



URBANIZATION: Challenges and Opportunities



ABSTRACTS

3rd Graduate Conference on Environment and Sustainable Development (GCESD)

Trade Tower, Thapathali, Kathmandu

April 03-04, 2017 (Chaitra 21-22, 2073)



Tribhuvan University
CDES



Institute for Social and Environmental Transition - Nepal

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Conference at a Glance

Background

Nepali society needs visionary and creative thinkers to understand the changing social, political, cultural and economic climate. In particular, young graduates can play a significant role in sharing their ideas among their peers and other groups within society. Graduates from Nepali universities need to engage with each other and wider society to promote economic development, social welfare and environmental stewardship.

The Central Department of Environmental Science (TU-CDES), Institute for Social and Environmental Transition-Nepal (ISET-Nepal) and Resources Himalaya Foundation (RHF) have come together to create the yearly Graduate Conference on Environment and Sustainable Development (GCESD) known as Himalayan Knowledge Conclave (HKC).

The conference brings together graduates to present their research and review each other's work. The conference aspires to develop leadership and public speaking skills of the participating graduates by involving them in the conference processes. The conference also provides an opportunity for networking among peers and experts. The conference is held on first week of April.

Conference goal

To establish an interdisciplinary knowledge-sharing platform for young researchers, with a particular focus on environment, resource conservation, management, economic development and natural science.

Modality

An advisory board provides overall guidance and supervision. Management team coordinates scientific and logistic aspects of the conference. ISET-Nepal, as the conference secretariat, takes care of logistics and conference management for 2017.

Participants

All interested graduates and young researches in the areas of environment, sustainable development and related disciplines can participate. The students who are currently studying in Master's level and/or recently completed the level can make oral and paper presentations. However, the students studying in Bachelors level can only participate in the discussions and events.

Thematic Areas

- a. Pollution and health
 - Air, water and land
 - Impact on health
 - Remedies
- b. Disaster and climate change
 - Earthquake, landslide, flood, drought, lightning, snow avalanches, epidemics
 - Impacts, adaptive practices, resilience building, indigenous knowledge and technology that support adaptation
 - Development and disaster interface
 - Economics of climate change and DRR
- c. Basic services, infrastructure and housing
 - Status of basic services: infrastructure, housing etc
 - Community-based practices
- d. Urban-ecosystem, biodiversity and food system
 - Ecosystem-based adaptation
 - Urban heat island issues
 - Status, challenges and opportunities
- e. Solid/liquid waste management
 - Status, constraints and opportunities and alternatives
- f. Heritage and conservation
 - Status, challenges, and opportunities

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Message from the Chair

I am pleased to announce that Tribhuvan University-Institute of Science and Technology (TU-IOST), in cooperation with the Ministry of Population and Environment of the Government of Nepal, is organizing the Third Graduate Conference on Environment and Sustainable Development (GCESD) on April 03 and 04 of 2017 in Kathmandu. This Conference, also known as Himalayan Knowledge Conclave (HKC), is jointly organized with support from the Central Department of Environmental Science (TU-CDES), Institute for Social and Environmental Transition-Nepal (ISET-Nepal) and Resources Himalaya Foundation (RHF).

The conference aims to establish an interdisciplinary knowledge-sharing platform for young researchers, with a particular focus on environment, resource conservation, management, economic development and natural science. This year, the Conference is accommodating about 50 oral presenters and 25 poster presentations.

I earnestly believe that this conference will provide young researchers with an effective medium to share their experiences and discuss issues and challenges concerning the environment. I, therefore, have a strong conviction that this conference will motivate young researchers, develop networks between them and help them hone their leadership skills. On the behalf of the organizing team, I express immense gratitude to all the organizations, institutions, individuals, HKC team members and delegates for providing their continuous support and cooperation.

May the conference be memorable, inspiring and fruitful. I wish the organizers the very best of luck.



Prof. Ram Prashad Katiwada, PhD

Dean

Institute of Science and Technology

Tribhuvan University

Conference Chair-HKC-2017

Contents

Conference at a Glance Message from the Chair

Agriculture and Livelihood	13
Impact of Zinc Application on Chilli Yield <i>Achyut Gaire, Situ Khanal</i>	14
Study of Drought of Gorkha District and Its Impact on Agricultural Productivity <i>Ashok Kumar Shrestha, Binod Dawadi</i>	15
Urban Agriculture: Scenario and Necessity for Sustainability <i>Khem Raj Awasthi, Dr. Suresh Gautam</i>	16
Production Economics of Maize Seed Production in Palpa District, Nepal <i>Mahesh Sapkota, Rishi Ram Kattel, Nirajprakash Joshi, Mahima Bajracharya</i>	17
Impacts of Climatic Variability in Agriculture in Goljung VDC, Rasuwa Nepal <i>Sijal Pokharel, Kedar Rijal</i>	18
Shifting from Orange to Vegetable Farming in Ghasekuwa Village of Tanahun, Nepal <i>Sunam Pradhan, Udhav Raj Khadka</i>	19
Post-Harvest Loss of Wheat and Its Impact on Food Security: A Study from Raikwar Village of Kanchanpur District, Nepal <i>Suresh Raj Paneru, Giri Prasad Joshi And Chandra Prasad Pokhrel</i>	20
Wildlife Conservation	21
Breeding Success of White-rumped Vulture (<i>Gyps bengalensis</i> Gmelin) in Rupandehi District <i>Bina Ghimire, Karan Bahadur Shah</i>	22
Human Rhesus-Macaque Conflict at Goldhunga, Kathmandu Nepal <i>Kushum Regmi, Man Kumar Dhamala</i>	23
Prevalence of Gastro-Intestinal Parasites of Rhesus Macaque (<i>Macaca mulatta</i> Zimmermann, 1780) And Hanuman Langur (<i>Semnopithecus entellus</i> Dufresne, 1797) in Devghat, Chitwan, Nepal <i>Pujan Prasad Adhikari, PitambarDhakal</i>	24
Occurrence, Abundance and Distribution of Small Mammals in Ghodaghodi Municipality, Kailali, Nepal <i>Rasmi Kunwar, Khadga B. Basnet And Sandhya Sharma</i>	25
Assessment of Pet Trade (Turtle and Tortoise) In the Kathmandu Valley <i>Sandesh Neupane, Man Kumar Dhamala</i>	26
Distribution and Habitat Characteristics of Red Panda (<i>Ailurus fulgens</i>) in Chitwan-Annapurna Landscape, Nepal <i>Damber Bista, Saroj Shrestha, Shanta Raj Jnawali, Sonam Tashi Lama, Manish Kohk, Gokarna Jung Thapa, Pema Sherpa, Kapil Khanal, Arjun Thapa</i>	27
Population Status, Distribution of Nilgai (<i>Boselaphus tragocamelus</i>) and its Conflict with Human in Rupandehi District, Nepal <i>Srijana Khanal, Achyut Aryal And Nanda Bdr. Singh</i>	28
Plant Biodiversity	29
Application of Game Theory to Determine the Profitable Strategy: REDD+ or Forest Product Trade (A Case Study from Pragati Community Forest, Shaktikhori VDC, Chitwan, Nepal) <i>Dhroj Prasad Koirala, Prof. Dr. Krishna Raj Tiwari</i>	30

Naturalized Plant Species in Central Mid-Hills of Nepal <i>Gajendra Prasad Chataut, Mohan Siwakoti, Bharat Babu Shrestha</i>	31
Effects of Anthropogenic Disturbances on the Regeneration of <i>Quercus semecarpifolia</i> Sm. Forest <i>Ganesh Bhattarai, Man Kumar Dhamala, Paul Egan</i>	32
Floristic Study of Ferns in Altitudinal Gradient from Besishahar to Lower Manang, Nepal <i>Hira Shova Shrestha, Sangeeta Rajbhandary</i>	33
Impact of Community Management of Forests on the Diversity of Invasive Alien Plant Species: A Case Study from two Community Forests of Nepal <i>Laxmi Khaniya And Bharat Babu Shrestha</i>	34
Diversity and Assemblages of Canopy and Ground Layer Beetle of Sal Forest and Riverine Forest in Chitwan National Park, Nepal <i>Pradip Subedi, Indra Prasad Subedi</i>	35
Variation in Plant Functional Traits in Two Threatened Species of Orchids along a Subalpine-Alpine Gradient in Manang, Central Nepal <i>Pratikshya Chalise, Yagya Raj Paneru And Suresh Kumar Ghimire</i>	36
Diversity of Invasive Alien Plant Species across vegetation types in Terai and Siwalik regions of central Nepal <i>Sajita Dhakal, Bharat Babu Shrestha And Mohan Siwakoti</i>	37
Naturalized plants in the Modi Watershed of Annapurna Conservation Area, Nepal <i>Samiksha Banjade, Mohan Siwakoti, Bharat Babu Shrestha</i>	38
Naturalized Plant Species along Marsyangdi River Valley, Central Nepal <i>Sangita Thapa, Mohan Siwakoti, Bharat Babu Shrestha</i>	39
Increased Herbivory Hinders Competitive Ability of Native <i>Alnus nepalensis</i> against Invasive <i>Ageratina adenophora</i> <i>Sujanbalami, Lal Bd. Thapa</i>	40
Estimation of Carbon Stock under Different Forest Management Regimes of Bara District, Nepal <i>Sujata Karki, Anjana Devkota, Bharat Babu Shrestha</i>	41
Taxonomic Study of the Genus <i>Aster</i> Linn. (Asteraceae) of Nepal <i>Sunita Shrestha, Sangeeta Rajbhandary, Maan Bahadur Rokaya</i>	42

Disaster Risk Reduction **43**

Characterization and Distribution Pattern of Landslides in Mailung, Rasuwa <i>Akash Acharya, Krishna Pudasaini, Subodh Dhakal</i>	44
Landslide Susceptibility Mapping and Sediment Loss Estimation along the Road Corridor, from Bandeu to Barahabise, Sindhupalchok District <i>Anu Khadka, Subodh Dhakal, Ajay Bhakta Mathema</i>	45
Landslide Characterization and Mapping on the Way from Munglin to Abu Khairini <i>Arishma Gadtaula, Rabina Hada, Sharmila Neupane, Shila Bhattarai, Subodh Dhakal</i>	46
Estimating Earthquake Social Vulnerability Index of City Core Area: A Case of Ward No. 26 Kathmandu Metropolitan City <i>Ashok Maharjan, Govinda Acharya, Amrit Sharma</i>	47
Landslide Characterization and Analysis Using GIS for Rapid Risk Reduction <i>Badal Pokharel, Harish Dangi, Sanjeeta Pandit, Subodh Dhakal</i>	48
Characterization and Mapping of Malebagar Landslide along Beshishahar to Chame Road Section <i>Bhuvan Panday, Pushkar Bhandary, Krishna Pudasaini, Subodh Dhakal</i>	49
Floodplain Analysis in Upstream Region Of Koshi River, Nepal <i>Pritika Pushpam, Keshav P. Sharma</i>	50

Pollution And Health	51
Pathogenic Bacterial Contamination in Metropolitan Water Supply in Nepal <i>Abhusani Bhuju</i>	52
Assessment on Sensitivity of Roadside Plants by Using Air Pollution Tolerance Index <i>Bhumika Sunuwar, Madan Koirala</i>	53
Changes in Water Sanitation and Hygiene Practices in Baijanathpur <i>Dikshya Dahal, Sanjay Nath Khanal, Bikash Adhikari</i>	54
Potential of Agricultural Water Security through Wastewater Use: Case Study of Harisiddhi Wastewater Treatment Plant <i>Manina Baidya, Robert Dongol</i>	55
Potential Reduction of Dioxin and Furan through Environmentally Sound Health Care Waste Management Model in Hospitals of Nepal <i>Puna Bhaila, Ram Charitra Sah, Sunil Babu Khatri</i>	56
Environmental Impacts Caused by Open Dumping: A Case Study of Banepa, Kaverepalanchowk <i>Ram Sharan Devkota, Bharat Bhandari</i>	57
Bacteriological Profiling of Burn Wound from Patients Visiting Nepal Cleft and Burn Centre, Kritipur, Nepal <i>Saru Bhattarai, Basudha Shrestha, Nabin Kishor Bimali</i>	58
Climate Change	59
Impacts of Climate Change on the indigenous Majhi community in Nepal <i>Bashudev Neupane, Ruth Butterfield</i>	60
Climate Change Impacts on Reservoir Based Hydropower Projects in Nepal: A Case Study of Budhi Gandaki Hydroelectric Project <i>H.L. Budha, Robert Dongal</i>	61
Tree Carbon Stock in Mountain Forest of Central Nepal <i>Kushum Shrees, Anjana Devkota, Bharat Babu Shrestha</i>	62
Comparison of Carbon Stocks in Community Forests of Lamahi Corridor, Kailali in Terai and Basanta Corridor, Dang in Inner Terai <i>Pratima Thapa Karki, Ram Asheshwar Mandal</i>	63
Climatic Upshot on Growth Pattern of <i>Pinus roxburghii</i> In Mountain Sub-Tropics (A Case from Panchase, Western Nepal) <i>Sugam Aryal, Dinesh Raj Bhuju, Deepak K. Kharal</i>	64
Impact of Climate Change on a Selected Building's Energy Consumption in Kathmandu Valley <i>Sameer Pandit, Nawraj Bhattarai</i>	65
Cross Cuttings	67
Seasonal Dynamic of Coffee (<i>Coffea arabica</i> L.) Insect Pests and Their Management in Thanpati VDC, Gulmi District, Nepal <i>Binita Pandey, Dayaram Bhusal</i>	68
Environmental Consideration and Corporate Social Responsibility: A Case of Varun Beverage, Kathmandu, Nepal <i>Manju Shrestha, Udhav Raj Khadka</i>	69
Revisiting REDD Plus Pilot Project for Tree Biomass Assessment in Kayarkhola Watershed, Chitwan District, Nepal <i>P. Bhusal, P.C. Aryal</i>	70
Assessing In-kind Contribution of Syaubari Community in Biodiversity Conservation and Effectiveness of Buffer Zone Program in Household Income, Langtang National Park, Nepal <i>Roshan Sherchan, Kedar Rijal, Siddhartha B. Bajracharya</i>	71

