেদনে আলোচনা করা হয়েছে।

CAUSES RELATED TO SINKING LANDMASSES OF KALIMPANG SUBDIVISION AND NEED FOR A COMPREHENSIVE WATERSHED MANAGEMENT

Partha Basu

Department of Geography, Bhairab Ganguly College, Kolkata

The sinking of landmasses is the most important process of mass wasting in the mountainous tracts of Kalimpang subdivision. Unlike a landslide it is slow and gradual. The rate of movement of a sinking landmass is variable ranging from a few cm per year to a few metres per year. Slippery subsurface and toe erosion by a river are the two processes which are ideal combination to initiate a sinking area. However, the referred processes are independent of each other.

The drainage basin of the Rilli River (locally known as Relly) covers about 169 km^2 area of Kalimpang subdivision. The Rilli river cuts through the southern side of the toe of the ridge on which Kalimpang town is situated. This southern face of slope is long, wide and slightly concave and devoid of any forest cover. The other face of slope of the northern Rilli basin is steeper and partly covered with forest. However, the Rilli basin at present includes as good as 25 landslips and sinking areas. The case study of Dungra-Sindipong-Gairigaon sinking area characterises the effectiveness of the two processes mentioned above. The slippery subsurface

of the area is an anthropogenic contribution. The lithology belonging to the Daling Group of rocks with a number of thrust contacts within the basin. This favours the hazardous situation. A comprehensive watershed management is earnestly solicited.

FLASH FLOOD: A SUDDEN, UNEXPECTED DISASTER IN THE HIMALAYAN REGION

Sayan Mandal

Department of Geography, University of Calcutta, Kolkata

Flash floods are by their nature difficult to predict and control. It is possible to reduce the risk of lives and property through different measures. The major objectives of this work is to identify the major causes of flash floods in the Himalayan region, and the different measures that can be used to reduce the potential impacts.

The study area extends between 28º–34ºN and 75º–95ºE. The Himalaya range is the youngest mountain chain of the World. High relief, steep slopes, complex geological structures with active tectonic processes and continued seismic activities, and a climate characterised by great seasonality in rainfall, all combine to result in natural hazards, especially water-induced hazards. In the Himalayan region flash floods are severe flood events triggered by extreme cloudbursts, glacial lake outbursts, or the dam failure of man-made dams or dams caused by landslides, debris, ice, or snow etc. Flash floods can have an impact hundreds of kilometres downstream; yet the warning time available is counted in minutes or, at the most, hours.

A number of case studies had emphasised the fact that flash floods posed a serious threat to the livelihoods of mountain people (as well as downstream riverine people) in the Himalaya Region – where they cause a loss of at least 5,000 lives annually. An unknown number of people too are affected in different ways; and this is quite a substantial number. Flash floods have resulted in displacement. Poor people, especially women, the elderly, and children are the most vulnerable. The integrated strategy for reducing flash flood risks includes: a) Community awareness b) Hazard Control c) Forecasting early warning d) Policy formulation e) Community based disaster risk management.

It is difficult to predict the exact location, magnitude, and extent of most flash floods, thus it is rarely useful to carry out large-scale structural measures like building of embankments, dams, and levees. But there are many non-structural measures that can help to reduce the impact of floods, ranging from land use planning, construction codes, soil management and acquisition policies, through

insurance, awareness raising, public information, and emergency systems to post-catastrophe recovery plans. Such non-structural measures are generally sustainable and less expensive. Small-scale structural measures like check dams, small-scale levees using local materials, and sand bag embankments can also be useful. The best solution is usually a combination of small-scale structural and non-structural measures. Flash floods should be addressed while implementing national and regional flood management policies, and integrated water resources management and disaster risk management plans.

EARTHQUAKE IN THE HIMALAYAN REGION

Soumita Banerjee

Department of Geography, Calcutta University, Kolkata

Seismologists have made a distribution of earthquake prone zones all over the world and among them, the Himalayan mountains fall into the mid-continental belt, which is located along the Alpine Himalayan chains of Eurasia and Northern Africa with epicentres in fault zones. In India, since the time of the upliftment of the Himalayan mountains, it has been proved to be one of the highest earthquake prone zones in terms of magnitude and intensity.

The study area lies between 28°–34°N and 75°–97°E. The states of Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, Northern part of West Bengal and Arunachal Pradesh falls within the study area.

There are some possible reasons which augment the frequency of the occurences of earthquake particularly in Himalayan belt. The reverse fault, placed at its boundary, is considered as a proof of plate movements in this region. As the Indian plate and the Eurasian plate are converging a stress is built up and this causes the crust to bend. Depending upon this principle the "elastic rebound thoery" has been developed. This theory enables the seismologists to understand and illustrate the causes behind major earthquakes in this region. But the process of Himalayan mountains building is still going on as the Indian plate is moving towards the Eurasian plate at a rate of 2 cm/yr. Where the change of inner crustal uniformity is very sharp, earthquakes occur like those of north Western Kashmir, North eastern angle of Assam, Baluchistan Questa(Pakistan) etc. In the foothills of Himalayas there occurs a vigorous fluvial erosion which sometimes leads to earthquake.

Himalayan ranges have experienced some major events of earthquakes in the last thousand years. For example, the southern Tibet, Agra, Northern Ganga plain earthquake of 1803, the historical earthquake in Nepal of 1833, Bengal-Assam earthquake of 1897, Kangra earthquake of 1905, Bihar earthquake of 1934, Assam

earthquake of 1950, Uttar Kashi earthqake of 1991, Chamoli earthquake of 1999, Kinnaur earthquake of 1975 and the two very recent - Kashmir earthquake of 2005 and Bhutan earthquake of 2009.

Possible mitigations of earthquakes includes risk, vulnerability and hazard assessment of Himalayan earthquake prone zones, forecasting and predictions of possible earthquakes through electronic media and to rescue the victims and to provide immediate relief.

An attempt has been taken to study the seismic activities occurring in Himalayan region in order, to recogni se the earthquake prone areas of the Himalayan region, to assess the probabilities of occuring earthquakes in near future and to take the essential mitigations to prevent the loss of lives and properties of Himalayan people.

PROBLEMS OF GLACIER RETREATS IN THE HIMALAYA AND ITS RELATED ENVIRONMENTAL HAZARDS

Sutapa Mukherjee

Department of Geography, Dr. Kanailal Bhattacharyya College, Santragachhi

A large area of the Himalayas is covered by glaciers. Origin of the glaciers owes to the huge amounts of snowfall and their subsequent accumulation under freezing temperature. The Himalayas cover about 500,000 km^2 area in the northern part of India, out of which 3/5th falls within Indian territory and the rest in Nepal and Bhutan. Most of the Glaciers are found in the Greater Himalayas. The mountain complex has as many as 1500 glaciers and along with their snowfields they occupy about 33,000 km^2 area. Mountain glaciers are more sensitive to climate change. The temperature in the Himalayan region has risen by about 1 ^oC since 1970s and this pattern of climatic amelioration causes meltdown of snow fields and retreat of glaciers at an average rate of 15 m per year. Recent studies have revealed that almost 67% of the Himalayan glaciers have retreated markedly in the past decades. This paper discusses changes in glacial extent, pattern of retreat and its related problems. There is every possibility that the rapidly melting glaciers would swell local lakes in the mountains triggering flash floods in the narrow valley downstream. Melting of glaciers is expected to increase even further under changing climatic conditions which would lead to increased flows in some rivers. Photographs and secondary data have been used to demonstrate the pattern, rate of glacial retreat and its associated problems in some important glaciers in the Himalayas. The records show that Gangotri Glacier in the Garhwal Himalayas is now retreating by about 30 m per year confirming the view that rate of ice melting is faster than accumulation. There is overall reduction in glacial area from 2,077 to 1,628 km^2 since 1962 and overall deglaciation of 21% and loss

of 0.2347 km^2 of glacial ice between 2000 and 2002. At present the rivers rising from the Western Himalayas have shown 3% to 4% surplus water due to 10% increase in the melting of the glaciers.

EVALUATING PHYSICO-ANTHROPOGENIC INFLUENCES ON LANDSLIDE VULNERABILITY IN KURSEONG TOWN, WEST BENGAL

Utpal Roy, Soumendu Chatterjee and **Nilanjana Das**

Department of Geography and Environment Management, Vidyasagar University, Medinipur

Landslide is associated with high energy environment of the mountains. Mountain regions of India, particularly the Darjeeling Himalayas are highly prone to landslide events. In assessing the vulnerability associated with landslide, physical parameters are customarily taken into account considering landslide as a natural hazard but in the urbani sed landscape of mountain environment landslides are required to be emphasi sed as quasi-natural event where vulnerability analysis should include anthropogenic influences. This approach has been followed in analyzing landslide vulnerability associated with the Kurseong urban area (26°51'40"- 26°53'35" North and 88°15'25"-88°17'45" East) of Darjeeling district, West Bengal. Kurseong is located along the eastern face of Mahaldiram cliff of Darjeeling Himalaya. The landscape has undergone anthropogenic modifications due to rapid urbanisation which has played key role increasing the landslide episodes. Along with the physical factors like geology, drainage, slope, aspect etc. anthropogenic parameters like landuse change, man-made drain density, road density, building density etc. have been considered in assessing the landslide susceptibility. The analyses lead to the production of a landslide vulnerability map which can be considered as a reference for future planning decisions.

Theme-III: Biodiversity and mountain environment

RETREAT OF GANGOTRI GLACIER, HIMALAYA: SOME OBSERVATIONS

Alpa Basu

Department of Geography, University of Calcutta, Kolkata

A glacier is a large persistent body of ice, originating on land. On Earth, 99% glacial ice is contained within vast ice sheets in the Polar Regions, but it is found

in mountain ranges of every continent except Australia. The retreat of glaciers since 1850 affects the availability of fresh water for irrigation and domestic use, mountain recreation, animals and plants that depend on glacier melt, and in the longer term, the level of the ocean. The temporal coincidence of glacier retreat with the measured increase of atmospheric green house gases is often cited as an evidentiary underpinning of global warming. Mid latitude mountain ranges such as Himalayas, Alps, Rocky are experiencing some of the largest proportionate glacial loss. It is true that the glaciers of Asia are experiencing a rapid decline in mass.

The area of study, Gangotri glacier is located in Uttarkashi District, Uttarakhand, India. The glacier extends between 79º4'41"–16'34"E and 30º 43'22"N–55'49"N.

Gangotri is one of the most famous glaciers in Indian Himalayan Range. It retreated 34 mts/year between 1970 and 1996 and has averaged a loss of 30 m/yr since 2000. Gangotri glacier has retreated 1km in the last 30 years and presently its areal extent is 286 km^2. The headwaters of the river Ganga (Bhagirathi) is the Gangotri glacier, with the retreat of Gangotri glacier, there is a growing concern for potential for flood, which is a threat to the lives in the foothills and Ganga valley. According to studies by World Wide Fund for Nature, due to the rise of temperature the river flow will increase by 20% initially due to this snow melt but ultimately the flow will decrease by 20%.

A population size equal to that of Europe lives in the Ganga basin. Their livelihoods are dependent on the river system. Hence, the 'Threat' as explained above is continued, it will be a great tragedy. The author aims to explore the occurrence of the retreat of Gangotri Glaciar and to analyse the geomorphological evidences and the impact of the retreat of the glacier, so as to highlight the magnitude of the problem.

UNIQUE AND THREATENED BIODIVERSITY OF HIMALAYAS

Aparna Ghosh, Shalini Bairagi, Rima Joarder, Priyankar Ganguly and **Siddhartha Bhattacharjee**

Department of Geography, Jogesh Chandra Chaudhuri College, Kolkata

Biological diversity refers to the variety of life forms, the genetic diversity they contain and the assemblages they form. The direct benefits of biodiversity to humanity are myriad. We derive our food, fuel, fibre, medicines and raw materials for a host of manufacturing processes from the variety of organisms. Beyond direct values, they provide ecological services and play an important role in maintaining the earth's environmental processes. Their ethical and aesthetic values are not easily quantifiable, but nevertheless they are real and pervasive.