Abstracts Of Poster Presenters

73

- Fuelwood Demand and Supply Assessment in Bajani Kilaupad Community Forest:
A Case Study of Api-Nampa Conservation Area, Nepal 74
Vijay Dev Bhatt, Kedar Rijal, Nabina Maharjan
- Effect of Biochar Application on Soil Micronutrients and Crop Yield 75
Aashna Shakyra, Roshan Man Bajracharya, Nani Raut
- Tree Diversity and Forest Sustainability through Participatory Forest Management:
A Case of Chainpur VDC, Chitwan Nepal 76
Anima Shrestha, Suman S. Bhattarai, Prakash Chandra Aryal
- A Case Study on Environmental Assessment of Bakharka-Lakuri-Suntola-Ghoreta Road of Surkhet 77
Arjoo Khadka, Sagar Dhakal, Prakash Chandra Aryal
- Conservation Attitude of People Linking with Ecotourism in Vulture Safe Feeding Sites:
A Case Study in Pithauli, Nawalparasi and Gaidatal, Rupandehi 78
Bijeta Thapa, Khadananda Paudel
- Firewood Characteristics of Locally Preferred Trees of Middle Hills of Nepal:
A Case Study from Chitre VDC, Parbat District 79
Bikash Bastola, Jay Ram Adhikari, Prakash Chandra Aryal
- Gastrointestinal Parasites of Wild Ruminants and Chauris in Langtang National Park, Rasuwa, Nepal 80
Bishnu Achhami, Ashok Bahadur Bam And Hari Prasad Sharma
- Medical Ethnobotany of Yakkha Communities of Sankhuwasabha District, Eastern Nepal 81
Karun Dewan, Bharat Babu Shrestha, Ph. D., Ramesh Pd. Sapkota
- Assessing the Roosting sites of Vultures around Jatayu Restaurant: Case Study of Jatayu Resturant
in Nawalparasi 82
Kopila Wagley¹, Dinesh Raj Bhujui
- Water Conservation by Eco-san Toilet: A Comparative Study of Eco-san and Ordinary Toilets 83
Kribina Pathak And Saroj Adhikari
- “Is Climate Variability Really Inducing Disasters?” (A Case Study of Rainfall versus Landslide In
Lamjung District) 84
Kripa Shrestha, Udhab Raj Khadka
- Cloning and Overexpression of Mitochondrial Homolog of Cancer Hsp90 Chaperone 85
Mitesh Shrestha, Amere Subbarao Sreedhar, Tilak R. Shrestha
- Geospatial Analysis of River Channel Shift of Babai River 86
Muma Ram Bhusal, Bharat Bhandari
- Estimation of Carbon Stock of Nil Barahi Community Forest, Bhaktapur, Nepal 87
Nabina Prajapati, Susmita Dhakal
- Pesticides Use Practices and Its Impact on Human Health: A Case Study of Rapti Municipality,
Chitwan 88
Nabina Tiwari, Rejina Maskey
- Impact of Kunth (*Mikania micrantha*) Invasion in the Habitat of Wild Water Buffalo
(*Bubalus Arnee* Kerr, 1792) In Koshi Tappu Wildlife Reserve, Nepal 89
Niru K. Magar, Mukesh K. Chalise
- Fire and Economic Risk Assessment of Petrol Pumps within Kathmandu District 90
Pawan Paudel, Prof. Kedar Rijal
- Post-Earthquake DRR and BBB Activities on Restoration and Reconstruction of
Damaged Heritage Sites: A Case Study of Dattatraya Durbar Square Area, Bhaktapur 91
Prakriti Koirala, Jibgar Joshi

Ecotourism Potential of Sailungeshwor Village Development Committee, Dolakha <i>Ram Prasad Dhungel, Narayan Babu Dhital</i>	92
Impacts of the Gorkha Earthquake 2015 on Occurrence, Distribution and Illegal Trade of The Chinese Pangolin (<i>Manis Pentadactyla</i> Linnaeus, 1758) In Chautara Municipality of Sindhupalchowk, Nepal <i>Sandhya Sharma, Khadga Basnet, Hem Bahadur Katuwal And Rasmi Kunwar</i>	93
Livelihood Improvement and Respiratory Problem by Stone Quarry: A Case Study of Agra River, Dhading, Nepal <i>Sanjita Tamang, Udhab Raj Khadka</i>	94
Status and Ecological Correlates of Occurrence of Leopard <i>Panthera Pardus</i> (Linnaeus, 1758) in Bhaktapur District, Nepal <i>Sapana Khajju And Mukesh Kumar Chalise</i>	95
Economic Valuation of Drinking Water Supply Services from Panchase Protected Forest in Chitre VDC, Parbat <i>Sarala Regmi, Preamsagar Chapagain</i>	96
Sero-Prevalence of Brucellosis in Pregnant Women Visiting Gyenecology Department of Kathmandu Model Hospital, Nepal <i>Seema Thapa And Mahendra Maharjan</i>	97
GIS and Remote Sensing Based Assessment of the Encroachment of Bagmati River Corridors in Kathmandu, Nepal <i>Shradha Shrestha, Sunil Thapa</i>	98
Spring Water Status of Tarkeshwor Municipality, Kathmandu <i>Sujeeta Dhital</i>	99



3rd Graduate Conference on
Environment and
Sustainable Development

Agriculture and Livelihood

Impact of Zinc Application on Chilli Yield

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Chilli (*Capsicum annuum* L.) production is being constrained due to the lack of micro nutrients such as zinc (Zn). Impact of foliar application of Zn on chilli production has not been evaluated well. A field experiment was conducted in the horticulture farm of the Institute of Agricultural and Animal Science, Lamjung Campus, in Lamjung of Nepal in 2014 (April to July) to evaluate the response of chilli to Zn application. The experiment was conducted in Randomized Complete Block Design with four treatments (control, 20 ppm, 40 ppm, and 60 ppm of Zn). Four replications of each treatment was done. Each plot consisted of 6 plants with a spacing of 60 cm × 45 cm, and area of 1.62 m² per plot. NS 1701 variety of chilli was used as the test crop. There was a significant impact of foliar Zn spray on all the growth and yield characters of chilli. The plant height, fruit number, fruit length and fruit yield increased with increasing concentration of Zn. Plant height, fruit number, fruit length and fruit yield of chilli sprayed with 60 ppm Zn were 1.46, 1.67, 1.63 and 3.07 times higher, respectively, than of those in control. Therefore, farmers are advised to conduct foliar spray of Zn accordingly to increase chilli yield in the mid hills of Nepal.

Keywords: Foliar spray, Micronutrient, Randomized Complete Block Design, Yield

Study of Drought of Gorkha District and Its Impact on Agricultural Productivity

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Drought is a deficiency of precipitation over an extended period, which results in water shortage and impacts vegetation, animals and/or human beings. It is a natural disaster and a slow hazard that directly affects crop yields and leads to economic losses. In countries like Nepal, where people are mostly dependent on agriculture for their livelihoods, natural hazards like droughts cause much vulnerability. This study focused on the droughts of Gorkha District and its impact on paddy and millet crops. For the analysis, Standardized Precipitation Index (SPI) and 40 years (1975-2015) worth of records on precipitation were used. The paddy and millet yield productivity data from 1999-2015 was also taken and compared with the 3-month SPI drought. The result indicated that extreme droughts occurred in 1988, 1992, 1993, 1995, 1997, 1998, 1999, 2000 and 2006. Some of the years (1992, 1998 and 2006) faced prolonged drought. Analysis showed that prolonged drought occurred in 1999 (for 6-months). The assessment showed that the highest paddy production of 2013 (3231 kg/ha) and millet (1373 kg/ha) of 2014 were associated with favorable rainfall condition. However, crop production decreased in 2015 (i.e. 2315 kg/ha and 1236 kg/ha respectively) with the increase in drought. The major cause of decreasing yield productivity in 2015 was less rainfall. Damages faced by the irrigation canals and drying up of natural spring sources, which occurred as a result of the Gorkha earthquake, might also be responsible for impacting crop productivity.

Keywords: Standardized Precipitation Index (SPI), drought, productivity, Gorkha

Urban Agriculture: Scenario and Necessity for Sustainability

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Urban agriculture is essential for the sustainability of urban food systems. Yet, it is very difficult to motivate urban people to practice agriculture. In fact, it is even difficult to conceive the idea of urban agricultural practices in highly commercialized places. This paper explores agricultural practices like rooftop gardening, traditional farming and horticulture in the urban context. The paper reflects on the contribution of urban farmers in the food system of Nepal. It also highlights issues related to policy formulation and implementation related to urban specialization in agricultural development. It identifies and documents the perceptions, practices and sustainability measures of urban agriculture in the Lalitpur District where farmers practice rooftop gardening and horticulture in addition to traditional farming. Urbanization is a fast growing problem in the country. Only few urban farmers have good social status and are aware of the positive effects of urban agriculture on the economy and environment. They get demotivated as they face problems related to agro market, lack of land, middle-men and deceitful contractors. The study recommends that non-government organizations play an active role in urban agriculture for its sustainable promotion.

Keywords: Urban, sustainability, commercialized, horticulture, rooftop, economic and perceptions.

Production Economics of Maize Seed Production in Palpa District, Nepal

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Maize is second most important crop produced in Nepal. The production and yield of maize is very low despite numerous programs and activities to increase yield in periodic plans and policies. The maize seed research is handicapped by low domestic research and production capacity. In this backdrop, this paper investigates the production economics of maize (*Zea mays* L.) seed production in Palpa District of Nepal. A total of 182 farmers among the maize seed producers in Palpa were selected using simple random techniques in June of 2016. The data were subjected to descriptive analysis, Cobb-Douglas production function analysis, and determination of efficiency ratios of major inputs using Statistical Package for Social Sciences (SPSS) and STATA software. Farmers were categorized into large and small holder farmers based on the average area under maize seed production. The overall share of labor cost was about 55% followed by Farm Yard Manure (28%) in the study area. The cost of major inputs such as seed, FYM, labor, tillage and management/other were higher in small holder farmers as compared to large holder farmers. The maize seed production was profitable for large holder farmers. Inputs such as FYM, tillage and labor were overused and should be decreased by 664%, 456% and 68%, respectively. Similarly, seeds, chemical fertilizers and managerial/other inputs were underused and need to increase by 92%, 69% and 96%, respectively, for optimum allocation of resources. Farmers should allocate their resources wisely to increase profitability in maize seed production.

Keywords: efficiency ratio, optimum input, profitability, resources.

Impacts of Climatic Variability in Agriculture in Goljung VDC, Rasuwa Nepal

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Climate change and climatic variability are great concerns in the world today since they affect not only living beings but also whole ecosystems. Its impact on agriculture is unquestionable as the agro sector is more dependent upon natural circumstances. Mountains are often a blank spot in terms of academic research and data availability on societal response to climatic and environmental change. The study conducted in Goljung VDC of Rasuwain Nepal tries to access people's perception on the changing climatic variables and its impacts upon agriculture. It also explores the reason behind the failure of non-functional irrigation canals. This case study has adopted the broad social research approach and the changes in climatic events are based on people's perception reflecting their experiences. Convenience non-probability sampling technique was adopted while sampling. Transect walks, Focus Group Discussions (FGD), Key Informant Interviews (KII) and Personal interviews were conducted to access the information from the community. Along with climatic changes, social changes such as migration was observed which directly led to the lack of labor during farming periods. 76% of the participants during FGD reported that food grains become deficit during the last few month of harvest. Erratic rainfall, decreasing snow, droughts and pests invasion during recent years were among the many manifestation of climate change in the community. Subsistence farming practices became less reliable due to variation in climatic events which was further amplified by the failure of irrigation canals. Many irrigation canals was abandoned due to the lack of ownership of the project as 45 % of the respondents had no concern toward the project. it is recommended that local institution conduct effective implementation of their plans and missions and keep in mind the sustainability of any developmental project. Autonomous adaptation strategies and indigenous adaptation practices should be encouraged among the farmers to adopt effective and sustainable adaptation practices.

Keywords: climatic variables, agriculture, irrigation canal, food insecurity.

Shifting from Orange to Vegetable Farming in Ghasekuwa Village of Tanahun, Nepal

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Nepal, an agricultural country, is the fourth most vulnerable country to the impacts of climate change. Each year Nepal faces a lot of economic loss due to environmental constraints like erratic rainfall, prolonged dry seasons, harsh winds, accelerated erosion etc. Changing climate too has invited many pests and diseases which people find difficult to get rid of. The most critical issue for profitable management of plant diseases is obtaining a correct diagnosis with proper eradication measures. The Ghasikuwa Village Development Committee area of Damauli has a scenario where farmers have switched from traditional orange farming to vegetables. The present study was planned to identify possible drivers for this shift in farming practice. The study adopted a broad social science research approach with methodologies like Key Informant Interview (KII), Focus Group Discussion (FGD), Household Interview (HI) and literature reviews. Convenience sampling design of non probability sampling was chosen while selecting samples. Two KII was done - one with the horticulture specialist at District Agriculture Office in Damauli and other with a local farmer. Two FGDs were done, both with the local farmers of the area. Five years back, 67% of the land cultivated orange which had declined to 5% at the present. Today, 53% of the land is used for vegetable farming. Data and observations show a high trend of switching. Most respondents (85%) blamed viral disease (Citrus tristeza virus, **CTV**) to be the main reason for the destruction of oranges, whereas other reasons could have been improper orchard layout (60%), and unfavourable climate (32%). Farmers used local techniques (e.g. spraying of cow urine, spraying of CaCO₃ in soil etc.) to get rid of CTV, but results were negative. That had compelled the farmers to adopt vegetable farming. However, even such farming is troubled by wild monkeys and porcupines. Government efforts to solve such problems have been lacking.

Keywords: climate change, agriculture, disease

Post-Harvest Loss of Wheat and Its Impact on Food Security: A Study from Raikwar Village of Kanchanpur District, Nepal

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A considerable amount of cereals produced in developing countries is lost due to improper post-harvest operations which lead to a considerable gap between the gross production and availability. Minimizing these losses can increase their supply without bringing additional land under cultivation. In this research, we assessed the post harvest management practices of wheat and its post-harvest losses in Raikwar village of Kanchanpur District in Nepal. Prevalence of stored seed borne fungi in different containers and the status of wheat availability for a yearly consumption among farmers of different ethnic groups were assessed. Assessment of wheat grain loss during harvesting, threshing, and winnowing were done. Out of 258 households growing wheat, about one third (83 households) were interviewed regarding post-harvest management practices and status of food security. Among them 35 households were selected for seed sample collections, based on the types of containers and treatments applied to minimize the loss during storage. These seed samples were used to assess fungal prevalence. Post-harvest loss was found about 12% that includes storage loss (8%), harvesting (3%) and winnowing loss (1%). About 57% farmers used metal drums for storage of grains; the other means of storage were traditional *Kothia*, *Dheri*, *Bhakari*, and Plastic sacs. The loss was higher in traditional containers than in metal drums. Eight types of fungi (*Aspergillus flavus*, *Rhizopus* spp., *Penecillium* spp., *Bipolaris sorokiniana*, *Alternaria alternata*, *Chaetomium* spp., *Aspergillus niger* and *Fusarium* spp.) were prevalent in different types of containers. Eighty two percent of the farmers had sufficient availability of wheat grain for yearly consumption. The *Janajati* households had sufficient availability of wheat grain followed by *Brahmin-Chhetri* and *Dalits*. It was estimated that 12% of the grain was lost during post-harvest operation - this amount can support the food for ca. 2.8 person/year. Overall, technology intervention and improved storage structure can play a positive role in reducing post harvest losses and reduction in prevalence of storage fungi can improve long-term storage and improve the food security of the farmers.

Keywords: winnowing, traditional storage, kothiya, Janajati, fungal prevalence



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Wildlife Conservation

Breeding Success of White-rumped Vulture (*Gyps bengalensis* Gmelin) in Rupandehi District

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Breeding success is crucial for restoring the critically endangered species, *Gyps* in its natural habitat. Studies have been done on the breeding success of the vulture with Diclofenac residues in carcasses. Breeding success is affected not only by the presence of Diclofenac but also by habitat destruction, human disturbance and other ecological factors. Thus, understanding the vulture's breeding success, and the different factors that affect it, is important to establish species conservation. The study was carried out in two community forests of Rupandehi District (Western Nepal) where the nests of the critically endangered White-rumped vulture (WRV) (*Gyps bengalensis*) are found. The study was done to determine the effects of different factors on breeding success. Exploratory research was used for the purpose of this study. The vulture's nests were located and observed and the trees with the nests were tagged. Different factors (vegetation characteristics, nest location, human disturbances and different forms of habitat destruction) were recorded using the modified method used by Arroyo & Razin (2006). Altogether, 47 nests were identified with 58.82 % breeding success with active nest as primary unit and 45.45% with occupied nest as the primary unit. All active nests were found in *Terminalia alata* tree which has an average height of 22.90 m. The nesting sites were located at the edge of forest area near human settlements. Based on the variables, habitat destruction ($p < 0.05$) has a negative impact on the breeding success. Food scarcity and lack of awareness among people was other major threats to the vultures. Conservation awareness programs for local people and school children along with habitat conservation in nesting sites are recommended for conservation of this critically endangered species.

Keywords: Conservation, Critically endangered, Habitat destruction, Nesting

Human Rhesus-Macaque Conflict at Goldhunga, Kathmandu Nepal

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Human wildlife conflict is one of the most critical threats that wildlife faces. Crop raiding is one of the causes of conflict between herbivores and farmers. This area was selected on the basis of the reported incidences of crop raiding by *Rhesus macaque*. The reason behind the presence of macaque in the area was due to its proximity to the Shivapuri - Nagarjun National Park. Human activities like deforestation, agriculture, and urbanization have encroached wildlife habitats. This interference has manifested as the conflict between human and monkeys. The study was conducted in Mudkhu, Phuyalthok and Bicharthok Villages of Goldhunga VDC of the Kathmandu Valley. Semi-structured questionnaire were administered to gather information on status, current relationships and mitigation measures for reduction of impacts of the *Rhesus macaque* on human settlements. From both the interview and observation, it was found that number of monkeys were increasing and making it difficult for the villagers to deal with them. Many people of this area have been badly affected by the *Rhesus macaque* which damages the crops, snatches things, injures people, and damages cultivated lands. In turn, monkeys were also facing extreme hate, severe injuries and retaliatory killings by the local people. The study showed the damage caused by the *macaques* decreased with increasing distance from the forest. A strong local political commitment is needed to control the encroachment on the forestland which will deter the dispersal of monkeys and diminish the conflict between monkeys and human. The local people should always be included during conservation efforts and the benefits from the National Park should also be shared with local people to minimize the conflict.

Keywords: monkey, human-wildlife conflict, Shivapuri-Nagarjun National park, Goldhunga

Prevalence of Gastro-Intestinal Parasites of Rhesus Macaque (*Macaca mulatta* Zimmermann, 1780) and Hanuman Langur (*Semnopithecus entellus* Dufresne, 1797) in Devghat, Chitwan, Nepal

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The present investigation was undertaken to study the prevalence of gastrointestinal parasites in Rhesus Macaque and Hanuman Langur at Devghat of Chitwan. Altogether 93 fresh fecal samples were collected from Rhesus Macaque belonging to five troops and Hanuman Langur of two troops. About 10 gm of fecal material was collected in sterile vials with 2.5% potassium dichromate solution. These samples were examined microscopically by fecal concentration methods viz. floatation technique and sedimentation technique in the laboratory of Central Department of Zoology, T.U. Kirtipur. Out of 93 samples, 69 (74.20%) were found positive for single or multiple species of parasites. Altogether, 10 species of parasites, including seven helminth (52.68%) and three protozoa (40.86%), were identified based on the morphological characteristics of their eggs and cysts under light microscopy. The most commonly detected parasites were *Balantidium coli* (27.95%) followed successively by *Eimeria* sp. (16.12%), *Entamoeba* sp. (13.97%), *Trichuris* sp. (23.65%), *Ascaris* sp. (11.82%), *Strongyloides* sp. (10.75%), *Oesophagostomum* sp. (5.37%), Hookworm sp. (3.22%), *Trichostrongylus* sp. (3.22%) and *Hymenolepis* sp. (1.07%). Unidentified larvae of nematodes were also recorded in 6.45% of the total samples. Single, double, triple and multiple species of parasites were found in 36.55%, 29.03%, 6.45% and 2.15% samples respectively. Parasitic prevalence in monkeys of this area was high and 2.15% monkeys were identified to bear a risk of critical infection due to multiple parasitic burdens. Finally, this study provides baseline data for further action plan.

Keywords: concentration, microscopically, morphometric, potassium dichromate, troops

Occurrence, Abundance and Distribution of Small Mammals in Ghodaghodi Municipality, Kailali, Nepal

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Small mammals are important components of bio-diversity that serves as food for many predatory mammals, birds and reptiles. Though the role of the small mammals in maintaining ecological balance is relatively higher, not many studies on these mammals have been done. This study assessed occurrence, abundance and distribution of small mammals in different habitats (croplands, grasslands, riverine and mixed forests) of Ghodaghodi Municipality. The study was conducted in April and May of 2016. Three different live trapping methods (Sherman traps, Tube traps and Camera traps) as well as direct observation methods were used in 10 plots of all habitat types. From a total survey effort of 2400 trap nights, altogether 10 species of small mammals representing four orders and eight families were recorded. The abundance of small mammals was found highest in croplands whereas the species richness was highest in mixed forests. The small mammals' distribution pattern was clumped in their most natural habitats. Moreover, Canonical Correspondence Analysis (CCA) demonstrated a higher association of small mammals abundance with croplands and grasslands ($p < 0.05$) during the study period. Pollution and fires were some of the most recent threats affecting their distribution. The study suggests that a detailed survey of small mammals, including both Volant and non-Volant species, should be done to obtain baseline data.

Keywords: small mammals, abundance, distribution, traps, species, Volant

Assessment of Pet Trade (Turtle and Tortoise) in the Kathmandu Valley

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Turtles/tortoises are kept as pets in homes. Our religion considers them as modes of transport for Hindu Deities since archaic ages. Assessment of pet trade (turtle/ tortoise) in Kathmandu valley was done in aquarium/curio shops, customers and temples via questionnaires, interviews, rapid surveys/ opportunistic methods. Number of turtles/ tortoises that were kept as pets in valley was estimated to be around 3500. Major trade routes for turtle/tortoise import inside of valley included India, Bangkok and Tarai districts such as Surkhet, Nepalgunj, Butwal, Jhapa and Dang. One shop caught tortoise from the Koshi Tappu Wildlife reserve. *Trachemys scripta* was identified as the species that were imported through airways via wholesalers. Only one shop, out of surveyed 40, had a pair of turtles on sale. Two local species (*Indostuda elongata*, *Lissemys punctate andersoni*) were also recorded. Pets were bought rather than gifted (local species & Tortoises in general found to be gifted). Temples exclusively harbored tortoises. The estimated market cost around turtle/tortoise accessories was found to be around Rs. 26,00,000/ year in the valley. The average selling price of turtles was Rs.1,055 while the highest price reached up to Rs.8,000, depending on the size of the turtle. People were unknown about the conservation status of the species and an average of Rs. 2,100/year was spent on them as pets in households. Turtle food sold in the market was also assessed. Vegetables were the homemade food preferred by pet keepers. Diseases, hibernation, hiding were found to be major problems. =. About 7000 turtles were in demand in the valley. Achievements in turtle/tortoise trade control showed that nine people had been arrested and 116 alive turtles had been rescued so far. Curio shops still sold turtle/ tortoise shells to tourists as decorative items and a few were sold by locals for medicinal purposes. Forming action plans, further research, raising awareness and improved monitoring was seen to be necessary during conservation and control of trade.

Keywords: import, arrest, tortoise shells

Distribution and Habitat Characteristics of Red Panda (*Ailurus fulgens*) in Chitwan-Annapurna Landscape, Nepal

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The red panda (*Ailurus fulgens*) is a threatened mammal of the Eastern Himalayas. The most pressing problem faced during conservation of the red panda, especially in the Himalayas of Nepal, is the lack of reliable information about them.. The major objectives of this study was to generate scientific knowledge regarding red pandas' distribution and abundance, their habitats, the existing and emerging threats they face and identifying hotspots for their conservation. The study was carried out in Chitwan-Annapurna Landscape (CHAL) of central Nepal. An extensive field survey was conducted in ten districts to estimate species distribution by the presence-absence occupancy modeling and to predict distribution by presence-only modeling. The presence of red pandas was recorded in five districts. The predictive distribution model indicated that 1,904.44 km² of potential red panda habitat is available in CHAL with the protected area covering nearly 41% of the total habitat. The habitat suitability analysis based on the probability of occurrence showed only 16.58% (A=315.81 km²) of the total potential habitat is highly suitable. Red panda occupancy has been estimated to be around 0.0667, indicating nearly 7% (218 km²) of the total habitat is occupied with an average detection probability of 0.4482±0.0377.

Altogether eight variables including elevation, slope, aspect, proximity to water sources, bamboo abundance, height, cover and seasonal precipitation were observed to have significant role in red panda distribution. Similarly, out of 165 species recorded in the entire survey area, only 25 tree species were documented in red panda sign plots with the dominance of *Betula utilis* followed by *Rhododendron* *sps.* and *Abies spectabilis*. Extermination of red panda from previously reported areas indicates a need for immediate action for the long-term conservation of this species in CHAL.

Keywords: abundance, distribution, occupancy, potential habitat, threats

Population Status, Distribution of Nilgai (*Boselaphus tragocamelus*) and its Conflict with Human in Rupandehi District, Nepal

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The Nilgais (*Boselaphus tragocamelus*) in Nepal have created challenges as most of their population lie outside protected areas and thus have conflicts with local communities. The study aimed to determine population ecology, conflicts with local people and economic losses due to crop damage by Nilgais. The field work was conducted from March to October of 2016. The line transect method was implemented to find out the population status and distribution and household questionnaire surveys were conducted to find out more about the human-Nilgai conflict.

The total population of 303 Nilgais (individual) was determined in the study area. This showed that their population had increased since 2007. This study found that the number of Nilgais was highest in community forest habitats (107) and lowest in grassland habitats (40). The distribution pattern of Nilgais was found to be of clumped type with an average of 5.61 animals per herd. The male to female sex ratio was found to be 81:100.

Crop damage by Nilgais was a serious problem in most VDCs/ Municipalities that lay near to their potential habitat. The total projected value of crop yield losses due to Nilgais in the study area was NRs 72,75,507 (US\$ 68,633) between March 2015 to March 2016. One-Way Anova test revealed that there was significant difference between crop losses and frequency of Nilgai visits. Vegetables and pulses were damaged contributing to 14.48% and 10.38% losses respectively.

The perception regarding Nilgais was both negative (77%) as well as positive (23%) in the local communities. People adopted different strategies to control Nilgai intrusion in their field including deterrents, physical barriers, power fences and scare crows.

Keywords: Nilgai, crop damage, perception, level of tolerance, mitigation



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Plant Biodiversity

Application of Game Theory to Determine the Profitable Strategy: REDD+ or Forest Product Trade (A Case Study from Pragati Community Forest, Shaktikhor VDC, Chitwan, Nepal)

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Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+) is discussed as the most cost effective option for reducing greenhouse gases emission. However, many countries are generating revenues and employment opportunities from the forestry sector and boosting their economies. Nepal also needs to explore strategies that are economically more profitable and ecologically more viable. During the course of this study, forest carbon inventory was carried out in Pragati Community Forest, Chitwan. Five carbon pools- above ground tree carbon and sapling carbon, their below ground carbon, leaf litter herbs, grass carbon and soil organic carbon were estimated employing different allometric and regression equations. Total carbon stock and its increment was estimated to be 293.925 t/ha and 7.535t/ha/yr, respectively. According to the international carbon market, the total carbon revenue was appraised to be US\$ 132.737/ha/yr. Whereas, the revenues obtained by selling volume of stems (dbh \geq 10 cm), tantamount to annual increment/hectare in the local-market was appraised to be US\$ 3,370.149/ha/yr, including its shadow price. Hence, it was determined that timber trade was more profitable under the contemporary market conditions. After applying game theory, trade of timber was found to be in good Nash Equilibrium for both the parties, i.e. people and the government: it is the option where utility of both was found to be the highest, and pareto optimal.