The Himalaya stretching for over 4,000 km is a singular entity of immense physical dimension owing to its topography and climatic variability. The Himalaya contains rich biological diversity. It occupies approximately 0.3% of global area but constitutes nearly 10% of world flora. The region contains four biodiversity hotspots, 60 eco-regions, 488 protected area, 1106 important bird areas and 53 important plant areas. But now human induced changes as well as natural disturbances have posed high degree of threat to the biological diversity. The loss of diversity has been attributed to the loss and fragmentation of natural environment. The present work is about the loss of biodiversity in Himalayas and the present status of different species.

POLLUTION OF NAINI LAKE, NAINITAL, UTTARAKHAND: A CRITICAL ENVIRONMENTAL ISSUE

Nandini Chatterjee

Department of Geography, Presidency College,Kolkata

Pollution of Naini Lake is a significant environmental issue of the tourist town of Nainital. 'The water is as clear as crystal' was the description given by the British during the discovery of the lake in 1841. Nainital is located in the Lesser Himalayas, in the Nainital Basin alongside the Almora Crystallines. The contact plane is the South Almora Thrust. The rocks comprise of less metamorphosed sedimentaries mostly conglomeratic, pebbly to gritty quartzites and limestones. A section of these rocks are asymmetrically folded. Fracture zones, as that of the 65 metres crack along China Peak, in Naintal, form serious threats. Landslides are common especially due to constructions on the friable rocks of the hillslopes. The 1987 landslide, uprooted 100 trees. The rubble naturally slides down slope into Naini Lake increasing sediment accumulation.

Increase of population has contributed to the increase of domestic sewage and solid wastes, especially plastics. These ultimately find their way into the Lake. The population increased from 7000 in 1901 to 12000 in 1951 and to 39000 in 2001. 'Floating' population was estimated at 4 lakhs in 2003. Peak season estimates are considerably high. According to The Central Pollution Control Board estimates (2001-2002), DO level was 13.26mg/l, pH was 7.25, BOD was 6.5mg/l, COD was 24mg/l, total Hardness was 228mg/l and TDS was 212mg/l. Aquatic macrophytes and algae flourish, reducing transparency of the waters. Total colliforms range from 16200 – 166000/ 100 ml. There are ten main slums, some along the lakesides which have no regular latrines.

The Nainital Lake Region Special Area Development Authority was established in 1989 to improve the overall situation. Lake conservation measures include strengthening outlets of the Lake, catchment conservation, lake dredging and

water quality monitoring. However the situation still requires enforcement of stringent measures.

A REPORT ON SOME OF THE BUTTERFLY FAUNA FROM THE HIGHEST ALTITUDINAL ZONE OF THE NEORA VALLEY NATIONAL PARK, WEST BENGAL, INDIA

Panchali Sengupta [1] and **Narayan Ghorai** [2]

[1] *Department of Zoology, Presidency College*

[2] *Department of Zoology, West Bengal State University*

Neora Valley National Park, situated in the Eastern Himalayan Region between 88°28′–88°56′E and 26°51′–27°12′N, covers an area of 88 km^2. This National Park has an altitudinal variation from 300-3150 metres. The highest altitudinal zone (2000-3150 meters) of this National Park forms a part of the Eastern Himalayas sub alpine 14/C-2 coniferous forests.

The wide floral diversity of this vegetation zone supports a rich variety of lepidopteran fauna. In the present study a survey was conducted to have an idea on the diversity of butterflies on this particular zone of biological importance. Butterflies of this zone were observed and photographed for identification between March-June, 2010. Butterflies were sampled by direct observation and identified from published literature. The probable larval host plants and adult food plants of the observed butterfly species were noted. A high diversity of butterflies belonging to Nymphalidae, Hesperiidae, Lycaenidae and Pieridae families were observed. Plants such as *Utrica dioica, Debregeasia longifolia, Girardinaria diversifolia, Boehmeria* sp and *D. bicolor* (Utricaceae) were found predominantly in this zone. These plants supported the larval population of Indian Tortoise Shell, Indian Red Admiral, Painted Lady, Himalayan Jester, Common Jester and Mongol (Nymphalidae) butterflies. Mountain Skipper (Hesperiidae) butterfly was sighted in this zone due to the presence of its host plants such as *Rubus paniculatus* and *R. pentgonus.* Extensive distribution of *Arundinaria maling, Poa annua* and *Imperta cylindrica* plants (Graminae) were found throughout this zone of the National Park. These plants thereby served as larval host plants of Chequered Darter, Himalayan Darter, Straight Swift, Bewan's swift, Veined Scrub Hopper and Indian Ace (Hesperiidae) butterflies commonly sighted at different regions. Occurrence of overhanging parasitic flora (Viscum spp, Loranthus spp, Scurrula spp) on trees served as larval food plants of Peacock Royal, White Royal, Tufted Royal and Bi-Spot Royal (Lycaenidae family) butterflies extensively distributed in this region. *Rhododendron arboreum, Rhododendro*n spp (Ericaceae), *Juglans regia (*Juglandaceae*), Dendrobium amoenum (*Orchidaceae*), Rumex nepalensis and Rumex hastatus (*Polygonaceae*),*

commonly present in this region served as larval food plants of Fawn Hairstreak, Powdery Green Hairstreak, Walnut Blue, Orchid Tit, Common Copper and Sorrel Sapphire (Lycaenidae) butterflies respectively. Cultivated legumes, Desmodium spp (both belonging to Leguminosae), along with *Arundinaria spp* widely distributed in this region served as larval food plants for Pea Blue, Forget-me-not and Lesser Punch (Lycaenidae) butterflies respectively commonly sighted in this region. The presence of *Medicago* spp, *Trifolium* spp (Leguminosae), along with *Cassia* spp and *Brassica* spp supported a larval population of Clouded Yellows, Common Grass Yellow and Indian Cabbage White butterflies respectively of Pieridae family. The abundance of *Rhododendron arboreum, R. falconeri, Magnolia campbelli* (Magnoliaceae), *Dendrobium* spp, *Vanda cristata* (Orchidaceae) probably served as important floral (pollen and nectar) resource of the adult butterflies.

Thus, this study not only provides a preliminary report on some of the butterfly fauna of the Neora Valley National Park but it also points towards an intrinsic relationship shared by the butterflies with their specific larval host plants.

হিমালয়ের সরোবর

রতনলাল বিশ্বাস

হিমালয় পর্যটক ও আলোকচিত্রী

হিমালয় ও ট্রান্স-হিমালয় জুড়ে রয়েছে অনেক ছোট বড় সরোবর। অধিকাংশ সরোবর বা কুন্ডই পবিত্র ও দর্শনীয়। সিকিম হিমালয়ে সরোবরের পবিত্রতা রক্ষার জন্য সরোবরের তটে ক্যাম্প করাও নিষিদ্ধ। দর্শন, পুজার্চনা ও অবগাহনের জন্য বহু তীর্থযাত্রী ও পর্বত-পদযাত্রী পৌঁছে যান সরোবরের তীরে, কখনো গাড়ী চেপে আবার কোথাও হাঁটাপথে। চির সবুজে ঢাকা পাহাড়ের কোলে আছে বহু সরোবর, আছে তুষারাবৃত পর্বতমালা বেষ্টিত সরোবর। মরু পাহাড়ের দেশে ছড়িয়ে ছিটিয়ে রয়েছে বহু সরোবর। এরা সকলেই হিমালয়ের সৌন্দর্য্যের শ্রীবৃদ্ধি ঘটিয়েছে।

নানা ঋতুতে ও দিনের নানা সময়ে এদের রং বদলায়, সেই সঙ্গে রূপের বদল ঘটে। সুউচ্চ হিমালয়ের বুকে এই সরোবরগুলির রং কোথাও নীল, ধূসর নীল, সবুজ, পান্না সবুজ, আবার দিনের শেষে আলতা ধোওয়া লাল। কোথাও নীলাভ, সরোবরের জলে ভেসে বেড়ায় বরফের টুকরো। শীতকালে বহু সরোবরই গায়ে জড়িয়ে নেয় বরফের চাদর। কোথাও যাযাবর পাখীরা ভিড় জমায় সরোবরের জলে। সরোবরের স্থির জলে পাহাড়ের প্রতিফলন সর্বত্রই মন কেড়ে নেয়। হিমালয়ের সৌন্দর্য্য বৃদ্ধিতে সরোবর হল এক অলংকরণ।

প্রায় চল্লিশ বছর হিমালয় ভ্রমণের মধ্যে দিয়ে বহু সরোবর দেখার সৌভাগ্য হয়েছে। দেখেছি সরোবরের নান্দনিক রূপ। শুনেছি সরোবরের রূপকথা। আঞ্চলিক মানুষের বিশ্বাসে আস্থা রেখে এদের কাছে নতজানু হয়েছি। নদীনালা চলার পথে প্রাকৃতিক কারণেই গতিরোধ হয়ে বা পাহাড়ে ঘেরা উপত্যকার তলদেশে জলাশয়ের সৃষ্টি হয়েছে। কোথাও হিমবাহ মাঝে তৈরী হয়েছে হিমবাহ হ্রদ। প্রবল বেগে

প্রবাহিত ঝোড়ো হাওয়া মরু পাহাড়ের দেশের সরোবরের জলে ঢেউ তোলে। সেই ঢেউ আছড়ে পড়ে সরোবরের তটে। ঢেউ-এর মাথায় যাযাবর হাঁসেরা ওঠানামা করে। আবার সেই ঢেউ-এর উপর মধ্যাহ্নের সূর্যের আলো মণিমুক্তো ছড়িয়ে দেয়। প্রত্যুষ, মধ্যগহন, গোধূলি, ক্রমশ দিন শেষ হওয়া আলোর খেলা সবই ধরা পড়ে এই সব সরোবরের জলে। কাকভেজা হয়ে দেখেছি সরোবরের সৌন্দর্য্য। আবার সারা গায়ে চাঁদের আলো মেখে দেখেছি সরোবরের আর এক অনন্য রূপ।

বিলুপ্তির পথে খাজিয়ার হ্রদ

সায়ন্তন দাস

ভূগোল বিভাগ, কলকাতা বিশ্ববিদ্যালয়, কলকাতা

হিমাচল প্রদেশের চাম্বা জেলায় বিখ্যাত শৈলশহর ডালহৌসির নিকটে অবস্থিত খাজিয়ার হ্রদ ভ্রমণপিপাসুদের একটি অত্যন্ত জনপ্রিয় ঠিকানা। ভূপৃষ্ঠ থেকে ১৯৬০মি. উচ্চতায় অবস্থানকারী পর্বতবেষ্টিত এই জলাশয়টি বহুদিন ধরেই পারিপার্শ্বিক নৈসর্গিক শোভার কারণে পর্যটকদের আকর্ষণ করে এসেছে। জলাশয়ের সন্নিকটে রয়েছে সর্পদেবতা 'খাজিনাগ' এর মন্দির, যা প্রাচীনকাল থেকে স্থানীয় মানুষের ধর্মীয় ভাবাবেগের সঙ্গে জড়িয়ে আছে এবং এই মন্দিরের জন্যই অঞ্চলটি খাজিয়ার নামে পরিচিত। সেই একই কারণে খাজিয়ার হ্রদকে পবিত্রতার প্রতীক হিসাবে গণ্য করা হয়ে থাকে। সুউচ্চ পর্বতমালা, সরলবর্গীয় উদ্ভিদের সারি, জলাশয়ের চারিদিকে সবুজ ঘাসের গালিচা এবং তাতে চারণরত পশুর দল – এই সমস্ত কিছুর সহাবস্থান এক অনন্য পরিবেশের সৃষ্টি করেছে যা খাজিয়ারকে অন্যান্য পর্যটনকেন্দ্র থেকে আলাদা করেছে। ঘন পাইন এবং দেবদারু গাছের জঙ্গলে ঘেরা অঞ্চলটি প্রাকৃতিক সৌন্দর্য্যের জন্য 'Mini Switzerland' নামে পরিচিত।