Keywords: revenue, carbon increment, Nash Equilibrium, pareto optimal

Naturalized Plant Species in Central Mid-Hills of Nepal

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The Mid-hills region of Nepal is highly populated. This has caused the disturbance of natural ecosystems to be high as well. Therefore, this region has suffered from biological invasion. This study was conducted in the three districts of Mid-hills in Central Nepal, namely Dhading, Kaski and Tanahu at an elevation ranging from 500-1500 m. The objective of the plant study was to determine the status of various plants in the area. Vegetation survey (27 plots) was done by applying the Modified Whittaker Nested Method for *Shorea robusta*, *Schima-Castanopsis*, *Pinus roxburghii* forests and Shrub lands. A total of 238 native and 25 naturalized species, with 10 invasive alien plant species were recorded in all plots, most of which originated from American region. The mean alpha diversity was found to be highest for *Pinus roxburghii* (65.67) and was lowest in *Shorea robusta* forest (54.33). 15.37% of naturalized plants, having 8.78 % IAPS, were the highest in the shrub land and 6.77 % of naturalized plants, having 3.06 % IAPS, were the lowest in the *Shorea robusta* forest. Similarly the *Schima-Castanopsis* forest of Dhading showed the highest species turn over between the plots. Canopy cover and naturalized plant species were negatively correlated with each other ($R^2 = 0.1386$ and $y = -0.0434x + 7.7937$) and native and naturalized plant species showed a positive correlation between each other. The naturalized plants were more common in disturbed areas such as roadsides, grazing areas, shrub lands and forest edges in comparison to core areas of the forests.

Keywords: naturalized plants, IAPS, alpha, beta diversity, Modified Whittaker Nested Method

Effects of Anthropogenic Disturbances on the Regeneration of *Quercus semecarpifolia* Sm. Forest

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Natural regeneration is a process by which woodlands are restocked by trees that developed from seeds, that fall and germinate insitu. This study aims to provide information regarding the poor regeneration of *Quercus semecarpifolia* Sm. forest under different anthropogenic variables, in Southeastern part of Takasindu VDC of Solukhumbu district. Systematic nested vegetation sampling was used in which 60 working quadrats of 10m × 10m were sampled and anthropogenic variables such as litter collection, grazing, cut stems, lopped trees and foot trails with canopy openness was determined in each plot. It was observed that the number of lopped trees, number of cut stems and litter collection was found to be more with minimum distance from the human settlement, indicating a greater human pressure and overexploitation of forest resources by Community Forest User Groups. Altogether, nine tree species were found in which *Quercus semecarpifolia* showed dominancy.. The density-diameter curve showed the unsustainable regeneration status of the *Quercus semecarpifolia* because of deviation from the typical reverse J shaped pattern. The species richness and diversity declined with increasing distance from human settlement which reveals that some disturbance intensity is essential for maintaining the structure and functioning of the community. Furthermore, seedling and sapling density of *Quercus semecarpifolia*, declines with increasing distance from human settlement and grazing land respectively. Also, canopy openness decreased with increasing tree basal area and it was concluded that the recruits of *Quercus semecarpifolia* was found higher with the intermediate level of canopy openness. Hence, for and by the concept within, Community Forest User Groups are an effective way for sustainable forest management under intermediate disturbance level.

Keywords: anthropogenic variables, canopy openness, disturbances,recruits, regeneration

Floristic Study of Ferns in Altitudinal Gradient from Besishahar to Lower Manang, Nepal

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Ferns and Fern allies are extremely fascinating because of their phylogenetic & morphological aspects. They occupy a unique position between non-seed bearing and seed-bearing plants and have an exquisitely beautiful appearance. Understanding the diversity of ferns and fern allies of the Himalayas is considered to be a basic requirement for knowledge in the field of Pteridology. This study aimed to document the ferns and fern allies along the altitudinal gradient from Besishahar to Lower Manang. A total number of 94 species of pteridophytes (of twenty families and 46 genera) were recorded. Among these twenty families, Pteridaceae was the largest family having eleven genera followed by Polypodiaceae having six genera. Among the total forty-two genera, Thelypteris was the largest genera with nine species followed by Pteris with seven species. On the basis of habitat, out of ninety-four species of pteridophytes, fifty-one species were terrestrial, twenty-three species epiphytic and the remaining twenty species were lithophytes. Out of the total species only one species *Nephrolepis cordifolia* was found on all three habitat viz. terrestrial, epiphytic and lithophytes. Six species were both epiphytic and lithophytic whereas, sixteen species were found growing on epiphytic and terrestrial habitat. Similarly, fifty species were found in the altitude range of 2000-2600m.

Keywords: fern, Manang, *Nephrolepis cordifolia*, Pteridaceae

Impact of Community Management of Forests on the Diversity of Invasive Alien Plant Species: A Case Study from Two Community Forests of Nepal

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Invasive Alien Plant Species (IAPS) have various impacts on forests such as reduction in tree regeneration, change in species composition, and increased frequencies of fire. Apart from this, abundance of IAPS has been also observed, in some instances to interfere with the recovery of degraded forests. To understand this dynamics, mapping and inventory of IAPS was conducted in Sundari Community Forest (SCF) and Dhusheri Community Forest (DCF) of Nawalparasi District. The selected community forests were highly degraded in the past which created enabling environment for IAPS. Focus group discussions and household surveys were conducted as social survey tools to understand the change in IAPS after the local community became involved in managing the forest. Both these communities employed similar management practices. The species richness of IAPS exhibited negative correlation with tree canopy and basal area (BA) in both community forests. The IAPS cover declined with increasing tree BA ($p = 0.0079$). The influence of BA on IAPS cover was more pronounced in Sundari CF compared to DCF. Among the IAPS *Chromolaena odorata* was abundant and a problematic species. The frequency and coverage of *Chromolaena odorata* was higher in plots sampled at the edge than in the plots located at the interior of the forest with high canopy cover. According to local people, the abundance of *Chromolaena odorata* declined over time as the degraded forests recovered after the initiation of community forest management system. This indicates that community management regime could be one of the strategies used to reduce the abundance of IAPS in the forests. The data generated from this research would be helpful to understand the interface between community forest management and IAPS in Nepal's lowland.

Keywords: biodiversity, biological invasion, IAPS, regeneration, composition, community forest, management

Diversity and Assemblages of Canopy and Ground Layer Beetle of Sal Forest and Riverine Forest in Chitwan National Park, Nepal

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Beetle assemblages of tropical forest in Nepal are still largely unexplored and the biodiversity they harbor is poorly known. This study investigated the beetle diversity and its assemblages in the canopy and ground layer of Sal and Riverine forests. Thirty-two trees were selected purposively from four management sectors of Chitwan National park where four trees of *Shorea robusta* and four trees of *Dalbergiasissoo* were selected from each sector. Canopy and ground layer beetles were sampled using flight intercept trap and pitfall trap respectively. 32 flight intercept traps (16 in Sal forest and 16 in Riverine forest) were hung in Canopy layer and 32 pitfall traps were sunk into the ground within two meter radius of the same tree where the flight intercept traps were hung. A total of 25,257 beetles of 27 families (143 morphospecies) were recorded from six sampling periods between April 15 and August 30, 2016. Species richness was found high in the Canopy layer compared to the Ground layer whereas their abundance was higher in ground layer of both types of forest. Scarabaeidae was the most prominent family in both ground and canopy layer. Beetle assemblages showed that the herbivores beetle dominated the canopy layer followed by predators in Canopy layer in term of both species richness and abundance. However, Saprophages dominant followed by Predator in Ground layer. The effects of environmental variables (DBH, Humidity, Rainfall, and Temperature) had varying effects on the beetle species richness and abundance and its assemblages. Variation of beetles in different types of forest and different layer in different time suggests that the distribution of beetles is structured in time and space.

Keywords: beetles, tropical forest, canopy layer, ground layer, biodiversity, assemblages

Variation in Plant Functional Traits in Two Threatened Species of Orchids along a Subalpine-Alpine Gradient in Manang, Central Nepal

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Plant functional traits (PFTs) vary along the environmental gradient, and this variation can be used to understand the assembly of plant communities and their responses to global and local environmental drivers. Recently, several studies have been carried out to investigate the variation of PFTs, but very few studies have incorporated elevation gradient into account, and those focusing on threatened groups like orchids are extremely rare. Thus, a systematic investigation of variation in PFTs in two threatened orchids viz. *Dactylorhiza hatagirea* and *Cypripedium himalaicum* was carried out along the elevation range of 3700 to 4600m asl in Bhimthang of Manang.

Eight different PFTs- plant height, collar diameter, specific leaf area (SLA), leaf dry matter content (LDMC), leaf thickness (LT), reproductive output and fruit dry matter content (FDMC)- were considered for this study. The variation of these individual traits with elevation was assessed through a generalized linear model in RStudio. In *Cypripedium himalaicum*, height decreased and collar diameter increased with elevation, whereas in *Dactylorhiza hatagirea*, height and collar diameter both exhibited a hump-shaped pattern with elevation, with maximum value at ca. 4200masl. SLA increased with elevation, whereas LDMC and LT decreased with elevation in both species. Reproductive output was measured only in *Dactylorhiza hatagirea*, which revealed that reproductive output was maximum towards mid elevation. However, FDMC was found to be decreasing with elevation in both species. This variation in PFTs with elevation indicates that plants exhibit adaptive response to existing environmental filters. Thus, the study recommends that prime focus should be given to documenting the variation of PFTs along a natural gradient like elevation in order to understand the response of individual plants and communities as a whole towards climate change.

Keywords: PFTs, elevation gradient, *Cypripedium himalaicum*, *Dactylorhiza hatagirea*, generalized linear model.

Diversity of Invasive Alien Plant Species across Vegetation Types in Terai and Siwalik Regions of Central Nepal

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Invasive alien plant species (IAPS) are one of the major drivers of environmental changes and the leading cause of biodiversity loss after habitat destruction. There is high concentration of IAPS in the southern half of the country (including the Terai and Siwalik regions) whose climate ranges from tropical to subtropical.. A detailed survey of IAPS in different vegetation types of Terai and Siwalik region in central Nepal was carried out by following the modified Whittaker vegetation sampling method. Altogether 38 plots of 0.1 ha (20m*50m) were sampled in four vegetation types. The number of IAPS in each plot ranged from 1 to 9 with mean value of 5.79 ± 1.23 and 3.71 ± 1.57 in Siwalik and Terai respectively. The IAPS richness showed a statistically significant ($p \leq 0.05$) difference across different vegetation types. Sal forest had relatively low number of IAPS in both the physiographic regions (3 ± 0.74 & 2.11 ± 0.61). Among the 16 species of IAPS recorded from the study area, *Asteraceae* family dominated the invasive alien flora. In 50% of the total plots, *Chromolaena odorata* had the highest cover among IAPS with highest frequency and was the most dominant species whereas *Alternanthera philoxiroides* had the lowest. The high β -diversity ($\beta=4.31$) indicated that there was very high species turnover from one type of vegetation to another in the Terai region. *Parthenium hysterophorus* was found to be the most problematic and dominant species in terms of coverage in grazing and fallow land while *Mikania micrantha* was found as the most dominant species in riverine forested area. The Siwalik region had a greater IAPS richness in all vegetation types. This study revealed that IAPS richness varied with vegetation types with the highest number of IAPS in grassland of urban area used for cattle grazing. Plant invasion has been emerging as a serious problem in Siwalik and Terai region. Timely management intervention is needed to prevent the further spreading of IAPS.

Keywords: biodiversity, ecology, non-native species, residence time, propagule

Naturalized plants in the Modi Watershed of Annapurna Conservation Area, Nepal

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Mountain ecosystems are considered to be unique biological wilderness areas due to their mountainous terrain, diverse geomorphology and physical ruggedness. These ecosystems are under threat due to direct and indirect anthropogenic activities such as climate change, tourism, and introduction of alien species. This study assessed the status of naturalized plant species (which also includes invasive alien plant species) in the Modi river watershed of the Annapurna Conservation Area, one of the most visited tourist destinations in Nepal's Himalaya. Using the Modified-Whittaker nested vegetation sampling methods, vegetations were surveyed at three locations, with three different vegetation types at each location. For each vegetation type, three plots were sampled. In each plot, vascular plants were enumerated and their cover estimated. Herbarium specimens of plant were collected both from the plots and along the trekking trails. Species reported in previous studies were also included to compile a list of vascular plant species present in the study area. Species were categorized into native, naturalized and invasive alien, based on their origin and spread. We recorded 565 species of flowering plants including 23 naturalized plant species. Out of 23 naturalized plant species, 8 species were invasive alien plants. The naturalized species of Tropical American origin, belonging to the family Asteraceae, were the abundant. Maximum numbers of species were found in roadside shrub lands and *Alnus* forests (140 sp.) and minimum in grasslands of subalpine region (84 sp.). It was deduced that floral composition naturalized species were more abundant in temperate region (16.42%) than in subalpine region (1.12%), whereas invasive species were totally absent in subalpine regions. However, the temperate region housed 8 species and the beta diversity was greater here than in the subalpine region. Alien species were most frequently present in the temperate region rather than in the subalpine region and their number decreased with the increase in elevation and varied with vegetation types.

Keywords: mountain ecosystem, biodiversity, altitude, tourism, land use pattern, alien plants, biological invasion.

Naturalized Plant Species along Marsyangdi River Valley, Central Nepal

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The threat of invasive alien plant species (IAPS) is increasing due to the globalization of trade and tourism, and climate change. This has caused major shifts in the range of IAPS- they are moving from low to high elevations. In this study, we documented vascular plant species in the Marsyangdi River Valley of Annapurna Conservation Area in central Nepal to analyze the abundance of naturalized and invasive plant species along the elevation gradient. Following the Modified-Whittaker vegetation sampling method, vascular plant species were recorded in 27 plots (50m × 20m) located in forests, shrublands and grasslands. Species composition and abundance, along with environmental variables like elevation, canopy cover, disturbance, etc. were recorded in each plot.

Altogether we recorded 914 species of vascular plants; 526 species were obtained from primary data and the remaining 388 species from previous studies. Reported species were classified as native, naturalized and invasive species according to their origin and invasiveness. Among the vascular plants, 41 were naturalized species and 6 were invasive (*Bidens pilosa*, *Ageratina adenophora*, *Mimosa pudica*, *Ageratum conyzoides*, *Galinsoga quadriradiata*, *Chromolaena odorata*). The number of naturalized species was found to be highest (16) in *Schima-Castanopsis* forest (1000 m), which shared 10.67% to the total plant species. The upper elevation limits of the 9 naturalized species were found to be higher than that reported by the previous studies. Species richness and diversity (γ -diversity and α -diversity) of vascular plants, as well as naturalized species, declined with increasing elevation. Elevation was the dominant environmental variable determining the distribution and composition of naturalized species, followed by canopy cover and other disturbances (for eg., fire). These naturalized species may turn into invasive species at any time under favorable conditions. So, preventive measures should be applied to avoid the spreading of naturalized species.

Keywords: naturalized species, IAPS, vegetation, species diversity

Increased Herbivory Hinders Competitive Ability of Native *Alnus nepalensis* against Invasive *Ageratina adenophora*

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We studied the herbivory patterns in the invasive plant *Ageratina adenophora* and the co-occurring native *Alnus nepalensis* at Chandragiri Community Forest in Kathmandu of Central Nepal. The percentage of foliage damaged in these species, by herbivores, was analyzed based on leaf number and leaf area. 20 individuals of each native and invasive plants were assessed for proportion of leaf damage and 320 leaves from each for leaf area damage. Results showed severe damage to the foliage in *A. nepalensis* and minimal damage in *A. adenophora*, in terms of number and area of leaves damaged. The differences were significant. This indicated that the invasive *A. adenophora* could have benefited from increased herbivory in *A. nepalensis*. Therefore, lessening herbivory in *A. nepalensis* could increase its competitive ability, and thus reduce the prolific growth of *A. adenophora*.

Keywords: herbivory, *Ageratina adenophora*, *Alnus nepalensis*.

Estimation of Carbon Stock under Different Forest Management Regimes of Bara District, Nepal

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Globally, climate change and its mitigation have been receiving increasing attention. Literatures have shown that forests have a tremendous role in lowering the net GHGs emissions from the atmosphere and significantly contribute to mitigating the adverse impacts of climate change. This study estimated forest carbon stock under different management systems: government managed, collaborative, and community managed forests. Three transects were designed on each forest, and each transect consisted of seven plots. Diameter at breast height (137cm DBH) of tree greater or equals to 5 cm were measured. The allometric equation developed by Chave et al. (2005) for the tropical forests was used to estimate the above ground biomass of the tree layer. Since the mean annual precipitation of the study area was 1541.44 mm, the allometric model for “moist forest” was used. The below ground biomass was assumed as 15% of the above ground biomass. Carbon stock was calculated as 47% of the total biomass. The highest number of species were recorded in Government managed forest (26 species) followed by Nagmani community managed forest (24 species) and Tamagadhi collaborative forest (22 species). The mean carbon stock of living biomass was higher in Nagmani Community forest (239.8830ct/ha) followed by Tamagadi collaborative forest (204.8124ct/ha), and Government managed forest (174.6694ct/ha). Carbon stock contribution was higher in *Shorea robusta*, *Terminalia alata*, *Lagerstroemia parviflora* and *Mallotus philipensis* respectively. Good management practices of community forests might be the reason for the higher carbon stock of community forest.

Keywords: climate change, carbon stock, breast height, allometric equation, above ground biomass, below ground biomass

Taxonomic Study of the Genus *Aster* Linn. (Asteraceae) of Nepal

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The name “Asteraceae” comes from *Aster*, the most prominent genus in the family that derives from the Greek ἀστήρ (astér), meaning star, and is connected with its inflorescence star form. It was first time described by Carolus Linnaeus (1753) in his Species Plantarum 2:872. *Aster* s.s. occurs mainly in the Northern Hemisphere in both Eurasia and North America and is estimated to comprise ca. 180 species. Nepal contributes 20 species and 3 subspecies belonging to 5 sections to the world flora. The present study deals with the taxonomic work and has been done from herbarium specimens deposited at KATH, TUCH and digital photographs from E, TI and BM and the field visits from different places of Nepal. This paper aims to provide the most important identifying characters of the species on the basis of their gross morphological characters including vegetative and reproductive including (habit, root system, stem, leaves, capitula, involucre, ray florets, disc florets, style, pappus and achenes), their leaf epidermal characters(epidermal cells, stomatal apparatus, trichomes and glands) and pollen morphology (pollen size, shape, aperture, length and number of spines, inter spinal distance and length of colpi) and besides these their distribution range and phenological period are also studied. Generally, *Aster* spp. were found in the elevation ranging from 1140m to 5200m above sea level, subtropical to alpine zone in Nepal.

Keywords: morphology, stomatal apparatus, phenology



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Disaster Risk Reduction

Characterization and Distribution Pattern of Landslides in Mailung, Rasuwa

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The April 2015 Gorkha Earthquake, with a moment magnitude scale (M_w) of 7.8 Richter scale, induced widespread landslides across central Nepal. This paper presents a preliminary analysis of the distribution patterns and characteristics of these co-seismic landslides around the Mailung area. The main types of landslides that occurred were debris slides, rock slides, rock falls and shallow, disrupted landslides from steep slopes. The terrain lay mainly on the zone of banded gneiss, it had quite a steep slope with massive discontinuity planes. These landslides were unevenly distributed within the study area and concentrated within the right bank of the Trishuli River. The upper part of the slope was steep (45-50 Degree) and the lower part was gentle (25-30 Degree). The results showed that slopes consisting of highly jointed banded gneiss, quartzite and schist were the more susceptible to co-seismic landslides.

Keywords: Gorkha earthquake, co- seismic landslide, distribution pattern, discontinuity planes

Landslide Susceptibility Mapping and Sediment Loss Estimation along the Road Corridor, from Bandeu to Barahabise, Sindhupalchwok District

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Landslides are one of the main natural hazards that occur frequently in the Himalayas of Nepal. They cause huge loss of life and property every year, especially during the rainy season. On 2nd August 2014, landslides occurred in the Jure village of Sindhupalchwok District, along the road corridor of Araniko Highway, and blocked the Sunkoshi River and caused a loss of 156 lives, damaged road sections and caused huge property loss. Due to its weak geological condition, rapid developmental activities and other inherent natural conditions, the Barahabise area of Sindhupalchwok district has been exposed to such landslide hazards. Therefore, the present study concentrates on landslide susceptibility mapping of the area, along the road corridor of Araniko Highway about 30 km from Bandeu to Barabise in Sindhupalchwok District, with the help of Arc GIS 10.3. The statistical index method was used to prepare the landslide susceptibility maps. The causative factors considered for the study were elevation, slope angle, slope aspect, geology, distance from drainage, distance from road, land use and rainfall. For the preparation of slope, aspect and elevation map, a Cartosat image with 30*30m resolution was used; for land use, geology and distance from drainage and road, factor data was taken from the Department of Survey; and for rainfall, factor data of Department of Hydro-meteorology was used. The landslide susceptibility map showed that low, medium and high susceptibility zones cover 12.22%, 29.73% and 58 % of total area respectively where 77.95% of the observed landslides fall under the high susceptibility zone. For an estimation of the total landslide sediment, volumetric method was used. Using this method it was found 7,0424,974 m³ of sediment production through field data as well as polygon drawn from Google Earth Image. The maps prepared during the course of this study can be used for slope management, land use planning and disaster management planning by the concerned authorities.

Keywords: Statistical Index Method, landslides, susceptibility, Cartosat Image

Landslide Characterization and Mapping on the Way from Munglin to Abu Khairini

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Prithvi Highway, the major highway connecting Kathmandu Valley with the rest of the country has witnessed many infamous landslides.. Bad alignment; fragile topography and geological conditions; and faulty construction and maintenance techniques make Prithvi Highway susceptible to landslides and other mass movement problems. Numerous news of road blockages have been reported along the Prithvi Highway. This occurs due to mass movement, especially during the monsoon season. With a continuous history of mass movements and landslides, Prithvi Highway can be regarded as a canvas for the study of landslides. This study focused on a massive landslide located on the way from Munglin to Abu Khairini as a representation of the active landslides along the highway. The documented parameters of the landslide were its location, dimension, and attribute properties. The attribute properties included geological, hydrogeological, geomorphological and socio-economic aspects. Based on Varne's Classification system, the landslide was of complex type. Highly jointed and weathered quartzite rock beds, along with toe cutting by the roads, contributes to the slope instability which leads to mass movement problem in the studied landslide. Based on the field study, construction of retaining structure such as gabion wall and catch wall, slope geometry modification, management of proper drainage are a few suitable mitigation options. Bio-engineering approaches can be a cost effective method to mitigate landslides such as this. The study suggests that this landslide needs immediate response from the government as it can lead to serious loss of lives and cause a blockage of vehicle along the Munglin Abu-Khairini road.

Keywords: Prithvi Highway, landslide, inventory form, USCS, government

Estimating Earthquake Social Vulnerability Index of City Core Area: A Case of Ward No. 26 Kathmandu Metropolitan City

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Kathmandu valley is vulnerable to earthquake hazards. This study aims to quantify the social vulnerabilities arising from such hazards by creating an index. This can be used as a reference document to estimate the cost of social losses and contribute to understanding those factors that threaten the sustainability and stability of the community. The analytical factor method was applied to generate the main factor of earthquake vulnerability in the study area. Eighty-seven samples were selected to conduct social surveys in Ward no. 26 of the Kathmandu Metropolitan City. The Social Vulnerability Index (SoVI) was constructed using Principal Component Analysis of SPSS, where the four types of factors (family structure with communication dimension, age and time dimension, education and occupation dimension and special needs population dimension) were introduced and the sum of all value was used to calculate the vulnerability index. The study has proposed an emergency evacuation plan as a recommendation. The study area was highly vulnerable and it was estimated that 642.91 square meters of area would be covered by debris if a massive earthquake occurred. Kendall's tau and Cronbach's Alpha (=0.9850) were used to test the validation of the building vulnerability index with support of the building damage index after the Gorkha Earthquake. Whereas only 69.88% could be validated with vulnerability index because of the absence of the soil and geotechnical data, difference the gravity value due to acceleration not included all parameters of structural buildings. The vulnerability index contributes to design preparedness, mitigation and emergency response measures. Similarly, the building vulnerability index helps estimate losses during the post-earthquake situation. Furthermore, the emergency evacuation plan helps reduce the vulnerability level and can also be replicated to others core areas in the city.

Keywords: building vulnerability index, earthquake, evacuation plan, validation

Landslide Characterization and Analysis Using GIS for Rapid Risk Reduction

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The Dumre-Besisahar-Chame Road section is increasingly facing incidences of landslides in the past. The stability of slope is weak due to road construction, poor drainage, high weathering of rocks and distribution of discontinuities. A landslide along Besisahar-Chame road section was studied. The landslide characterization and analysis was done using GIS. The parameters that trigger such landslides were weak geology, geological structure, elevation, slope aspect, and flow direction. These aspects were important considerations while designing risk reduction structures and future mitigation measures. The landslide's area was 42.68m with the slope inclination of 41 degrees. This was calculated using GPS co-ordinates which was noted during field and Google imageries. The contour extracted from satellite imageries were converted to vector file and transformed to elevation grid, landslide model in raster, slope aspect, flow direction and flow accumulation. The slope faces north and north east direction. The land use map was prepared by digitizing the topographic map. This aspect of slope clearly demonstrated that the area suffered low temperature and high humidity. The flow accumulation model indicated high build-up of water in the area. The land adjacent to the landslide area was dominated by vegetation implying the presence of soil. Elevation, slope aspects and flow accumulation come out to be the most probable causative factors contributing to slope failures. The analysis predicts the possibility of landslides in the near future which may block the highway. Construction of effective drainage structures and slope geometry modifications are suggested for rapid risk reductions of such landslides. Bioengineering can also be applied for mitigation which may require detailed study.

Keywords: landslide characterization, GIS, risk reduction, bioengineering

Characterization and Mapping of Malebagar Landslide along Beshisahar to Chame Road Section

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A major landslide at Malebagar, on the way from Beshisahar to Chame road section in Lamjung, District was studied. This landslide is located at the right side of the Marsyangdi River and is active. The landslide was classified on the basis of Varne's classification and was characterized in terms of geological, topographical, hydrological and social aspects. The crushed quartzite rocks, seepage throughout the road and excavation during road construction by toe cutting were identified to be the main causes that led to the re-activation of the old landslides. There are many creeping phenomena towards north and south of this landslide, which indicate that the area is not stable currently. Monitoring of creeping is necessary to prevent damming of the Marsyangdi River. It was identified that the catch wall and slope geometry modification were urgently needed for risk reduction and to prevent future extension of this landslide. Benching walls should be structured in problematic areas of creeping. At last, bio- engineering, performed as per the soil type of the area, could be an effective method for the permanent mitigation of this landslide.

Keywords: landslide, characterization, mapping, seepage, benching, bioengineering

Floodplain Analysis in Upstream Region of Koshi River, Nepal

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Flooding is a serious, common, and costly hazard that many countries face regularly. Flooding due to excessive rainfall in a short period of time is a frequent hazard in the flood plains of Nepal during monsoon. Therefore, this study was carried out to perform flood plain analysis in the upstream regions of the Koshi River. The study describes the technical approach of probable land use vulnerability and hazard analysis of floods.

The Koshi River catchment area of 60,400 sq.km of which 310.17 sq.km was referred for the study. Flood frequency analysis was performed using the Gumbel, Log Pearson Type III, Log Normal method and Gumbel's distribution method. It showed that for the discharge of 7368, 10526, 12605, 15231, 17180, 19114 and 21041 m³/s, the flood return period was 2, 5, 10, 25, 50, 100 and 200- years respectively. One dimensional hydraulic model HEC-RAS with HEC-GeoRAS interface in coordination with Arcview GIS was applied for the analysis. Area inundated by 2, 5, 10, 25, 50,100 and 200-years flood were 221.09, 233.04, 254.62, 273.09, 282.9, 295.19 and 349.64 ha respectively. The classification of flood depth area showed most of the area had water depth of 1-2 m. The assessment showed that a large percentage (> 65%) of vulnerable area was covered by forests followed by barren lands and agriculture lands/settlements. This study will enable authorities to plan to avoid any future disasters.