হ্রদটির প্রকৃত আয়তন প্রায় ১.৬ বর্গ কিমি হলেও দীর্ঘদিন ধরে সঙ্কুচিত হতে হতে বর্তমানে তা মাত্র ০.০০৫ বর্গ কিমিতে এসে দাঁড়িয়েছে। বহির্বিশ্বের কাছে পর্যটনকেন্দ্ররূপে পরিচিতি লাভ করলেও রক্ষণাবেক্ষণের দিক থেকে খাজিয়ার হ্রদ বহু বছর ধরেই অবহেলিত। হ্রদটি জলের যোগানের জন্য নিকটবর্তী কিছু পাহাড়ি নালার উপর নির্ভরশীল। চারপাশ ঢালু থাকার দরুণ সহজেই বৃষ্টির জল মূল জলাশয়ে পৌছতে পারে। দুর্ভাগ্যবশতঃ ধীরে ধীরে পলি সঞ্চিয়ের জন্য এবং লেকের ধারে 'ভাচা' (*Acorus calamus*) নামে একটি বিশেষ ধরণের আগাছার বৃদ্ধির কারণে হ্রদটির পরিধি ক্রমহ্রাসমান। 'ভাচা' তৃণভোজী পশুদের অত্যন্ত প্রিয় খাদ্য। ফলতঃ স্থানীয় গ্রামবাসীরা গৃহপালিত পশুদের চারণভূমি হিসাবে জলাশয়ের পার্শ্ববর্তী অঞ্চলকে ব্যবহার করে থাকে। তাই এই আগাছার পরিমাণ বৃদ্ধি পাওয়ার কারণ হিসাবে স্থানীয় গ্রামবাসীদের ভূমিকাও অগ্রাহ্য করা যায় না। এছাড়া নিকটবর্তী কালাটোপ অভয়ারণ্যের প্রাণীরাও জলের জন্য খাজিয়ার হ্রদের ওপর নির্ভর করে থাকে। এর সঙ্গে যুক্ত হয়েছে বিশ্বের বিভিন্ন প্রান্ত থেকে সারা বছর ধরে আসা পর্যটকের চাপ এবং আবহাওয়ার খামখেয়ালীপনা। পর্যটকদের আসার সাথে তাল মিলিয়ে খুব স্বাভাবিকভাবেই পরিবেশ দূষণ বৃদ্ধি পেয়েছে, কিন্তু তা নিয়ন্ত্রণ করতে যথাযথ পদক্ষেপ নেওয়া হয়েছে কিনা সে নিয়ে সন্দেহের যথেষ্ট অবকাশ রয়েছে। অনিয়মিত বৃষ্টিপাত এবং জলবায়ুর চরিত্রগত পরিবর্তন সমস্যাটিকে জটিলতর করে তুলেছে। ক্রমাগত অনবধানতার ফলস্বরূপ এই জলাশয় আজ একটি ছোট ডোবায় পরিণত। বর্তমানে যদিও হিমাচল প্রদেশের পরিবেশ বিভাগের পক্ষ থেকে খাজিয়ার হ্রদের সৌন্দর্য্যায়ন প্রকল্প শুরু করা হয়েছে, কিন্তু খাজিয়ারের হৃতগৌরব পুনরুদ্ধার করতে প্রকল্পটি কতটা ফলপ্রসূ হয় তা সময়ই বলতে পারবে।

THE HIMALAYAN WETLANDS: REGIONAL EFFORTS FOR CONSERVATION AND MANAGEMENT

Suranjana Banerji

Department of Geography, Taki Government College, Taki

The Himalayan Wetlands constitute a unique ecosystem that in general includes lakes, marshes, peat lands, wet grasslands, streams and rivers. These wetlands play a vital role in the functioning of the water cycle of the large Himalayan river basins which together cater to the needs of almost 20 percent of the world's population. They carry out a number of ecological functions and also support a high level of biological and cultural diversity. There is a significant variation in the areas considered to be the 'Himalayan Wetlands' and the high altitude wetlands (HAW) are of particular interest as they constitute an integral component of the mountain ecosystem. The high altitude wetlands play an important role in supporting livelihood for the pastoralists and the farmers who live in the rainshadow areas of the mountains.

The Himalayan Wetlands have received little importance so far in terms of conservation and water management. But, of late, their conservation and management have become significant as a result of the global climate change. Most of these wetlands are of glacial origin and climate change is causing severe impacts on them. Several studies provide evidence of much greater warming of the Himalayan region compared to the global average of 0.74 °C over the last 100 years. The melting rate of the Himalayan glaciers has rapidly risen in recent years. The loss of glaciers will result in a considerable decrease in the availability of freshwater in the region which in turn will not only adversely affect the wetland ecosystem, but also the local communities who are directly or indirectly dependent on these wetlands. In some places where the wetlands are drying up, the land is being converted to other uses.

Some of the Himalayan Wetlands are transboundary and in some places the catchments are shared by more than one country. Therefore, for conservation of these wetlands, regional cooperation through government efforts is needed. In order to promote regional cooperation, organisation of regional workshops and meetings are essential for providing a forum for meeting of representatives of the national governments, scientists and NGOs to achieve conservation. A series of regional meetings and workshops held since 2002 (Urumqi, 2002; Kathmandu, 2003; Sanya, 2004; Evian, 2004; Delhi, 2006 and Changwon, 2007) have taken the form of 'Himalayan Wetland Initiative' forum (HIMWET) under the framework of Ramsar Convention. HIMWET primarily aims at promoting the objectives of the Ramsar Convention and implementing the Ramsar Strategic Plan

through cooperation and collaboration among the neighbouring countries sharing the Greater Himalayan region for the conservation and wise use of wetlands. The forum effectively achieved regional exchange of ideas that involved all governments in the region (i.e. Bangladesh, Bhutan, China, India, Kyrgyzstan, Myanmar, Nepal, Pakistan, Tajikistan, and Kazakistan), inter-governmental organisations such as Ramsar Convention Secretariat and International Centre for Integrated Mountain Development (ICIMOD), international environmental organisations (WWF, International, Wetlands International, and IUCN), as well as universities, academic institutions and civil society partners. In 2005, Ramsar COP9 officially recogni sed 'Himalayan Wetlands Initiative' as an important potential regional initiative and encouraged further development of this initiative for its official recognition for Ramsar COP10 in 2008. A number of Himalayan Wetlands have been included in the list of Ramsar Sites.

The ICIMOD also has a long history of working with the Himalayan wetlands and is trying to establish a Himalayan wetlands database and information system and develop an integrated approach for the wise use of wetlands. Even Centre for Environment Education is actively taking part in the conservation of the Himalayan wetlands through education and awareness among the local people.

The present study aims to find out how far these workshops and efforts by different centres have been able to provide sound management plans and the extent of their successful implementation for the conservation of the Himalayan Wetlands.

Theme-IV: Socio-cultural diversity and change

THE ETHNO SPECTRA OF INDIAN HIMALAYAN REGION WITH SPECIAL REFERENCE TO GALOS

Amrita Paul

Department of Geography University of Calcutta, Kolkata

The Indian Himalayan region stretches over 2,500 km from Jammu and Kashmir in the west to Arunachal Pradesh in the east spreading between 21º57′–37º5′N latitudes and 72º40′–97º25′E longitudes covering partially or fully twelve states of India. The region has a total geographical area of about 533,604 km^2 and is inhabited by 39,628,311 persons (2001).

The Indian Himalayan region is vast, rugged and dynamic. It supports remarkable cultural, ethnic and biological diversity. Multiple ethnic compositions are a striking feature of the region. Broadly divided into Western, Central and Eastern Himalaya, this region has its rich cultural diversity. Ethnic spectra of Central and Western Himalaya differs conspicuously from that of the north-eastern Himalaya. The population in the Himalayan region is nearly 40 million. The Hindus mainly dominate the sub-Himalayan and the middle Himalayan valleys. In places like eastern Kashmir to Nepal, it is mostly Hindu population while in the Great Himalayan region in the north; it is mainly the Tibetan Buddhists who are seen from Ladakh to the North-East India. In central Nepal both Indian and Tibetan cultures have blended together, producing a mixed culture with Indio-Tibetan traits while in the eastern Himalayas in India and nearby areas of Eastern Bhutan people practice religion and culture similar to those living in northern Myanmar and Yunnman province in China. Muslims area mostly seen in Western Kashmir and their culture is similar to the population of Iran and Afghanistan. Here inhabitants are generally tribal and are the native people of the land who are believed to be the earliest settlers, commonly called 'adivasis', implying original inhabitants. But their mix and assimilation with the new migrant tribal groups have made the socio-cultural diversity more rich and sound.

The Galos constitute a major tribe of Arunachal Pradesh (eastern Himlaya), who was earlier known as the Duba or Doba or Dobah Abors, Gallong Abors, gallong etc. Traditionally or historically they have been grouped together along with the other, Abor groups of tribes. After independence the 'Abor' has been changed to 'Adi', meaning 'Hillman'. Regarding the physical characteristics of the tribe of the region between Siang and Subansri rivers, they are essentially Mongoloid but are regarded as Palaeo Mongoloids. It may be said that a branch of the Palaeo Mongoloids who was left in Tibet/China, when its main body moved away towards south and south-east Asia remained for a longer period in their original place where they developed a distinct culture and language.

Though most of the people are autochthonous, unspeciali sed and multifamily groups, a huge change has come to their lifestyle because of the improvements in communication and transportation system and with the help of Government sponsored schemes like Tribal Development blocks. They are now intermingling with the modern societies – affecting traditional culture and social system. It will not be wrong if we conclude that in the Himalayan region the human resource is finite, dispersed and need to be managed carefully. Therefore proper analysis of finite resources based on real data may help to implement effective plan sustainability in the Himalayan Region.

A GEOGRAPHICAL ACCOUNT OF SANGLA VILLAGE, KINNAUR, HIMACHAL PRADESH

Anwesha Haldar

West Bengal Pollution Control Board, Kolkata

Sangla, a remote village in Himachal Pradesh lying south of the Kinnaur District within the Baspa river valley is filled with romanticism and folk lore. The region is comprise of the metasedimentaries overlying the Rakcham Granites, Jutogh, Chail and Rampur formations. The unconsolidated deposits of the Holocene period form river terraces along the Baspa which preserves the Quaternary glaciogenic remnants. Having experienced phases of folding and landform rejuvenation, this village situated on a terminal moraine, came into being after the glaciated meltwater lake receded. It has a thin podsolic soil profile suited for coniferous thickets. Demographically and culturally this place has both Tibetian and Indian traits. The people are vibrant, hospitable, hardworking and law abiding who believe in god and spirits. A unique matrimonial culture of polyandry, a tradition brought in by the Pandavas, existed till 1950s. The village has a linear settlement pattern extending north-westward along the road connecting NH 22 at Karcham. The wooden houses with slate roofs are intricately carved. Their economy is mainly agro-pastoral. A variety of apples, apricots, olives, walnuts and saffron have wide national and cross border market. Retail and tourism industry are also gaining prominence.