Keywords: Koshi, flood disaster, hazard, flood frequency analysis, modeling, GIS



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Pollution and Health

Pathogenic Bacterial Contamination in Metropolitan Water Supply in Nepal

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Kathmandu is the only Metropolitan city in Nepal. Needless to say, it is densely populated with unplanned housing and disaster prone infrastructure. Water supply is irregular and people more often than not rely on substitute supplies like well water, stone spouts and tanks. Water borne diseases are rampant and rise with seasonal variation. This discussion is on chronic pathogen Salmonella, virulent strains of which cause Enteric Fever (commonly known as Typhoid) and a relapsing pathogen, Vibrio cholerae, which is feared for life-threatening diarrheal illnesses and has put Nepal on a world map of epidemics since Haiti. Salmonella is a mutating pathogen with shortening list of susceptible antibiotics. Cholera is a disease that resurfaced after years of control post disaster. The main aim here is to discuss how municipal water supply is compromised with contamination of these two virulent strains and what our past encounters with these diseases have taught us. Proper sanitation and treatment of water can minimize episodes of diseases and curb their spread.

Keywords: Salmonella, Enteric Fever, Vibrio cholerae, water-borne diseases

Assessment on Sensitivity of Roadside Plants by Using Air Pollution Tolerance Index

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Air pollution is a critical form of pollution that affects the wellbeing of human beings, animals and plants. Roadside trees are more sensitive to air pollution as they are in direct contact with pollutants. Urban greenbelts contribute to ecological beautification and play an important role in the amelioration of urban air quality. Monitoring air pollution and its impact on plants using biochemical parameters helps to determine the susceptibility of plant to polluted urban condition. This study assesses the sensitivity of roadside plants to air pollution. Three sites within Ring Road, i.e. Kalanki, Tinkune and Maharajgunj were selected for the study. In these areas, eight common tree species were selected. Mature and fresh leaves of selected species were collected for measuring biochemical parameters such as chlorophyll, pH, ascorbic acid and relative water content. The Air Pollution Tolerance Index (APTI) was calculated subsequently. The APTI determination is a reliable method that can be used to determine the susceptibility of plants to air pollutants. The APTI exhibited by the studied plants ranged from 84.04 to 5.85. *Populus deltoides* (Laharepipal) was found to have the highest tolerance whereas *Callistemon lanceolatus* (Bottle brush) had the least. The APTI for the selected samples were in order of *Populus deltoides*>*Jacarandamosifolia*>*Cinnamomum camphora*>*Thuja* sp.>*Ficus elastica*>*Eucalyptus* sp.>*Ficus benjamina*>*Callistemon lanceolatus*. According to APTI categorization, *Populus deltoides* was the only tolerant species to air pollution. Other roadside plants at the study sites were found to be sensitive to air pollution. The study recommends maintaining the greenbelt of roadside with pollution tolerant species.

Keywords: Pollution, greenbelt, *Populus deltoides*, sustainability

Changes in Water Sanitation and Hygiene Practices in Baijanathpur

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Water Sanitation and Hygiene (WASH) is among the most important aspects that determines the health of an individual. With the introduction of the nation-wide WASH programs, a marginal reduction in diseases like diarrhea, cholera and skin diseases has been observed. However, data related to changes in WASH practices among the population of rural areas can be useful for authorities to target more effective interventions within the country. This study examines the WASH status along with the drinking water quality of four randomly selected wards of the Baijanathpur Village Development Committee (V.D.C) in Morang district. The study was carried out using questionnaire surveys that were prepared in line with World Health Organization's (WHO's) "core questions on drinking-water and sanitation for household surveys". Water samples were tested using the standard operating procedure of American Public Health Association (APHA), 2014 at Nepal Environmental and Scientific Services (NESS) Laboratory in Kathmandu. It was found that a majority of the respondents perceived that the drinking water under use was safe and did not need any purification before use. However, water sample tests showed the presence of coliform. With the installation of tube wells, various waterborne diseases were found to be decreasing over the last few years. Almost one-fourth of the sampled population practiced open defecation, even in wards that were declared to be Open Defecation Free (ODF). Lack of timely monitoring after implementation of the WASH programs in the study area was found to be the main reason for the poor status of village. Effective community level awareness among women was urgently required since most of the women were found to be unaware about menstrual hygiene. On the basis of the kind of sanitary napkins used by women during menstruation and the type of water and sanitary facilities present at their place of living, vulnerable groups of women were identified through the study.

Keywords: WASH, ODF, sanitation, menstrual hygiene, vulnerable

Potential of Agricultural Water Security through Wastewater Use: Case Study of Harisiddhi Wastewater Treatment Plant

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Harisiddhi Wastewater Treatment Plant (Scheme No. 1) is only partially functioning as a secondary treatment unit- the reed beds have collapsed and the primarily treated effluent from Activated Sludge Blanket Reactor (ASBR) is disposed to surface drain which is finally disposed to Karmanasa River. Farmers use this mix of partially treated effluent and drainage during periods of water scarcity. Objectives regarding technical, social, financial, environmental and institutional aspects were set to explore the potential use of wastewater during agricultural practices in the study area using the case study method. Waste water quality analysis, questionnaire surveys, key informant interviews and observation were used to collect data.

The quality of the treated effluent did not meet the standard for safe use, except for pH and EC. The mix of treated effluent and the surface drainage also did not meet the safe value except for pH, EC and phosphate parameters during dry season. However, the parameter values of pH, EC, phosphate, BOD and COD for the mix were within limits during the wet season. Microbial contamination was prevalent in all weather conditions and in all samples. The quantity of the treated effluent was very low to create irrigation value and therefore was not technically feasible to be used for irrigation. The mix of the partially treated effluent and the drainage was readily available to farmers who divert the drain to their farms. Though people use wastewater for agriculture, they were concerned with the water quality. Farmers had financially benefitted by using such wastewater in their fields because it disposed their household wastewater and irrigated their fields at the same time. The study found that management by Harisiddhi Wastewater Users' Committee, and its authorized subcommittee, was not satisfactory. These organizations need to engage in better management of the wastewater treatment plant.

Keywords: irrigation, management, waste water treatment, treated effluent, water quality

Potential Reduction of Dioxin and Furan Through Environmentally Sound Health Care Waste Management Model in Hospitals of Nepal

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Nepal is facing a serious problem of increased municipal and hazardous health care waste management. Primarily, open burning and incineration of medical waste without any pollution control devices has created favorable environment for toxic Persistent Organic Pollutants (POPs) production such as Polychlorinated Dibenzo Dioxins (PCDD) and Polychlorinated Dibenzo Furans (PCDF). These are commonly known as dioxin and furan respectively and are listed in the Stockholm Convention as POPs, ANNEX. With the aim to quantify the contribution of Environmentally Sound Management (ESM) of Health Care Waste (HCW) in reducing dioxin and furan emissions, this study was carried out in two hospitals namely Blue-Cross and Alka¹ of Kathmandu and Lalitpur district respectively. The ESM Model was developed in both hospitals within twelve months of following Best Environmental Practices (BEP) and Best Available Techniques (BAT). These were per the World Health Organization (WHO) guidelines of HCW management for onsite waste segregation, collection, transportation, storage, treatment, safe disposal and the 3R principle followed by training, orientation, demonstration and follow-up to health workers. Dioxin and Furan, before and after the intervention of ESM model, was estimated using revised UNEP Toolkit-2013. More than 70% of waste generated from both hospitals was non-hazardous type and hazardous waste was less than 30%. A model developed increased 42.4% to 71.1 % of recyclable waste result direct economic benefit every day. This has also contributed to minimizing waste volume that is likely to be added to landfill sites through municipal waste collection. And most importantly, the model was found to contribute to the reduction of dioxin and furan emission up to 99.7% in Blue-Cross Hospital and 99.8% in Alka Hospital.

Keywords: dioxin, furan, Environmentally Sound Management, health care waste, POPs, UNEP Toolkit

Environmental Impacts Caused by Open Dumping: A Case Study of Banepa, Kaverepalanchowk

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Solid waste management is one of the major challenges of rapidly growing cities like Banepa. Improper management of waste has threatened the environment and people living near the dumping area as wastes are haphazardly dumped. This study involves the effects of open dumping on different aspects of the environment in Banepa Municipality of Kaverepalanchowk District, Nepal. To analyze the effects of pollution on river water, water samples that lay below and above the dumping site were collected. Parameters such as Chloride, Alkalinity, Total Hardness, DO, Free CO₂, Conductivity, and Calcium Hardness were determined in the field, while parameters such as COD, TSS, Potassium, TDS, Ammonia, Nitrate, and Phosphate were analyzed in the laboratory. Standard Methods were followed for laboratory analysis of the samples. Questionnaires were also circulated to municipality officers to identify the key issues and problems. The measured water quality parameters such as pH, DO, COD, Alkalinity, Hardness, Ammonia, Phosphate, Turbidity, Conductivity, and free CO₂ show that the water quality of the river had degraded. This has adversely affected various aspects of environment including the life of people living near the dumping sites.

Keywords: open dumping, water quality, affect

Bacteriological Profiling of Burn Wound from Patients Visiting Nepal Cleft and Burn Centre, Kritipur, Nepal

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Secondary infections induced by burns are a serious public health problem in developing countries. A descriptive study was carried out on 30 burn patients admitted in the burn unit of the Nepal Cleft and Burn Centre in Kritipur. This study was conducted over a period of six months from January 2016 to July 2016. Wound swabs obtained from the burn patients were subjected to microbiological analysis. The isolates were identified using the standard microbiological techniques and their antibiotic susceptibility was determined by using the Kirby-Bauer disk diffusion technique. In the study, burn injury was the highest in the age group 21-30 years (56.81%). The male to female ratio of burn wounds sample was 1:1.08. Fire was the major cause of burn (78.60%) followed by scalding (7.10%). Among the 30 samples, a single organism was isolated in 40.74% samples, mixed organisms in 51.85% and no growth in 3.00% of the sample. A total of 44 bacterial species were isolated from the samples in which *Pseudomonas aeruginosa* accounted for the highest percentage (18.18%), followed by *Klebsiella pneumoniae* (15.90%), *Staphylococcus aureus* (15.90%), *Acinetobacter* spp (11.36%), *Staphylococcus* spp (11.36%) and Coagulase negative Staphylococci (CoNS) (11.36%). Gram negative bacteria were the dominating bacteria and exhibited lower sensitivity to most of the antibiotics used. Furthermore, *P. aeruginosa* was the least sensitive to most antibiotics used. Amikacin was the drug of choice for most Gram negative bacteria and vancomycin was for Gram positive organisms (*S. aureus* and CoNS). Regular surveys and analysis of the microbial spp and their antibiogram in burn patients can help with timely detection, control the spread of infection and help form effective antibiotic policies.

Keywords: burn, burn wounds infection, *P. aeruginosa*, antibiotics resistance.



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Climate Change

Impacts of Climate Change on the Indigenous Majhi Community in Nepal

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Climate change is already being felt and is increasingly being accepted as a major issue faced by Nepal (NCVST 2009; ICIMOD 2011; Xu et al. 2009; ICIMOD, 2013). Poor and marginalized people, in particular, are facing many difficulties because of uncertain food production, different natural disasters like flood and droughts, loss of land etc. This study looks at the impacts of climate change on the Majhi community in Bodgaun village, located in Bhimtar Village Development Committee of Sindhupalchowk district in Nepal. The study, based on surveys and group discussions, identified three major consequences of climate change in Bodgaun village: extreme drought (prolonged, increased/more regular occurrence of drought), extreme rainfall (intensity- heavy rainfall falling over a shorter time, and increased frequency of heavy rainfall events) and a prolonged summer season.

Keywords: Ethnic minorities, vulnerability, indigenous, natural disasters, climate impacts

Climate Change Impacts on Reservoir Based Hydropower Projects in Nepal: A Case Study of Budhi Gandaki Hydroelectric Project

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The power production capacity of reservoir based hydropower plants are decreasing because of the uncertain pattern of climatic variables. The average rainfall trend of the baseline period (1981-2014), taken from the eight nearby rainfall stations of Budhi Gandaki Basin, suggests that rainfall has decreased by 12.07 mm per year. However, according to forecast based on RCP 4.5 data of three stations, the future average rainfall trend, will increase by 4.0 mm per year during three time periods (2011-2040, 2041-2070 and 2070-2100). According to the average annual maximum and minimum temperatures of the baseline period in the three nearby meteorological stations (Khudibazar, Gorkha and Nuwakot) and according to future forecasts from RCP 4.5 data of Gorkha Bazar station, rainfall will decrease in the long-term implicating hotter days. Glaciers are retreating and a number of glaciers lakes have decreased by 37 of 12 during the eight years period but surface area has increased due to coalescence of small glaciers. So these lakes are holding huge volume of glacier melt water behind the moraine dam, which increases the risk of GLOFs. The maximum quantity flood estimated from the most critical Birendra Taal (15 out of 21 potentially critical glacier lake) burst ranges from 3500-4000 m³/s which will have minimal effect on designed reservoir of 9800 m³/s for 100 years of return period. The mean annual discharge trend of the BudhiGandaki River from the baseline period to long-term future period has decreased by 0.22m³/s per year. In the long run, contradict with conclusion of increasing rainfall pattern in the basin that may enhance more discharge and sufficient holding capacity of designed dam may have enough water and may not require to look into other water resources to divert for smooth hydroelectric generation.

Keywords: future forecast, water security, glacier risk, design techniques, power generation

Tree Carbon Stock in Mountain Forest of Central Nepal

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Forests are important regulators of carbon cycle and contribute to mitigate the adverse impacts of climate change. They play a critical role in reducing ambient carbon-dioxide levels by sequestering atmospheric carbon in their woody biomass through photosynthesis and also by increasing soil organic carbon. This study estimates carbon stock in living biomass of forest in Marshangdi and Modi river watersheds of Annapurna Conservation Area in central Nepal. The modified- Whittaker nested vegetation sampling plot design (20m x 50 m) was used for data collection. Diameter of tree greater or equal to five centimeter at breast height (DBH, 137 cm) were measured. The allometric model for different forest types was used to estimate the above ground biomass (AGB), and the carbon stock was also estimated. The study found that in the Marsyangdi river valley, the mean carbon stock of living biomass was highest in Schima – Castanopsis forest (Ngadi, Lamjung; 204ct/ha) followed by Oak – laurels forest (163 ct/ha), *Alnus nepalensis* forest (149 ct/ha) and temperate mixed conifer forest (57 ct/ha). Similarly, in the Modi river watershed of Kaski, the mean carbon stock was highest in *Rhododendron – Persea* mixed forest (114 ct/ha) followed by Bombax – Schima forest (80 ct/ha), Laurels forest (69 ct/ha) and *Betulautilis* forest (25 ct/ha). In Marsyangdi River valley, soil organic carbon was the highest in Subalpine mixed forest of Manang (7%) and the lowest in Bombax ceiba forest (Ngadi, Lamjung; 3%). Similarly, in the Modi River watershed, the soil organic carbon was the highest in *Betula utilis* forest (7%) and the lowest in Bombax – Schima forest (Lumle, Kaski; 2.2%). The study showed that mountain forests possess high potential of storing carbon. Thus, their conservation is needed for more economic and environmental friendly solutions to tackle climate change.

Keywords: climate change, biomass, allometric equation, mountain forest, soil organic carbon

Comparison of Carbon Stocks in Community Forests of Lamahi Corridor, Kailali in Terai and Basanta Corridor, Dang in Inner Terai

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Climate change is a global issue (Ferrarini, 2012; Zhang and Lui, 2012) and REDD+ is considered as an effective and efficient mechanism to address it (Skutch and Laake, 2009). Considering the size of the global carbon pool in forests, and its potential climatic effects on natural and anthropogenic emission, Reducing Emissions for Deforestation and Forest Degradation (i.e. REDD+) has received much attention in recent years. (WWF, 2011). The main objective of the study was to estimate carbon stock of Community Forests (CFs) in Terai and Inner Terai districts of Nepal. The study was carried out in Tulsipur CF and Radhakrishna CF of Kailali district (Terai) and Deuki CF and Kalika CF of Dang district (Inner Terai). Simple random sampling was applied, maintaining 1% sample intensity. The total number of sample plots was 29. The plot of 750 sq.m was selected so that a 15.45m radius was formed. Measurement of individual trees (having DBH > 5cm) within the plots was taken. Samples of shrub were collected from the sample plot of 25 sq.m at 9 m from the central point in north direction. Litter sample was collected from the sample plot of 1 sq.m at 9 m distance from the central point in all 4 directions. Bulk density was measured using core sampler from the center of each plot. For organic matter 500 gm soil sample was collected around 30 cm from the center of each sampling plots.

The results showed that the highest carbon stock was 526.38 tC/ha in Tulsipur CF, followed by Radha Krishna CF with 273.66 tC/ha, Deuki CF with 156.94 tC/ha and the least amount was found in the Kalika CF with 141.99 tC/ha. The total carbon stocked in Terai was higher in comparison to that of Inner Terai- this was due to the big sized trees found in Terai. It seemed that Sissoo (*Dalbergia sissoo*), Khair (*Acacia catechu*), Sajh (*Terminalia tomentosa*), Sal (*Shorea robusta*), Barro (*Terminalia bellirica*), Rohini (*Mallotus philippensis*) Asidha (*Lagerstroemia parviflora*), Dhau/Dheuti (*Anogeissus latifolia*), etc. were species that stored large amounts of carbon.

Keywords: Carbon Stock, Climate Change, Terai, Community Forest.

Climatic Upshot on Growth Pattern of *Pinus roxburghii* in Mountain Sub-Tropics (A Case from Panchase, Western Nepal)

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Dendrochronology is the scientific method of tree ring dating based on the analysis of patterns of tree-rings. The present study represented a dendroclimatic study of a conifer, *Pinus roxburghii* Sarg. from the subtropical mountain of Himalaya. For this study, altogether 34 healthy cores of *P. roxburghii* were selected from a collection of 80 cores extracted from Bicharichautari village of Syangja district in Panchase of western Nepal. The standard methodology was used for sample preparation. For tree ring width measurement, the LINTAB system was used. Computer programs such as COFECHA, ARSTAN and software packages based on R software, dplR and treeclim were used to develop a 165 years long chronology, spanning from 1851 to 2015 AD. The expressed population signal (EPS) cutoff analysis gave results that suggested that only a portion of chronology, from 1904 to 2015, was useful for this dendroclimatic study. In addition to this, like other previous studies in western Himalaya, a negative response was observed for pre-monsoon season, especially for monthly average temperature of April of current year ($r_2 > -0.25$, $p = 0.05$). The value of reconstruction skill test, reduction of error (RE) = 0.117 and coefficient of efficiency (CE) = 0.080, were supported and allowed to reconstruct the April temperature of the study area. Using this response, a 111 years long April temperature was reconstructed extending back to 1904 AD. The relationship of radial growth rate with the diameter at breast height was observed to be positive while relationship of radial growth with height was negatively correlated. Both the correlations, however, were statistically insignificant. The r^2 value for diameter at breast height was 0.016 at $p = 0.58$ whereas that of for height was 0.034 at $p = 0.42$. The study supported that *P. roxburghii* can be used for the past climatic study. The main constraint while studying *P. roxburghii* for dendroclimatic study was the presence of false rings and absent rings. Therefore, it is recommended that an in-depth study of anatomical features be undertaken to help identify such false and missing rings.

Keywords: climate reconstruction, pre-monsoon, radial growth, tree-rings

Impact of Climate Change on a Selected Building's Energy Consumption in Kathmandu Valley

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Global climate change is causing the earth to warm, and a substantial increase in building energy usage is anticipated in future. The objective of this research is to analyze the impact of climate change, which mainly occurs due to rise in atmospheric temperature, in a building's energy consumption in the future. The historical time series data used in this study is from 1973 to 1996 (23 years) and analysis have been conducted for the year 2010, 2020, 2030 and 2040. An existing Typical Meteorological Year (TMY) weather file of time span 1973-1996, compiled by Solar and Wind Energy Resource Assessment (SWERA) project, was assumed as the baseline climate data in this study. The monthly average temperature of future years (in business as usual scenario) predicted by Meteororm was downscaled to hourly temperature data using a downscaling method, i.e. morphing. Building energy simulation tool, e-QUEST was used to analyze the energy consumption pattern of a selected building located in Kathmandu.

The result showed that annual average air temperature of the atmosphere will increase by 1.64°C, 2.12°C, 2.52°C and 2.28°C from the baseline year in the years 2010, 2020, 2030, and 2040 respectively. The study also has shown that total energy consumption of the building for heating, cooling, lighting and miscellaneous equipment will increase by 4.9%, 6.2%, 7.3% and 8.3% for the years 2010, 2020, 2030 and 2040 respectively whereas cooling load will increase by 19%, 23%, 27% and 31% in the years 2010, 2020, 2030, and 2040 respectively. This analysis allows for the characterization of the potential for reducing the energy use of buildings in a quantitative manner and therefore aids in improvement of building design.

Keywords: energy consumption, climate change, e-QUEST, morphing



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Cross Cuttings

Seasonal Dynamic of Coffee (*Coffea arabica* L.) Insect Pests and Their Management in Thanpati VDC, Gulmi District, Nepal

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Coffee is widely consumed as a beverage in most countries across the world. Nepal has an enormous potential for cultivating coffee as the climate is suitable throughout the mid hills. This study was conducted in the Thanpati VDC of Gulmi District (western Nepal). It aimed to assess the status of coffee pests score in correspondence to different seasons, temperatures and carbon and nitrogen content that occurred from February to July 2016. This research is also an attempt to collect and scientifically document the knowledge on traditional pest management methods. The study was designed with an emphasis on three different orchards- shaded, unshaded and mixed. All of these were located at an elevation above 1200 masl and were selected through simple random sampling. Forty five coffee trees were sampled; 54 coffee growers were interviewed using semi-structured questionnaires along with Focus Group Discussions (FGDs); and 27 soil samples were analyzed in three different seasons- winter, summer and rainy. Results showed that 22 species of 7 orders were infesting the coffee plants in the three different seasons. Data were analyzed in "R" platform and using Microsoft Excel 2013. ANCOVA showed that the pest species were significantly associated with season ($P < 0.0005$) whereas carbon, nitrogen and temperature show no association with pest species. A negative correlation between carbon and nitrogen was observed but seasons show positive correlation with pest abundance (0.000575). White stem borer was identified to be the major pest (62.96%) followed by the red stem borer (37.03%). The study concluded that the unshaded orchard is prone to insect pests and that the summer season has the highest pest abundance whereas pest species are highest in the rainy season. Botanical pesticides are opined to be the pest management techniques adopted by farmers.

Keywords: coffee, pest, management, season, orchard

Environmental Consideration and Corporate Social Responsibility: A Case of Varun Beverage, Kathmandu, Nepal

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Corporate Social Responsibility (CSR) is a type of social responsibility that contributes to the development of a state. Social responsibility is mutually beneficial to businesses as well as the society. Environmental consideration is one key responsibility of any company. Water is an essential ingredient for the beverage industry. The Varun Beverage (Nepal) Pvt. Ltd. (VBNPL) industry that lies in the Kathmandu district extracts ground water to meet its needs and the effluent waste water is discharged to the nearby Manohara River through channels. This study aimed to investigate the CSR activities undertaken by the VBNPL and the environmental considerations it maintained. This study analyzed the information collected from Varun Beverage and local residences. During peak season, with an increase in production, water extraction was found to be high. In May 2016, the volume of water extracted was 30,923 KL, the total water extracted in the year 2016 was 217104 KL. The water was overdrawn without any provision of recharge. Scarcity of drinking water is among the main problems of Kathmandu Valley. To avoid the impact of such water scarcity for the local residents, this company was found to be providing drinking water to them. The quality of treated water provided to the local residents was within the limits prescribed by the National Drinking Water Quality Standards (NDWQS, 2006). By a rough estimation, the total water used by the public was 8400 L/day. On an average 210 people collected water daily from the VBNPL. The local residences were satisfied with this service. Sincere involvement in such social responsibilities has earned the industry a good reputation among locals. The effluent treatment plant of VBNPL was found to be not working properly and was hence contributing to the pollution of the Manohara River. This study recommends that the VBNPL develop a strategy to recharge ground water and repair its effluent treatment plant as well..

Keywords: Corporate Social Responsibility (CSR), environmental consideration, ground water, drinking water

Revisiting REDD Plus Pilot Project for Tree Biomass Assessment in Kayarkhola Watershed, Chitwan District, Nepal

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Forests play an important role in absorbing the atmospheric carbon dioxide. Tropical forests absorb more carbon than other terrestrial ecosystems. Such forests are considered to be an important means to mitigate the impacts of greenhouse gases on climate change. Increasing the amount of carbon on watershed may become an important policy goal with economic benefits accruing from the establishment of a carbon offset market. The study was carried out to assess and quantify the forest carbon stock in the permanent plots already established by the NORAD- REDD+ pilot project in Kayarkhola watershed of Chitwan district. A total of 50 circular sampling plots, covered by 6 Community Forests (CF), were taken to quantify tree and sapling biomass along with seedlings count for regeneration study. The tree species richness in the area was 38 with 940, 418 and 638 individual trees, saplings and seedlings respectively. Forest carbon stock was calculated in three major pools of carbon storage in accordance with dense and sparse strata. The total carbon stock stored in both dense and sparse forest strata of the six CF was calculated to be 144036.71 tones and 28724.28 tones respectively. The weighted average value of carbon stock was 177.18t/ha for dense strata and 128.175t/ha for sparse forest strata. For AGTB, *Shorea robusta* contributed 52.1% followed by *Lagerestreoemia parviflora*, whereas for AGSB, *Shorea robusta* contributed 26.1% followed by *Mallotus philippinensis*. The Box-and-Whisker plot showed variations in the degree of relationship between above ground forest biomass and canopy, grazing, fodder collection and strata. AGTB was found significantly higher in those plots free of invasive species while AGSB was found to be low. The tree, saplings and seedlings density was found to be 716, 758 and 32,634 per hectare on average showing their high regenerating potential. The DBH-Density curve showed a reverse J-shape indicating the good regeneration pattern of entire watershed forests in general and *Shorea robusta* species in particular.

Keywords: carbon stock, permanent plots, REDD+, regeneration

Assessing In-kind Contribution of Syaubari Community in Biodiversity Conservation and Effectiveness of Buffer Zone Program in Household Income, Langtang National Park, Nepal

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The Nepali Government has been adequately innovative and has experimented with new conservation approaches and models in the past. One such effort was observed in the Buffer Zone Management Regulations (1996). This study attempts to assess the contribution that the local community has made to biodiversity conservation. It also examined the effectiveness of the Buffer Zone program in improving local livelihoods. Two stages of sampling strategies were applied: The Buffer Zone community was purposively identified while the households were randomly selected. Focus group discussion was conducted with the park warden and 154 households were interviewed. The results of the study showed that people relied a lot on forests (92.4%). About 84% households had participated in the preparation of the Forest Operation Plan. In three years (2012-2014), the Syaubari Community contributed 715 days in biodiversity conservation. The highest contribution was made during forest meetings. The regression analysis reveals that there was no significant relationship between in-kind contribution with income, education level, remittance and landholding ($df=140$, $R^2 =0.06\%$, $p>0.05$). The average (HH/year) and total income were NPR 146,422 (US\$ 1,394) and NPR 21.2 million (US\$ 202,209) respectively. The share of Buffer Zone program was 4%. However, forest conservation greatly reduced the resources collection time. It saved 2,351 days or opportunity cost worth US\$ 11,190 yearly. The study concluded that although direct benefit was low, indirect benefit was substantial. It is recommended that in-kind contribution should be increased.