With an orderly network of the panchayat body and other agricultural, irrigational, educational, health departments, electricity board and banks, the people have access to the basic amenities of life. Even then life is not easy for the residents of Sangla. The major natural hindrances are the bitter winters leaving the land snow covered, barren and unproductive. During snowmelt, landslides and floods are common, aggravated by clearing of virgin forests for plantation and agriculture. The region is tectonically unstable causing frequent earthquakes resulting in loss of life and property. Human exploitation in the form of unplanned tourism development and horticulture has caused environmental pollution, cultural ingression and disruption to the native lifestyles. Yet it may be said that Sangla has high prospects to prosper if the residents fix the developmental priorities by preserving their past traditions and successively adopting modern techniques and innovations.

THE QUEEN AND THE COOLIES: A CASE STUDY OF SHIMLA, HIMACHAL PRADESH

Nilanjana Das

Department of Geography, University of Calcutta, Kolkata

Shimla, the Queen of hills, was the summer capital of colonial India. In the post-colonial period it expanded to become one of the major tourist destinations in the Himalayas. The porters (commonly known as coolies) are the mainstay of the tourism/ urban economy since most of the roads of Shimla are too steep to be motorable. This paper attempts to study the socio-economic conditions of the coolies. Their demographic structure, migration pattern, habitat and work environment have been examined to understand the extent of exploitation on which the economy of Shimla sustains itself.

PEOPLE OF DARJEELING HIMALAYA: SOME OBSERVATIONS

Rajib Chatterjee

Centre for Himalayan Studies, University of North Bengal, Raja Rammohanpur

Darjeeling, popularly known as the 'Queen of the Hills', is considered a hot spot for cultural diversity as the region is a mosaic of diverse ethnic groups. Owing to its geomorphic setting, these groups were less exposed prior to the British annexation. Hinduism, Buddhism, Christianity, and to some extent Islam, remain the predominant religion and Nepali, Hindi, Bengali, Tibetan or Bhutia and English are the prevailing languages. However, due to socio-cultural assimilation through the years, Nepali language has emerged as common lingua franca and most acceptable mother tongue.

The objective of this paper is to analyse the ethnic composition of the people living in Darjeeling Himalayan region. The paper is based on both secondary data sources and empirical data gathered during the field visits.

IMPACT OF TRIBAL CULTURE ON ECOLOGICAL SUSTAINABILITY OF THE ARUNACHAL HIMALAYAS

Satarupa Das Gupta

Department of Geography, Nagar College, Nagar

Arunachal Himalayas 'the land of the dawn-lit mountains' is India's richest region in terms of terrestrial biodiversity. A wide altitudinal range (less than 100 m in the foothills to more than 6,000 m), an associated diversity of habitats (tropical rainforests, subtropical and temperate forests, alpine meadows), and a unique geographical location contribute to the phenomenal range of biodiversity in

Arunachal Pradesh. The state has almost 82% forest cover (Government of India, 2005). It is considered a global biodiversity hotspot and is among the 200 globally important eco-regions of the World. It also has a rich cultural resource base – home to 26 major tribes and almost 110 sub tribes, with an intrinsic lifestyle and unique cultural behaviour.

The livelihoods of the tribes inhabiting this region are determined by the rich diversified terrestrial indigenous bio-resources. Hunting of wildlife is part of the Adi, Miju Mishmi, Digaru Mishmi, Nyishi, Wancho, Nocte and Apatani tribal culture. It is carried out mainly for household consumption. It is also a traditional norm and practice especially during tribal festivals and weddings. The economy of many of the tribes is subsistence in nature and governed by barter system. The resources in use and exchanged could be both plant and animal – primarily collected from forests and jhum lands. Some of the tribes do have a considerable subsistent agricultural economy. The tribes like Nyishis, Mishmis, Mijis, Thangsas, Bangnis, Galos and Akas practice jhum cultivation. Apatanis and Adis do practice wet rice cultivation.

The greater dependency of the tribal culture and livelihood on the Himalayan environment do have positive as well as negative impacts on the Arunachal Himalayan biodiversity. The impact varies based on the variations in cultural behaviour and ideological level of the tribes.

Dependence on forest for fuelwood as a primary source of energy, coupled with jhum cultivation has been causing deforestation. The average fuelwood consumption is comparatively higher in the northeastern states. As for example jhum cultivation has led to land degradation and hunting has led to declining mammal and bird species of the Arunachal Himalayas. For example, the Hornbill species are facing extinction due to traditional killing, deforestation and loss of habitat.

On the other hand, conservation of bio-resources is a common practice among many tribes. They conserve certain plant and animal species reciprocally because of their own and other's use. For example, the Apatanis have the tradition of planting trees thereafter cutting. The tribal culture of the Brokpas of Tawang and West Kameng Disticts maintains sustainability of their local plant and animal species through barter system.

An attempt is made by the author in this paper to explore the reciprocal relation between the tribal culture, traditions, their adaptive strategies, livelihood sustainability and the Himalayan biodiversity. It also highlights the significance of the State's effort in policy formulation in order to restore the bio-resources of the Himalayan landscape of Arunachal Pradesh.

A SPATIO-STRUCTURAL ANALYSIS OF URBAN HABITAT TYPES IN GANGTOK TOWN, SIKKIM

Soumendu Chatterjee, Nilanjana Das and **Utpal Roy**

Department of Geography and Environment Management, Vidyasagar University, Medinipur

The urban landscape of Gangtok, Sikkim represents a heterogeneous land area containing a mosaic of discrete habitat patches displaying a complex spatial pattern in their distribution that has varied over time. Anthropogenic activities related to urban development have disrupted the structural integrity and coherence of the urban landscape that impeded the ecological flows across the habitats and thus compromise the functional interlinkages between the habitats. This paper emphasi ses quantitative analysis of the spatial patterns of urban habitats in Gangtok town with the prime objectives of assessing the pattern-process relationships using advanced GIS techniques. A categorical map (mosaic of patches) has been prepared in vector format to categories the composition and spatial configuration of patch mosaic. Various types of landscape metrics have been employed to discern the geometric and spatial properties of categorical map patterns. Such metrics include percentage of landscape occupied by each patch type, patch richness, patch evenness, patch diversity etc. They have been used to assess the landscape diversity in Gangtok urban area. Spatial configuration metrics have been used to measure the placement of patch type over landscape in relation to other patches and other patch types (patch isolation, patch contagion etc.); degree of influence of surrounding habitats on the ecological properties of the habitats (edge effects); spatial relationship of patches and patch type (nearest neighbourhood, contagion etc.); degree of fragmentation (patchiness porosity etc.); functional connection between habitats (connectivity) and biodiversity (terrain complexity, species richness, ecosystem uniqueness, biodiversity value etc.). The analyses reveal that the urban habitats in the study area have been significantly fragmented and thus have lost continuity due to urbanisation.

ভারমোর ও কুগতি - একটি তুলনামূলক আলোচনা

শ্রীতপা নন্দী

ভূগোল বিভাগ, কলকাতা বিশ্ববিদ্যালয়, কলকাতা

ভারমোর ও কুগতি - পর্বতবেষ্টিত হিমাচল প্রদেশের দুটি ক্ষুদ্র গ্রাম। বুড্ডিল নদীর উপত্যকায় অবস্থিত হলেও দুটি গ্রামের মধ্যে পার্থক্য বিস্তর। বুড্ডিল হল সিন্ধুর বিখ্যাত উপনদী ইরাবতীর একটি ক্ষীণকায়া ক্ষুদ্র শাখা। ভারমোর ও কুগতি, দুটি স্থানই হিমাচলের চাম্বা প্রদেশে অবস্থিত অন্তর্হিমালয়ের অন্তর্গত। সমগ্র অঞ্চলটির উচ্চতা সমুদ্রতল থেকে ১২১৯ থেকে ৫৮৮২ মিটারের মধ্যে।

প্রাকৃতিক বৈচিত্র্যের ক্ষেত্রে এই দুই অঞ্চলের কিছু কিছু মিল পাওয়া যায়। জলবায়ুর দিক থেকে এখানে শীতল পার্বত্য প্রকৃতির জলবায়ু পরিলক্ষিত হয়। পার্বত্য অঞ্চলে যে সমস্ত উদ্ভিদ পাওয়া যায়, তার প্রায় সবই এখানে বর্তমান। পর্বতের ঢালে ধাপে ধাপে পাইন, রডোডেনড্রন প্রভৃতির প্রাচুর্য লক্ষণীয়। তবে গ্রীষ্মকালে আরামদায়ক নাতিশীতোষ্ণ জলবায়ু অনুভূত হয় আর এই জন্যই এই অঞ্চলে পশুপালনের আধিক্য দেখা যায়। যদিও ভারমোরে কৃষিকাজ করা হয়। ভারমোর যথেষ্ট উন্নত শহর। কিন্তু কুগতিতে সমতল অঞ্চল নেই, তাই পশুপালন করে অধিবাসীরা জীবন যাপন করেন। এছাড়া, কিছু তাঁতকল, করাতকল ও সামান্য কিছু চাষবাস করা হয় পর্বতের ঢালে ধাপ কেটে (আলু, গম, ভুট্টা ইত্যাদি)।

ভারমোরের একটি প্রধান বৈশিষ্ট্য হল রাস্তার পাশে আপেল গাছের সারি। আপেল এখানকার প্রধান অর্থকরী ফসল। কুগতিতে পরিকাঠামোগত অভাবের জন্য এখানকার অধিবাসীদের সবসময়েই নির্ভর করতে হয় ১৩ কিমি দূরের ভারমোরের ওপর, যেখানে যেতে গেলে ধৌল পর্যন্ত হাঁটাপথ ভিন্ন উপায় নেই।

সাংস্কৃতিক দিক থেকে দেখতে গেলে কুগতি ও ভারমোরের মধ্যে ব্যাপক পার্থক্য বর্তমান। শিক্ষা, জীবিকা বা অন্যান্য সুযোগসুবিধা না থাকায় বিশেষত পুরুষশ্রেণী অপেক্ষাকৃত উন্নত ভারমোরে চলে আসে উচ্চশিক্ষা বা জীবিকার সন্ধানে। কুগতিতে একটিই মাত্র বিদ্যালয় রয়েছে, ফলে এখানকার শিক্ষিতের হার খুবই কম।

ভারমোরের যোগাযোগ ব্যবস্থা যথেষ্ট উন্নত। যদিও পর্বতসঙ্কুল, তাও সড়কপথে হিমাচলের অন্যান্য অঞ্চলের সাথে এর যোগাযোগ রয়েছে। অপরদিকে কুগতির সাথে যোগাযোগের ক্ষেত্রে হাঁটাপথই একমাত্র উপায়। এছাড়া, এখানে মোবাইল ফোনও কার্যকর হয় না। বর্হিবিশ্বের সাথে যোগাযোগের একমাত্র মাধ্যম উপগ্রহ টেলিভিশন Tata Sky। এই যোগাযোগের অভাবই হল অঞ্চলটির উন্নতির প্রধানতম অন্তরায়।

ভারমোর ও কুগতি - অনেক অমিল সত্ত্বেও এদুটি স্থানের একটি বিশেষ মিল রয়েছে - তা হল এই জায়গা দুটির অপূর্ব প্রাকৃতিক পরিবেশ। আশা করব যেন তা মানুষের হস্তক্ষেপে কখনো ধ্বংস না হয়ে যায়।

MAN, ENVIRONMENT AND DEVELOPMENT OF PARTS OF THE WESTERN HIMALAYA, WITH SPECIAL REFERENCE TO SOME TRIBES, UTTARKASHI, UTTARAKHAND

S. C. Mukhopadhyay

Former Professor, Department of Geography, Calcutta University, Kolkata

This is an applied Geographical Study on the problems of man, environment and development of three tribes namely Gads, Jaunsaries and Rajis residing in Uttarkashi district and its adjacent Himalayan mountainous terrain of Uttarakhand. The present paper has been based on the advanced techniques of analysis and intensive field work producing the data and related information from primary and secondary sources (modern methods) both qualitatively and quantitatively. The analysis advocates that the trends of development in all the

three tribal communities were guided by economic and cultural forces. The mode of economy and cultural conservation of the Jaunsaries, for example, did not allow them much to diversify their economy. The Jaunsaries, actually remained traditional agriculturists and economically poor. Their demographic behaviour, to a large extent, is mainly controlled by conservative cultural principles which had affected the quality of life, particularly of females. The Rajis with nomadic way of life coupled with superstitions and believes are in the lowest level of economic and social development. On the other hand, the enterprising Bhotia (Jad Bhotias) tribe with an upward looking way of life had successfully taken advantage of their improved economic and cultural elements to promote growth with prosperity. They have used their culture as frame work for trying out new ideas and changes. The author has also investigated the features of recent development and changes using economic indicators of development among the three tribes mentioned above.

Theme-V: Natural resource management and policy implementation

LAND RESOURCE MANAGEMENT OF KALEJ KHOLA BASIN, SIKKIM

Bedhas Ujjwal Mandal

Department of Geography, University of Calcutta, Kolkata

The objective of the paper is to suggest sustainable options of Land Resource Management of Kalej Khola basin, Sikkim with particular emphasis on land use patterns. This basin is situated in West District of Sikkim which is marked by its tectonic instability, typical fluvial landscapes and scenic beauty. The entire area is drained by Kalej Khola and its numerous tributaries; hence water resource is very important. The study area is dominated by various land resources mainly forest resources, followed by agricultural resources which influence the land use patterns as well as socio-economic status. The northern and southern marginal ridges and parts of the dissected terrain to the west are covered with wet deciduous and coniferous forests. These forest resources comprise more than 50% of the existing land resources and land use. Step cultivation on the river terraces includes seasonal farming of cardamom. Newly developed floriculture and horticulture along with dispersed rural settlement can be observed. The development of land resources in this basin is also influenced by the road connectivity along both sides of the river valley. The socio-economic

development of this basin is entirely dependant on the existing land resource-based land use development on the present fluvial landscape. Therefore, the management of land resources and the existing land use patterns in Kalej Khola basin is necessary for maintaining the ecological sustainability.

LAND RESOURCE MANAGEMENT OF CHALSA FAN AREA, WEST BENGAL

Dipanjali Naskar and **Sonali Das**

Department of Geography, Baruipur College, Baruipur

The present paper puts forward some observations and findings about the Land Resource Management of Chalsa Fan Area, West Bengal. The study area gives an ample scope for studying the developmental strategies of alluvial fans. The study area covers an area of 1000 km^2, demarcated by Tista and Jaldhaka rivers. According to Bull (1964) fan processes are classified as mud flow, braided stream flow and stream channel flow, among these stream channel flow is responsible for the development of alluvial fans over this area. The geometry of fans is mainly controlled by the related factors like relief, climate, lithology and the hydrographic characteristics of the streams. The study area is comprises of mainly the Tista and Jaldhaka fans, along with many micro fans like Chel-Mal fan, Mal-Neora fan, Neora-Murti fan etc. The alluvial fan deposits are coarse grained poorly sorted and immature sediments. Usually boulders and gravels predominate with moderate to low amount of sand, silt and sometimes clay. The process of soil formation is hampered by regular flood deposits.

The development of Chalsa fan is controlled by some integrated factors like slope, climate, parent material, decrease of velocity etc. The piedmont zone of the foothills is well marked by the development of the alluvial fan.

This fan area is also marked by variable land use, dominated by agriculture. Agriculture is well developed over the fertile alluvial deposits on which prominent soil layers have developed. The gently sloping cultivated plots mainly suffer from lack of proper irrigation, particularly in Rabi season. The 250 m contour line demarcates Bhabar and Khadar. Due to the presence of Himalayan Frontal Thrust water percolates and in the downstream area it reappears by capillary action. Beside this, the soil character is also responsible. The entire fan area is dominated by sandy to loamy soil having high infiltration rate and low water holding capacity. So in the middle part of every fan the amount of surface water is low which affect the agriculture on the fan deposited areas. So proper land use management and a well planned irrigation system is needed for agriculture to prosper in this area.

FLUVIAL ENVIRONMENT AND LAND RESOURCE DEVELOPMENT OF WEST DISTRICT, SIKKIM

Koheli Naskar, Sushmita Mondal, Bittu Baidya and **Nabarun Jana**

Department of Geography, Jogesh Chandra Chaudhuri College, Kolkata

The present paper concerns a comprehensive study on the fluvial environment and its impact on land resource development of West district, Sikkim. This area falls within the Rangit river basin under Tista drainage system and embodies some fluvial landforms under a tectonically unstable zone which influence the development of land resource base and the resultant landuse pattern.

The landcover and land resources are mainly influenced by climate, soil and lithology of this area. The area is characterised by sub-tropical monsoon climate, development of immature soil profile and is endowed with various resources. The 60% of the region is covered by wet deciduous-coniferous forests and fluvio-glacial wasteland over the western and north-western parts. The rest of the land is enriched with abundant water resources, agricultural resources on the river terraces, mineral resources and most remarkable aesthetic resource based on natural scenic beauty of Sikkim Himalaya. Various landuse like crop cultivation, plantation farming, lumbering, cottage industry and tourism have developed based on these land resources which form the important socio-economic base of the West district. Agricultural land and settled areas are found to be the dominant land use pattern along with the development of transport connectivity over the rugged terrain. Management and development of land resources are therefore necessary for the sustainable development of West district, Sikkim.

LAND USE / LAND COVER MAPPING IN WESTERN HIMALAYA: A STUDY USING DIGITAL IMAGE PROCESSING, REMOTE SENSING TECHNIQUES AND GIS

Padmini Pani

Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi

In the present study an attempt has been made to make land use / land cover analysis in a part of Himachal Pradesh using LISS III and LISS IV Remote Sensing data and GIS techniques. The ground truth collections in these zones are physically challenging due to tough terrain and restricted mobility. The detailed mapping of vegetations, snow cover area and other land use, land cover classes in these areas is therefore, extremely difficult. This paper describes the use of IRS-ID LISS III 2007 (4 bands), IRS 1D LISS III 2008, (4 bands) and IRS P6 LISS IV 2008 (3 bands) sensor for deciphering land cover details.

This analysis essentially is focused on bringing out various snow cover classes in

the study area. However the data types play a major role to classify the land use category. This analysis attempts to understand and classify the snow cover in the area. However, data type itself plays a major role in the classifications of the land use specially snow cover category. The two type of data from two different sensors are not only interpreted based on optical interpretations keys but also played a significant role in identifying various land use, land cover classes using different digital image processing techniques. Topographic maps were used as reference base maps of the region. This work is based on a time series analysis using image processing software ERDAS Imagine to identify changes in land-use patterns. Standard image enhancements, registration, classifications and change detection techniques were performed, followed by generation of Colour Composite; Band Ratios and Principal Component Analysis (PCA) layers. LISS III false colour composites (FCC) of bands 4, 3 and 2; LISS IV FCC of bands 3, 2, 1 provided useful information for land-use mapping in the study area. The best band ratio was selected for processing and classification based on visual interpretation. Ratio images using the Normalised Difference Vegetation index (NDVI) were used to evaluate vegetation and bare soil. With the use of maximum likelihood supervised classification various land-use classes – water, open land, sparse vegetation, dense vegetation, agriculture, fallow land, river and snow, were identified from satellite data and verifies by field surveys. The snow classes are further classified, as full snow cover, partial snow cover, scanty snow cover and glacier with the help of their tonal variations.

LAND CAPABILITY CLASSIFICATION – AN APPROACH FOR SOIL CONSERVATION WITH SPECIAL REFERENCE TO KALIMPONG SUBDIVISION, DARJILING DISTRICT, WEST BENGAL

Salma Sultana

Department of Geography, Aliah University, Kolkata

The land capability classification is designed primarily for soil conservation and determining the maximum intensity of land use consistent with low erosion risks and sustained productivity. The growth of population and consequent demand for land are very high in the study area and per capita availability of land is very low due to ruggedness of the topography. The indiscriminate use of available land resources is responsible for the emergence of several environmental problems in the region. Land degradation is mainly due to population pressure (due to flourishing tourism and tea plantation) which leads to intense landuse without proper management practices. Landuse without considering the slope and erodibility will lead to severe erosion and related problems in the study area. Therefore, land capability classification is being considered as a necessary approach for sustainable soil conservation especially in the hilly region.

The Kalimpong subdivision is located in the eastern part of Darjiling district and comprises of three blocks i.e. Kalimpong I, Kalimpong II and Gorubathan. The region falls within the humid subtropical climate having mean annual precipitations of about 2500 mm, maximum and minimum temperatures of about 13.6 ºC and 6.3 ºC respectively and relative humidity of about 67%. Physiographically, the area is a part of Darjiling Himalayas (Eastern Himalayas), characteri sed by rugged hilly terrain and a complex geologic formation. The natural vegetation is divided into three forest zones depending on altitudinal variation, viz. tropical moist deciduous, tropical evergreen lower montane and tropical evergreen upper montane.

The deterioration of natural resource that has been taking place in this region is primarily due to indiscriminate felling of trees and clearance of forest canopies in both agricultural and plantation areas. Beside deforestation, steep slopes suffer from heavy run-off and soil losses. The main constraints of normal crop production are strong soil acidity, severe soil erosion and limited soil depth. Beside tea, other crops like maize, millet, cereals, oil seeds and fruits can grow well with adequate soil conservation measurement. Therefore, with a view to conserve natural resources within the region the land could be managed according to its land capability.

RURAL SANITATION SCENARIO IN THE KALIMPONG–I BLOCK, DARJILING DISTRICT: A CASE STUDY

Saptarshi Mitra

Department of Geography, Malda College, Malda

According to the Census of India 2001, the coverage of rural sanitation in West Bengal appears to be of 26.93 per cent. Out of this only 7.1 per cent households have latrines with water arrangements. In fact, lack of proper sanitation infrastructure in large number of rural households and unplanned drainage system tend to provide such unhygienic environment as to be the ideal breeding place for diseases like diarrhoea, cholera, dengue, malaria and typhoid.

The Central Rural Sanitation Programme was launched in India as well as in West Bengal in 1986. The objective of the programme was to reduce cases of airborne and waterborne diseases by improving healthy environment, securing privacy and dignity to women by providing safe sanitation facilities and to check the number of drop out of schoolgirls.

The three hilly Sub-divisions of Darjiling, Kurseong and Kalimpong in Darjiling, the northern most district of West Bengal, faced various problems at different times in implementation of sanitation programmes. During the early part of this

century due to socio-political disturbances in these three sub-divisions, all the developmental works including sanitation programmes came to a halt for some years. The programme however restarted in 2007-08 in collaboration with some NGOs. Kalimpong-I block, located in the northern boundary of the district has achieved relatively good position among the eight hilly blocks in the district. Initially the Gram Panchayats implemented rural sanitation programmes for constructing sanitary latrines in rural areas. The selection of families was made from the priority lists of prepared by the local Panchayats. Subsidy was given to the selected below poverty level (BPL) families for constructing sanitary latrines. In the year of 2007-08 and 2008-09, Kalimpong-I block accounted for more than 85 percent and 35 percent of total number of sanitary toilets constructed in the district respectively. Due to high slope and characteristic settlement patterns, site selection forms an important consideration for implementation of proper sanitation system in these areas. It seems that the efforts taken in this direction have started yielding fruitful results.

HYDROPOWER POTENTIAL AND EMERGING DISPUTES IN THE EASTERN HIMALAYA: THE CASE OF BRAHMAPUTRA RIVER

Teesta Dey

Department of Geography, Asutosh College, Kolkata

Brahmaputra, one of the most resourceful rivers draining the eastern Himalayan, is now becoming subject of a major controversy after the Chinese have planned to construct a major dam on its headwaters. Historically flood prone, the Brahmaputra is now perceived as a major source of economic development in India's northeast. The enormity of available water in the Brahmaputra can be gauged by the fact that more than 20% of the annual average of all the rivers of India is contributed by this river system alone which drains just 4.78% of the total geographical area of the country. The availability of this vast natural resource, combined with mountainous terrain characterised by the mighty Himalayan ranges, has offered great prospect for generation of hydropower in this region. The potential of this is assessed at about 28% of that of the whole country. From the construction of Umtru hydro power station in the south-bank of Brahmaputra river in 1957 (first in the Northeast region) to the recent Dikrong hydel power station, commissioned in 2001, the Brahmaputra system alone accounts for 34,920 MW of potential hydro power out of the total of 84,044 MW of the entire country. In spite of these potentialities, a number of hindrances—including ecological sensitivity and strategic significance of the area—have deterred development of power generation on this river. However, to achieve optimality in electricity generation in an economic way, development of full potential of the Brahmaputra river needs special attention. The present paper attempts to outline the prospects

of hydro power development on the Brahmaputra and tries to identify its benefits as well as negative impacts. Finally, a management plan for its overall improvement is also suggested.

Theme-VI: Role of geo-informatics in natural hazard management

IDENTIFICATION OF LANDSLIDE PRONE AREAS OF DARJEELING DISTRICT USING REMOTE SENSING AND GIS TECHNIQUES – A CASE STUDY

Soumen Dey

Department of Geography, University of Calcutta, Kolkata

Darjeeling district of west Bengal has faced massive landslides in recent years. The objectivity of the study is to locate the landslide prone areas based on the factors like landuse, slope, drainage density, stream ordering, lineaments and hydrogeological characteristics.

The Global Land Cover Facility (GLCF) data, the primary source of orthorectified images like MSS, TM, ETM+, and L7 of landsat satellite, showing the temporal change in the land use pattern as well as the rate of deforestation, are co-registered in UTM projection using the WGS-84 datum. Land slope, drainage density, stream ordering and lineaments have been recogni sed with the help of 90 metres resolution Shuttle Radar Topography Mission (SRTM) data. The temporal variation in land use pattern during the years 1977, 1989, 2000 and 2005 have been identified and mapped in the ERDAS imagine 9.2 platforms. A hydrogeological map of Darjeeling district has been digiti sed with the help of ARC-GIS 9.2 software. Every factor has been reclassified according to Landslide Hazard Evaluating Factor rating scheme (LHEF). Then each aspect has been combined giving specific weightage to identify the landslide prone areas of Darjeeling district with the help of Raster calculator in the spatial analysis tool in ARC-GIS.

The present study reveals that the landslide prone areas generally predominate in moderate to high sloping area with soft rocks traversed by one or more lineaments with high drainage density and without proper drainage control. The events are triggered mainly due to heavy rainfall along with the human activities in the form of high rate of deforestation and tea plantation. This tourist place has been turned

into a calamity prone area, which needs special attention to address its problems, especially in the monsoon months.

A STUDY OF LANDSLIDES THROUGH ANALYSIS OF CAUSES AND SUSCEPTIBILITY ZONING IN THE KURSEONG SUBDIVISION OF DARJILING HIMALAYAS

Sunil Kumar De

Department of Geography and Disaster Management, Tripura University, Suryamaninagar, Tripura

Landslides and related phenomena are the most serious natural hazard in the Kurseong subdivision of the Darjiling Himalayas. From the past records it becomes apparent that the area is suffering from landslide problems since 1849 and the situation has deteriorated further in recent times. The post-independence (1947) period, especially the last two decades (since 1968), have witnessed the worst landslides.

Ever since the British occupation, the physico-cultural set up of this region has been seriously disturbed. Vulnerable geological structure along with heavy and concentrated rainfall are primarily responsible for the occurrence of such menace but the situation has further deteriorated due to unscientific and unplanned usage of land for tea plantations, extensive heedless deforestation and haphazard construction works. From different records, maps and field survey 80 active landslides (till Dec, 2009) have been identified in the whole subdivision out of which 72 have been found in the sites of human interventions (29 in slope modification sites for road construction and other activities, 39 in other construction sites and 4 in tea gardens).

The main objectives of the present paper are to analyse the causes of these landslides and to prepare a landslide susceptibility map of the study area using RS and GIS techniques. For preparing such a map various thematic layers, viz. thrust buffer, lineament buffer, road buffer, lithology, relative relief map, drainage density map and aspect map were generated. Different classes of thematic layers were assigned the corresponding rating value as attribute information in the GIS environment and an attribute map was generated for each data layer. Summation of these attribute values were then multiplied by the corresponding weightage to yield the Landslide Susceptibility Index (LHI) for each cell. Finally a Landslide Susceptibility Zone (LSZ) map was prepared showing five susceptibility zones with ratings of ‘very low’, ‘low’, ‘moderate’, ‘high’ and ‘very high’. It is seen that the ‘moderate’ LSZ possesses the highest number of landslide events (35) in the area.

Theme-VII: Tourism, mountaineering and other anthropogenic actvities

SATOPANTH TAL (LAKE) – MYTH AND REALITIES

Bratati Dey

Department of Geography, Dhruba Chand Halder College, Dakshin Barasat,

The majesty and splendor of the Himalayas have captivated people from all over the world. The Himalayas have profoundly shaped the cultures of South Asia. Many Himalayan peaks have religious significance to Hinduism, Buddhism and Sikhism. Since time immemorial mountaineers, trekkers, tourists and researchers have studied and explored the Himalayas from different perspectives. In this paper an attempt has been made to integrate the geographical realities of an area as well as the mythological discourse.

Satopanth Tal –the glacial lake which is around 25 km from Badrinath, could be reached after an arduous trek crossing Lakshmiban and Chakratirtha. Natural Caves along the path are used as night shelter. Around Badrinath every place is steeped in legends so are Lakshmiban and Chakratirtha. It is said that goddess Lakshmi (goddess of wealth) and her husband Narayana meditated in Lakshmiban and Chakratirtha respectively and while meditating Narayan kept his famous Sudarshan Chakra on the ground which depressed by its weight and formed a beautiful round shaped valley surrounded by meadows and lofty mountains.

Traversing on to Satopanth glacier and hours of hard trekking on the treacherous moraine under the last ridge one can reach the lake. The first thing that strikes is the strange ethereal ambience of the lake. The perfectly triangle shaped lake at the base of the snow crested Chaukhamba peak, surrounded by lofty mountains. The crystal clear water of the lake mirrors the snow crested Chaukhamba peak. It is said here lays a path traversed by the Pandava brothers on their last journey to the heaven.

Information has been gathered through trekking experience, documentary evidences and verbal communication with local people which not only enrich one's understanding of the reality but also helps to relate the reality with mythology. The study of Satopanth Tal explores some geographical realities and tries to find out the mythological relevance. This documentation is significant for further research and analysis.

TOURISM OF NEWLY EXPLORED PARTS OF WESTERN HIMALAYA – A CASE STUDY OF CHAMBA DISTRICT

Kamalika Basu

Department of Geography, Dwijendralal College, Krishnagar

Himalaya, the mountain of antiquity and scenic beauty is a wonder in itself for every visitor. The land of mystic serenity, enchanting vistas, refreshing air, lofty mountain passes and slopes provides ample opportunity for nature lovers. Both the western and eastern parts of Himalaya are bestowed with numerous sites of tourist attraction. A major portion of the economy of Himachal Pradesh, Uttaranchal and Jammu and Kashmir significantly depends on tourism industry. Yet there are many unexplored places with huge tourist potentiality.

The present paper is an attempt to justify the potentials of tourism of many newly explored places of Western Himalaya considering Chamba town as well as Chamba district of Himachal Pradesh as the study area. In this regard emphasis has been given on geo-physical setting of Chamba, its economy backed by tourism, tourist potentiality and problems and prospects of tourism in Chamba.

TOURISM AND TERRORISM: A STUDY OF NORTH EAST INDIA

Piyal Basu Roy [1] and **Sukanta Das** [2]

[1] *Department of Geography, Alipurduar College, Alipurduar*

[2] *D.B.J.H. School, Bhatibari, Jalpaiguri*

At present, tourism is the largest service industry in India contributing 6.23% share to the country's GDP and 8.78% of the total employment in India. The states of India have myriad of tourist attractions with varied contribution to this emerging sectors. But there are a lot of states which, despite having immense tourism potential, cannot pull tourists due to threats in the name of terrorism – a buzzword in the 21st century. All the North-Eastern states of India belong to this category. This systematic spread of terror in the form of coercion within those states has significant impact on tourism demand. It cannot be denied that terrorism adversely affect tourism in a developing country like India by targeting its tourists and the same is broadly true in the seven sister states in Indian subcontinent. Tourists in general travel to get mental peace, relaxation of mind and satisfaction of their need by visiting natural as well as man made attractions worldwide. But it has been noticed that both domestic and international tourists remain reluctant to travel to Northeastern states due to increasing rate of terrorism. This growing terror among visitors compelled them to choose other destinations than the states of Northeastern India. This prominently influences the socio-economic prosperity and status of thses states despite their thrilling beauties and enchanting landscape.

The paper highlights here a correlation between the tourism and terrorism and tries to propose few interventions to reduce the tension among the tourists.

TOURISM FOR SURVIVAL: A CASE STUDY ON LACHEN AND LACHUNG, NORTH SIKKIM

Premangshu Chakrabarty

Department of Geography, University of Kalyani

Lachen and Lachung are the two villages in north District of Sikkim which are well known tourist destinations and tour operators in north Sikkim prefer these villages for the night stay of visitors travelling to Yumthang Valley, Thangu and Gurudongmar Lake (5,425 m). The valleys of Lachen and Lachung are the home of the Bhutia community who migrated from Tibet after the 15th Century. Till Indo-China border was closed in 1962, they regularly visited Tibet for trade and pasture land. The closure of border made life difficult for people of these two villages. As agricultural potentiality of the area is less due to physical constraints, the economy of the region suffered a set back as marginal people lost their primary occupation and became dependant on government aids. In such a scenario, the growing tourism activities in north district of Sikkim appear as a new hope. Tourism may be considered as the only sustainable option for the survival of the once self-sufficient agro-pastoral tribe living in the high altitude valleys of north Sikkim.

TRANSPORT AND TOURISM OF THE HIMALAYAN REGION

Shilpi Roy and **Anindita Mukherjee**

Department of Geography, University of Calcutta, Kolkata

Tourism is a significant industry in the Himalayan states. The picturesque Himalayan landscape has been the main reason for its development. It is to note that transport accessibility and connectivity plays a key role in the development of tourism industry in the Himalayan belt.

The study area lies between 28º–34ºN and 75º–97ºE and includes the following mountain states of Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, Northern Part of West Bengal and Arunachal Pradesh.

Road transport has been the major form of transport in the Himalayas. Pathankot-Uri is the most important nodal point joining almost all the important towns in Kashmir region having a road density of 3.3 km/km ^{2} of which 60% are surfaced. In the Ladakh region the only road is from Srinagar to Leh. Water and air transport are also available in Jammu and Srinagar. The Himachal region has very limited rail and air links. Rope ways are be provided for hauling timber, minerals

and emergency services. Two narrow gauge railway lines pass through the Kalka Shimla and the Pathankot-Jogindarnagar railway. Air service is seasonal between Delhi-Chandigarh-Bhuntar (Kulu). The road network in Uttarakhand is developing very fast but no air transport is available in this region. Though the development of transportation has accelerated since 1962 not broken. In the entire Himalayan region Darjeeling can only be regarded as a well connected town. The road network in all parts of Sikkim has developed enormously. In Arunachal Pradesh, there are six transport co-operative societies operating goods-cum-passengers services in the various parts of the territory. There are four airstrips in Arunachal Pradesh. The importance of transportation and tourism plays a very important role in the development of the Himalayan region.

Rugged terrain in association with thick forest cover, frequent landslide and heavy snowfall causes severe transport problems in the Himalayan region causing a hindrance to the tourism industry. The natural landscape offers a variety of tourist spot, which are often visited by not only domestic tourists but foreign tourists as well. Majority of the foreign tourist comes from U.S.A (54%) and U.K.(22%).

The authors in this paper attempt to analyse the modes of transportation and transport accessibility of the Himalayan region and transportation problems related to tourism of this region.

PROSPECTS OF ADVENTURE TOURISM IN THE HIMALAYAS – A COMPARATIVE STUDY OF TREKKING IN UTTARAKHAND AND SIKKIM

Sk Munsur Alam

Department of Geography, University of Calcutta, Kolkata

Today's tourists are not content only with traditional tourist places based on scenic beauty, culture or religion. They look for something more in a tourist place which has an element of adventure. Adventure tourism provides the tourist with a special thrill and feeling of adventure whilst participating in sporting activities in rivers, water bodies, hills and mountains. Trekking is one of the most popular forms of adventure tourism which means a journey to be undertaken on foot in areas where means of transport is generally not available. Trekking always refers to walking on trails; it does not entail cross-country hiking or climbing over rough terrain. Trekking is not mountaineering but just days of walking, along with adventure.

The Himalayan regions are famous for trekking. The most popular trekking areas are in Nepal, Sikkim, Darjilling and of course the vast belt of Jammu-Kashmir, Himachal, and Uttarakhand. But the objective, route pattern, altitudinal variation, scenic beauty and necessities of trekking in Western and Eastern Himalaya are

quite comparable. The present paper is an attempt to analyse the comparative nature of trekking in Western and Eastern Himalaya considering Uttarakhand and Sikkim as the two areas of illustration.

In this paper tourist flow pattern, nature and objective of trekking, mode of trekking, infrastructural support for trekking and other miscellaneous information has been discussed. Trekking in Uttarakhand and Sikkim is a complete adventure portal on the Himalayas. This paper aims to highlight the importance of adventure tourism and trekking in the Himalayas.

A SWOT ANALYSIS OF TOURISM IN SIKKIM AND FINDING MEANS FOR A SUSTAINABLE DEVELOPMENT

Sunita Chandra

Department of Geography, LalBaba College, Belur

In Sikkim, major tourist spots are located in the east (near Gangtok) and the west (the trekking zones) and some in the north of Sikkim. The state, considered as a tourism wonderland in the Eastern Himalayan region, is imperative to promote this industry since it generates employment and adds to GDP. On the other hand, the development of the tourist industry has to be planned and monitored carefully for reducing the negative impacts of tourism and environmental sustainability. There has been a tremendous growth in the domestic visitor arrivals for the past decade (18.4% annually). The growth of international visitors has also been consistent at about 5.6% on an average. As per the figures of 2007, out of 349,100 tourists, 331,263 comprised the domestic and 17,837 international. Domestic visitors for 2015 are expected to rise to 763,958 and International visitors to 33,631 as per calculations made by a study team comprising Government of Sikkim and Building & Construction Authority of Singapore.

THE ROLE OF TOURISM IN THE WATER SCARCITY OF DARJILING TOWN

Sutapa Saha

Department of Geography, Barrackpore Rashtraguru Surendranath College, Barrackpur

Darjiling, one of the oldest hill towns in India was established under the domain of the British Empire. The Darjiling Municipality was set up in 1850 with only 10000 population. During the period, 1910-1915, the water supply system was developed to cater to the needs of only 15000 population. The mode of operation in those times was basically to arrest the surface flow in reservoirs and then distribute it on the basis of gravity flow. With the passage of time, the town experienced phenomenal growth of population. (107197 population according to

2001 census).Over the period, a few water supply plants were installed in addition to the earlier ones, but these could not cope with the rapid increase of population. Hence, water crisis has become a perpetual problem in the dry period. In order to bring equity in the distribution, the municipality has no choice other than to start rationing of water which normally starts in the month of February and continues till the heavy showers in monsoon. At this stage because of the huge demand of water for domestic purpose, people are compelled to buy water which in turn has initiated 'water marketing'.

Unfortunately, the peak tourist season in Darjiling coincides with this water scarcity period. Generally in a peak tourist season, more than one lakh tourists gather in this small town and thereby create a huge demand for water for commercial purpose. At this juncture, 'water marketing' plays a crucial role and tussle between the domestic and commercial water sector finally turns it to a 'vicious cycle of water poverty'. The result is evident everywhere – starting from pollution to social unrest. It proves that this huge load of population is beyond the carrying capacity of Darjiling Municipality.

In this paper, the author has tried to analyse the situation of water scarcity during the peak tourist season and its impact on the social life .The theme has been conceptuali sed and structured through field survey, questionnaire survey and on the basis of information provided by the concerned authorities. The conclusion has been drawn on the basis of in depth data analysis and graphic representation.

PROBLEMS AND PROSPECTS OF TOURISM IN KASHMIR HIMALAYA: A CASE STUDY OF PAHALGAM

Suvradip Halder [1] and **Mahua Bardhan** [2]

[1] *Chinsurah Rabindra Sikshayatan High School , Chunchura*

[2] *Department of Geography, Netaji Satabarshiki Mahabidyalaya, Ashoknagar*

Kashmir is called the 'Paradise of the Earth'. The state of Jammu and Kashmir has become a famous and attractive tourist region since the Mughal period. Unfortunately due the problems of socio-political conflict and terrorism only the portion under India (Indian Occupied Kashmir) is now under tourism, covering only 35 - 40% of the entire area of the state. If the entire Kashmir Himalaya could be brought under tourism then it would really be a great economic support for the regional people as well as for India. Another important problem has arisen recently in the Indian Occupied Kashmir. It is the socio-political instability and agitation caused by the Muslim inhabitants to protest against the Government. Their activities have stopped temporarily for their own economic benefit.

The Indian occupied portion of Kashmir Himalaya has many breathtaking tourist places like Srinagar, Gulmarg, Pahalgam, Ladakh as well as pilgrimages like Amarnath, Vaishnodevi etc. Among these Pahalgam, the most famous and safest hill station in Kashmir valley has been selected as the study area. Pahalgam is situated at the confluence of Aru and Seshnag River in Anantanag District of Jammu and Kashmir at a distance of 96 km from Srinagar and 287 km from Jammu in the Kashmir valley between Pirpanjal range to the south and Zanskar range to the north surrounded by snow capped mountains of Western Himalayas. Pahalgam means 'The First Village (*pahela gaon*) on the way from Kashmir Valley to Ladakh. It was known as 'Shepard's Village' in the past and popular as a recreation centre in the Colonial era. Now the population is 5922. Gujjar is the main tribe in Pahalgam. The climate of Pahalgam is more pleasant than the surrounding hilly areas. Its lush green valleys have made it the main shooting spot of many Indian films promoting tourism. All types of tourist amenities coupled with facilities for adventure tourism and pilgrimage have labelled it as a perfect tourist spot.

But limited accessibility, less no of public vehicles, electricity problem and limited telecom connection hinder the growth of tourism here. The place is suffering from very poor condition of the local people with low literacy rate in women, unemployment in educated Gujjars, less opportunity for higher study, increasing child labour and shortage of mobile schools for the nomadic people. Besides these socio-economic problems, the melting of Kolahoi – the biggest glacier of Indian territory for last 3 decades may cause great danger in near future. The silt laden glacial melt water is not only increasing the volume of water in Lider River but is also shallowing the river course. These two factors can lead to flood in Lider valley area in near future affecting the tourism at Pahalgam.

The economic prospects can be seen in the budding globalisation scenario of the town as it is near Pampur which is the only Saffron cultivating area of Asia. It is the gate way to Amarnath, not affected by landslide problem like other hilly areas, less polluted, less congested and safest for Indian and foreign tourists in respect to the other tourist destinations in Kashmir. It should be highlighted by the Government to improve the socio-economic condition of the inhabitants for developing the tourism industry and vice-versa.

GORKHALAND: BEACON AGAINST RISE OF STATEHOOD

Chandrima Bandyopadhyay, Doyel Ghosh and **Ananya Sarkar**

Department Of Geography, Barrackpore Rastraguru Surendranath College, Barrackpur

The post-independence era witnessed a vulnerable situation for the people residing on the hills of West Bengal. Due to the age old subjugation, the plight of the Gorkhas living in Darjeeling region plummeted into an abyss. An analysis of how the social and cultural links have been diversified and changed, eventually highlights three phases – the pre-independence period, the British period and the post-independence period. Darjeeling was a part of the Gorkha Empire (1788-1815) and in 1816 restored by the British to the King of Sikkim. It was then a Lepcha-Bhutia tract. But the subsequent influx of people from Nepal led to the reduction of Lepcha-Bhutia inhabitants to an insignificant minority leading gradually to the separatist movement of the ethnic Nepalese settled in Darjeeling. In 1946, Ganeshlal Subba and Ratanlal Brahmin, members of Communist Party of Nepal (C.P.N) submitted a memorandum to Jawaharlal Nehru for the creation of 'Gorkhasthan' an independent country comprising of the present day Nepal, Darjeeling and Sikkim. During 1980s the Gorkha National Liberation Front (GNLF) leader Subhash Ghishing raised the demand for the creation of a state called Gorkhaland. The movement took a violent turn leading to an agitation and the issuing demand for statehood culminated into the formation of Darjeeling Gorkha Hill Council (DGHC) in 1988. Presently a new party, Gorkha Janamukti Morcha (GJM) formed on October 7, 2007 by Bimal Gurung, demanded for separate statehood (Darjeeling along with Dooars) once again and the struggle continued. Because of this serious agitation the two primary means of livelihood of the people – tourism and tea production, has been hampered. The primary objective of this paper is to focus on how the fear of deprivation and anxiety of losing their cultural identity work as a motivating force for diversified groups of various cultures – Indian born Nepalese, Migrant Nepalese, Lepcha-Bhutia, and the Bengalis inhabiting the hills. Finally the study highlights and emphasi ses upon the causes and impacts of agitation in the proposed Gorkhaland area from the geo-political point of view.

HIMALAYAN GEOPOLITICS: A QUEST TO COMMAND OVER NATURAL RESOURCES

Kunaljeet Roy and **Chandrama Bhattacharya**

Department Of Geography, Barrackpore Rastraguru Surendranath College, Barrackpur

The Himalayas separate the Indian subcontinent from the Tibetan Plateau. By extension it also signifies the massive folded mountain system which includes the Himalaya proper, the Karakoram, the Hindu Kush, and a host of minor ranges extending from the Pamir Knot. Through the ages the Himalaya is the storehouse of various natural and cultural resources. Geo-strategy of the region is witnessing marked changes in recent times. Two major powers, China and India, including Pakistan and even U.S.A are competing for a firm foothold in the vast region that has assumed unprecedented strategic as well as economic importance. China is reviving the 3,000 year old Silk Route, to make it the jugular vein of vast Sino-Eurasian trading region. Apart from it, Beijing is also considering initiation of Trans Karakoram railway project, connecting China with Pakistan. India's entire northern frontier from Siachin Glacier westwards to Keran-Tithwal range becomes vulnerable and any future plan in Sino-Pak geo-political strategy will largely shrink India's sphere of influence northward and westward, also imperiling the security of entire northern border. Water has emerged as a key issue that could determine whether Asia is headed towards mutually beneficial cooperation or deleterious inter-state competition. China, reign the Tibetan plateau being the source of major rivers of Asia, considered as lifeline to world's two most-populous states, China and India, as well as to Bangladesh, Myanmar, Bhutan, Nepal, and Pakistan. The fact is that, China is building dams on the Brahmaputra to divert water to its territory which may result in water scarcity in the northeast regions of India. Not only that, the Chinese are also building hydropower projects in Tibet and Zangmu and even plan to build four more dams at Jiacha, Zongda, Lengda, Jiexu and Langzhen. The construction of Baglihar dam on the Chenab near Jammu adds to the list as it causes immense conflict between India and Pakistan. Moreover China has a fundamental national interest in retaining Tibet, because Tibet is the Chinese anchor in the Himalayas. If Xinjiang became independent, a vast buffer between China and India would break down. So, in view of this complex geo-political scenario, the present paper traces the roots of the trans-national conflicts and controversies arising in the Himalayan region following its short and long term effects, especially on the local environment. The analysis has been done on the basis of various newspaper reports, maps and satellite imageries of disputed areas, accompanied by reasoned interpretation. Finally few way outs have been suggested to improve the current situation, ensuring sustainability of the Himalayas.

CHINESE HEGEMONY IN GEOPOLITICS OF THE HIMALAYAN REGION

Lakshmi Narayan Satpati

Department of Geography, University of Calcutta, Kolkata

Technological development in military activities has proved that the Himalaya is no more an effective barrier to protect the countries against aggression of their neighbours. Since the late 1950s, the rise of China as one of the powerful nations, its annexation of Tibet, and nature foreign policy have proved to be a potential threat to India. Although an uncomfortable truce between India and China became possible after the bitter Indo-Chinese war in 1962 under the *Panchsheel Agreement*, 1954, some of the incidents of the recent past on part of the Peoples' Republic of China are highly provocative to invite any untoward relation between the two countries. China has already occupied a huge area of Arunachal Pradesh in the North East Indian mountain region, and also in Akshai Chin. Recent documents suggest that the presence of the Peoples Liberation Army (PLA) of China is very active in the Gilgit-Baltistan region and also in almost entire northern boundary of the Himalaya. Chinese military engineers are said to be engaged in construction of dams over the Yarlung Tsang Po River, the upper part of the Brahmaputra, and are also planning to build dam at Namcha Barwa region either to store and divert water and/ or to generate hydro-power. Chinese long range ballistic having overhead nuclear capability can strike quite accurately at any location within a distance of 20000 kilometres. It is also said that China has secret missile launching centre at high Tibetan Plateau from where it can control almost entire Asia and South West Pacific-Indian Ocean region. George Ginsburg and Michael Mathos in the book *Communist China and Tibet* (1964) pointed out *"He who holds Tibet dominates the Himalayan piedmont; he who dominates the Himalayan piedmont, threatens the Indian subcontinent; and he who threatens the Indian subcontinent may well have all of South-East Asia within his reach, and all of Asia".* Completion of the Trans-Tibetan Railway popularly known as Qingzang Railway, in 2007, to connect Lhasa with Beijing has facilitated easy transfer of man and materials to these previously remote areas. China is in the process to build a huge dry port at Tatopani east of Kathmandu and is connecting all weather roads with Tibetan region. The dominance of China in the economy and policy of Nepal has been increasing over the last few years, which can be ascertained by the political scenario of the country. According to Claude Arpi (2010), "Communist China had not only decided to establish her *de facto* suzerainty over Tibet, but it was the first step towards the South, the opening of the gateway to India and to

other countries that China claimed as her own. Mao had termed Tibet as the palm of the hand with the five fingers being Ladakh, Sikkim, Nepal, Bhutan and NEFA". This is because present China needs to have more food and other life sustaining facilities for its billion plus population who are now in a position to compete with any other nation in terms of skill and competence.

GEOPOLITICAL CONFLICTS IN HIMALAYAN BUFFER REGIONS: A REVIEW ON GEOGRAPHICAL PERSPECTIVE

Md. Iqbal Sultan

Department of Geography, University of Calcutta, Kolkata

The Great Himalaya is not only a natural wall between Indian sub-continent and middle Asia but is a dividing line between divergent cultures. There is a long political conflict in the 'Buffer Regions' of Himalaya like Kashmir, Tibet, Arunachal Pradesh and even Sikkim. But undoubtedly it is not only a political dispute among the rising powers of South-East Asia to control over the so-called controversial areas. According to Structuralism, the root of conflict lies in economic, anthropogenic and cultural structure of the respective areas. Though most of the regions are geographically relatively isolated due to difficult terrain and climate but they are rich in natural resources. Besides many biotic and abiotic resources, the region has immense potentiality of tourism. On the contrary, the transitional regions have their own history and unique cultural entity. A clash between people and state is rising in these regions which is not always a mere political issue.

The main aim of this paper is to analyse the problems of land, resource and culture of the Himalayan Buffer Regions in the perspective of Political Geography as well as Social Geography.

THE HIMALAYAS: SILK ROAD GEOPOLITICS

Rituparna Khan (Bishnu)

Department of Geography, Krishnanagar Govt. College, Krishnanagar

The Silk Road (or Silk Routes) is an extensive interconnected network of trade routes across the Asian continent connecting East, South, and Western Asia with the Mediterranean world, as well as North and Northeast Africa and Europe. In ancient period the Silk Road was of immense significance, both for overseas as well as regional trade across and along the passes of the lofty Himalayas. In recent years, both the maritime and overland Silk Routes are again being used, often closely following the ancient routes. The Himalayas, since time immemorial, have played a pivotal role in business activities across the silk routes.

For almost four thousand years, the old Silk Road connected a dozen cultures on the swaying backs of camels carrying silk and gold between China, Central Asia, Middle East and the Levant. Along this road religious ideas of Gnosticism, Nestorian Christianity, Hinduism, Buddhism and Islam were exchanged, influencing major civilisations including Persia, India and China. In the course of time religion intermingled with politics. Power and wealth in Eurasia was often related to an ability to control at least part of the Silk Road, which was important to Persians, Parthians, the Kushans, and China.

By the 18th century the Silk Road was reduced to secondary importance, with more significance for regional trade rather than the trade between Europe and Asia. The intrusion of European naval power into Arabic, Indian and Asian waters was also instrumental in the decline of the economic relevance of the Silk Route.

The geostrategic views and related heartland idea conceptuali sed by Halford J. Mackinder played a significant role in the Silk Road geopolitics. However, with renewed economic growth in East Asia, and a transformed political landscape in Central Asia, the time seems ripe to reconsider these doctrines. Today, we have in Central Asia a region that is allowed to pursue more realistic economic policies, to fulfill indigenous nationalistic and religious expectations, and to begin to engage in trade and cultural exchange with adjacent sectors to the south, west, and east. We can now turn around the sea and heartland doctrines to suggest that the doctrine of land, (continental integration) combined with suitable air-power and communication technologies can once again play a significant role for the future of Europe and Asia.

What role this Eurasian region will play in reacting with emerging Pacific-Rim dominant economic structure, and the existing Atlantic cultural-military-economic structure, also needs to be considered. The paper aims to analyse the importance of the Silk Road from the perspectives of explorers, traders, the Eurasian Super-Region and inter-regional trade. These perspectives have been considered to get a view of how the Himalayas, since ancient days have helped in controlling the geopolitics of trade through the Silk Road.

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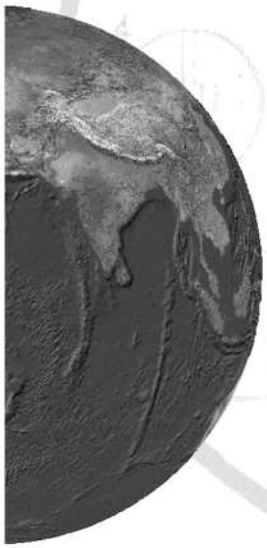

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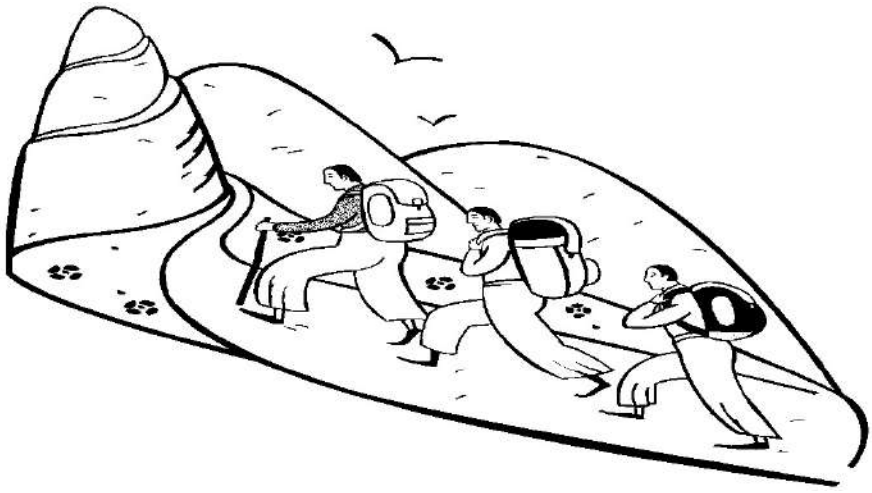

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Theme-VII: Tourism, mountaineering and other anthropogenic actvities

SUSTAINABLE TOURISM IN SIKKIM

Sanjukta Sattar

Department of Geography, Gokhale Memorial Girls' College, Kolkata

Sustainable tourism is a type of tourism that avoids damage to the environment, economy and cultures of the tourist destination. This type of tourism attempts to make a low impact on the environment and local culture, while helping to generate income, employment and the conservation of the local ecosystem. WTO defines sustainable tourism as an activity that leads to the management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support system. It also aims at meeting the needs of the present tourist and host communities whilst protecting and enhancing the needs in the future.

The small and beautiful Himalayan state of Sikkim with a fragile ecosystem claims to be an ideal example of a tourist destination committed to the principles of sustainable tourism. Against this backdrop the following paper attempt to explore how the development of tourism industry in Sikkim has taken place guided by the tenets of sustainable development and to what extent it is benefiting the host community, hence acting as a tool for the overall development of the state at the same time enhancing and preserving its natural and cultural resources.

Information has been gathered through trekking experience, documentary evidences and verbal communication with local people which not only enrich one's understanding of the reality but also helps to relate the reality with mythology. The study of Satopanth Tal explores some geographical realities and tries to find out the mythological relevance. This documentation is significant for further research and analysis.

ELECTORAL POLITICS IN JAMMU AND KASHMIR

Aritra Chakraborty

Department of Geography, Presidency College, Kolkata

India is a democratic nation; therefore, elections of the legislators are a routine exercise in this country. Being a part of this country the state of Jammu and Kashmir should also be a part of this electoral system. However, democracy in this state has lost its meaning because this vast ethnically diverse state has become an international cause of disagreement where its people have become a pawn of this game. Unlike the other states of India, Kashmir's internal politics works differently, where low voter turnout, large-scale violence, demand for self-determination, vote boycott and clash of interest between various social groups play an important role and dilutes the very basic essence of democracy. The question of development, education, health, governance, food and shelter fades out on the background of gunfire, security forces, and militancy and ethnic clashes. This makes the way for certain political outfit to capture power who can swing this turmoil situation into their favour. It is interesting to note that in case of Kashmir the electoral outcome is highly related to ethnic and regional questions. Not only the regional political parties but also the national political groups have certain pockets of vote bank, which are completely a function of high scale regionalism.

The present paper seeks to understand the nature of voting pattern in the state of Jammu and Kashmir and tries to analyse its significance as far as the regions political importance is concerned. It also shows how the question of region and ethnicity plays an extremely important role in the politics of Jammu and Kashmir. Finally, the paper also tries to seek the answer whether the spirit of democracy has been truly reflected in Kashmir or it has become a failed state in this regard.