Keywords: Community Forest, User Sub-committee, forest resources, non timber forest products



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Abstracts of Poster

Fuelwood Demand and Supply Assessment in Bajani Kilaupad Community Forest: A Case Study of Api-Nampa Conservation Area, Nepal

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Fuelwood demand and supply assessment is an effective way to deduce the sustainability of fuelwood in a particular area. In this research, fuelwood demand of the **Bajani Kilaupad** CFUG was determined with the help of household questionnaire surveys in 62 households. The supply from the forest was determined by using the methodology outlined in the Community Forest Resource Inventory Guidelines which was developed by the Department of Forest. The forest condition of the CFUG was found to be of medium standard. It was able to sustainably supply 187406.07 kg of fuelwood each year. However, the total demand for fuelwood in the CFUG was 238400.71 kg per year. This meant that the CF was able to supply only 78.61% of the total demand sustainably. The per capita fuelwood demand of the CFUG was 802.70kg/person/year. The change in the quality of the forest over time was analyzed by using the Landsat images of year 2013 and 2016. No significant changes were observed in the mean values of the NDVI, however there was a change in the spatial distribution of the forest. The old forest growth in the south was seen to be degraded and fragmented, whereas new forest patches had developed in the northern region. It was found that if all the HHs used alternative options like ICS and biogas, they could reduce the consumption of fuelwood by 40249.82 kg/year and 206909.01kg/year respectively.

The assessment of the fuelwood demand supply holds great significance in places of tourism as an increase in tourist inflow might lead to the increased fuelwood consumption in the region. The incurring demand of fuelwood demand is on one way or the other is met by the conservation area forest, as there is controlled resource use from the community forest. As this practice can undermine conservation efforts promotion of alternative energy options like ICS and biogas are highly recommended in the study area.

Keywords: fuelwood, renewable energy, forest inventory, ICS, biogas, NDVI, conservation

Effect of Biochar Application on Soil Micronutrients and Crop Yield

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Biochar is considered to be an effective soil management tool that improves soil health and enhances crop productivity in a sustainable manner. This study aims to assess the residual impact of biochar application on soil micronutrients (Fe, Mn, Zn and Cu) and crop yield. The experiment was conducted from February 2016 to June 2016 in a greenhouse located at Saraswatikhel in Duwakot VDC of Bhaktapur district. The research was based on the statistical comparison of soybean (*Glycine Max*) yield in terms of plant height, beans and plant biomass when planted on different plots with different biochar concentrations of 0, 2, 4 and 8 t/ha (with five replicates for each rate). The soil samples were investigated for micronutrient content using atomic absorption spectroscopy and the collected data was statistically analyzed using ANOVA in SPSS. The analysis indicated that biochar did not have a significant effect on plant height and bean yield ($p > 0.05$). Treatment plots under 4 t/ha and 8 t/ha resulted in a significant increase in fresh weight as well as dry weight of plant biomass ($p < 0.05$). Results from micronutrient analysis showed that Fe and Cu content of soil had significantly reduced in treatment plots under 4 t/ha ($p < 0.05$) which however also provided maximum yield based on beans and plant biomass. The results thus indicated 4 t/ha to be an ideal application rate in order to obtain satisfactory yield results. It was found that a higher rate of biochar application would not benefit soybean cultivation.

Keywords: biochar, soil amendment, soil micronutrients, crop yield, sustainable agriculture

Tree Diversity and Forest Sustainability through Participatory Forest Management: A Case of Chainpur VDC, Chitwan Nepal

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Community Forestry (CF) in Nepal is one of the most successful programs in Nepal that uses local level institutions to improve the greenery of degraded sites, to conserve biodiversity and, in overall, contribute to environment improvement. However, there was a substantial gap in knowledge related to the extent of CF's contribution to biodiversity preservation and livelihood improvement of community forest-user group members. This study explored the diversity of tree species and livelihood improvement of local communities brought about by CF in the Kankali Community Forest (KCF) of Chainpur Village Development Committee (VDC), ward number 1-9 of Chitwan District. Both the primary and secondary information was collected through sample plot assessment and participatory rural appraisal (PRA). A random sampling approach was implemented for collecting vegetation data where 90 circular plots of size 400 m² with sampling intensity of 0.5%, were established. Semi-structured questionnaire surveys, key informant interviews, focus group discussions and field observation techniques were used to collect socio-economic information. The ecological survey conducted revealed a total of 19 families, 30 genera and 33 tree species and the reverse J-shaped size class distribution indicated that the forest was young and regenerating.

The social survey conducted revealed that communities had diversified income sources. The program was found to be successful in providing firewood, fodder, grass and timber on a regular basis and community development activities like greenery promotion, income and employment generation opportunities were also conducted. Furthermore, the relationship between resource use and number of trees were positively related but not significant indicating that the resource were used and managed in a sustainable manner. An increasing density of Sal seedlings, sapling and trees was observed which may lead to a single species dominated forest and low-timber value in the future. It is concluded that awareness programs on biodiversity conservation and its relevance with community forest development and management is a priority for sustaining forest based livelihood and biodiversity.

Keywords: Community Forestry Program, Participatory Rural Appraisal, livelihood

A Case Study on Environmental Assessment of Bakharka-Lakuri-Suntola-Ghoreta Road of Surkhet

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This paper includes the Environmental Assessment of the newly proposed Bakharka-Lakuri-Suntola-Ghoreta Road of Surkhet. It involves a systematic evaluation and outlines the potential positive and negative impacts of building this road along with effective mitigation measures. The newly proposed road is 16 km in length and 5.5 km in width which covers an altitudinal range of 613 m to 1635 m. The road alignment covers a total of three villages namely, Bakharka, Suntola and Ghoreta with three Community Forests (CF), namely, Ramadi CF, Suntola CF, and Chuli CF respectively. The impact evaluation was conducted on the physical, biological, social and cultural aspects of the environment. The study sites were divided into 32 segments, each segment was 500 m in length. Each site's study included recording the latitude, longitude and elevation data for the physical aspect; questionnaire surveys, direct interview methods and focal group discussions for the social and cultural aspects; and flora and fauna listing (through direct observation and direct interviews) for the biological aspect. It was found that residents of different VDCs of the Jajarkot district would benefit from the proposed road. The road construction would damage one community water tap and some agricultural lands. As the road alignment was already constructed, it resulted in habitat fragmentation but no trees were seen to be affected by the road. However, the water irrigation canal was observed to be affected the most. Therefore, water irrigation canal management by relocation is suggested as the foremost priority. Questionnaire surveys showed that the road was the first development need in the area, where about 97% of the people supported its construction. Other important recommendations such as community tap relocation, corridor management for animal movement, compensation for land, corrective measures such as canal and cause way construction, preventive measures such as road widening in the road turns and bio-engineering techniques on the landslide prone slopes were suggested for the sustainability of the proposed road.

Keywords: road, Environmental Assessment, impact, mitigation

Conservation Attitude of People Linking with Ecotourism in Vulture Safe Feeding Sites: A Case Study in Pithauli, Nawalparasi and Gaidatal, Rupandehi

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Vulture Safe Feeding Sites (VSFSs) is a new practice adopted in bird conservation. Established in 2006, the Vulture Restaurant in Nawalparasi was the first among others in Nepal. It was also the first community managed Vulture Restaurant in the world. The Vulture Restaurant in Rupandehi, however, which was established in 2008, has yet to be recognized as an ecotourism destination. The main objective of this study was to understand the attitudes of local people towards VSFS and related ecotourism. This was done to explore the possibilities of such tourism in Gaidatal of Rupandehi. Seventy households were selected from each site for household interviews. Along with this, key informant interviews, VSFS staff interviews and focus group discussions were conducted in both study sites.

Gaidatal is a new settlement of migrants from mid-hills, especially from Syganja District. Magars dominate this community. Besides the vultures and forests, the Magar culture is another source of tourist attraction. It was found that local people have positive attitudes regarding vulture conservation and the Vulture Safe Feeding Sites of Gaidatal. Rupandehi District holds a great potential for ecotourism and can be the next emerging ecotourism destination due to the rich Magar culture, the presence of the Gaidahawa Lake, the potential wildlife habitat, and because it lies on the way to Lumbini.

Keywords: Gaidatal, Vulture Safe Feeding Site, Magar, ecotourism destination

Firewood Characteristics of Locally Preferred Trees of Middle Hills of Nepal: A Case Study from Chitre VDC, Parbat District

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This study on the firewood value index of locally preferred trees in the middle hills of Nepal was conducted in the Chitre VDC of Parbat district. Primary information on the distribution and frequency of preferred trees was obtained through key informants, group discussions and reconnaissance visits of the study area. Locally preferred tree species for firewood were *Schima wallichii*, *Garuga pinnata*, *Macaranga denticulate*, *Daphniphyllum himalayense* and *Alnus nepalensis*. *Schima wallichii* had the highest firewood value index of 10770.94. However, *Daphniphyllum himalayense* ranked first in terms of preference of the locals due to its dominant characteristics in the forest as well as its good firewood characteristics. The preference ranking of the trees was done by taking high calorific value and density of wood as positive characteristics, and high water content and high ash content as negative characteristics. Firewood consumption was influenced by climate and the season of the year. This study intended to develop an understanding regarding the firewood needs of the rural communities in the remote villages of Nepal. This study will help towards the sustainable management of forests.

Keywords: firewood value index, preference, calorific value, moisture content, density, sustainable

Gastrointestinal Parasites of Wild Ruminants and Chauris in Langtang National Park, Rasuwa, Nepal

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This study examined the prevalence of gastrointestinal parasites in wild ruminants and chauris in Langtang National Park. A total of 71 fecal samples (16 Himalayan Tahr, 31 Barking Deer, 9 Musk Deer, and 15 Chauri) were collected and analyzed using microscopic examination. The ova/oocysts/cyst and larvae of different parasites were identified according to the morphology and quantitative estimation by using the concentration method (floatation and sedimentation technique) in the laboratory of Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu. Seven species of parasites were identified among which one was protozoan (*Eimeria* sp.), four were nematodes (*Ascaris* sp., strongyle group, *Strongyloides* sp., and *Trichuris* sp.), one was cestode (*Moniezia* sp.) and one was trematode (*Paramphistomum* sp.). The parasites of wild ruminants and chauris had no significant difference ($p > 0.05$), i.e. the parasites in both were the same. The parasites had a high chance of transmitting from wild ruminants to chauris and vice versa. Contamination of the grazing land of wild ruminants by chauris could be one of the reasons for the presence of gastrointestinal parasites in wild ruminants. Moreover, the presence of vectors or intermediate host can play an important role in transmitting the gastrointestinal parasites. Controlling or restricting the grazing of chauris in the habitats of wild ruminants can help control the parasitic transmission between them.

Keywords: Chauris, ruminants, parasites, microscopic examination, contamination

Medical Ethnobotany of Yakkha Communities of Sankhuwasabha District, Eastern Nepal

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The research was conducted to study the ethnobotanical knowledge on medicinal plants of three different Yakkha communities of Sankhuwasabha district in eastern Nepal. Among the three different communities was the Mamling VDC (Community A) which was the most modernized, the Ankhivhu VDC (Community B) with its intermediate modernization and Tamafok VDC (Community C) with the least modernisation. Methods used were key informant interviews, informal (unstructured) interviews, structured interviews, focus group discussions, direct observations, participatory observations and herbarium collection. MS Excel and SPSS (16.0) were used for data analysis. A total of 150 respondents were selected for structured interviews. The documented 221 medicinal plants represented 87 families and were used for treatment of 75 different types of ailments. No fresh medicinal plant species contribution was made to the ethnobotanical database of Nepal from this research but few plant species (n = 10) with different uses were documented. 'Cuts' was the most dominating ailments. 'Infection' was the dominant usage categories. Informant consensus factor (Fic) was highest for "Muscular Skeletal System Disorder" (0.78) at community C, "Circulatory system disorder" (Fic= 0.9) at community B and "Nervous system disorder" (0.73) at community A. Response of medicinal plant species against gender showed no difference in its mean value. The proficiency also did not vary significantly with educational attainment. The years of experience (age) had significant relation with response of medicinal plant species only at Community C ($r = 0.387$; $p = 0.006$). The availability of medicinal plants at the local level have remained the same except for a few species. Conservation practices for medicinal plants were negligible. Whereas, outsiders used to visit the area for harvesting the available medicinal plants frequently. The current scenario was not sufficient for maintenance and preservation of indigenous knowledge on medicinal plants. Community empowerment programmes for plant diversity conservation are the immediate requirement for safeguarding such valuable floras.

Keywords: ANOVA, Indigenous Knowledge, Informant Consensus Factor, modernisation, Regression Analysis, Usage Categories

Assessing the Roosting sites of Vultures around Jatayu Restaurant: Case Study of Jatayu Resturant in Nawalparasi

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The study focused on the roosting sites of vultures in Nepal's first vulture feeding site which lies in Pithouli and Kawasoti villages of the Nawalparasi district. The study aimed to research the status of vultures in Jatayu restaurant, with reference to its various ecological needs such as roosting site, carcasses availability, feeding site etc. Also threats on vultures in the Jatayau restaurants were studied. Questionnaire surveys were done with the key respondents and information was collected during field observations. The study found that carcasses availability had been decreasing over the years. However, the vultures living there are not only dependent on the carcasses available within the restaurant. Field observations found that the Narayani River, which lies close to the restaurant, was the main source of food for the vultures. Similarly, the ban of Diclofenac in the area, and its subsequent declaration as a "Diclofenac free zone", was the other most important factor that had been aiding in the maintenance of vulture's population. Meloxicam, a safe drug for cattle, was found to be used in the area. Nimesulide, a harmful drug, was found to be used in very minimal quantity. Active participation of people in vulture conservation programs was found due to the provision of various livelihood programs. It was found to be increasing and was responsible for the success of vulture conservation acts and plans. But the next big challenge observed here was the spread of harmful diseases in nearby community due to the roaming scavengers. Roosting site assessment was done in the periphery and Google location map was made by tracing the GPS location.

Keywords: vulture, Diclofenac, Meloxicam, Nimesulide, harmful diseases

Water Conservation by Eco-san Toilet: A Comparative Study of Eco-san and Ordinary Toilets

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Conservation of water is a key issue in urban areas due to high water demand and low water supply. Water consumption in household toilets is much higher than water used for drinking. This study presents water consumption by Eco-san and ordinary toilets. The study was conducted in Ward 1, 3, 4 of Tokha Chadeshwori and Tokha Sarawasti in Tokha Municipality. In the then-Tokha VDC 148 Ecosan toilets had been established (Water Aid, 2006), which is highest in Kathmandu Valley. In this study, which was carried out in February 2016, ten Ecosan toilets and ten ordinary toilets were selected. About 70% of the respondents using Ecosan responded that they used less than 10 liters/day, while 70% ordinary toilet users responded that they used 40-60 liters/day. The quantity of water used for cleaning latrines was higher than the water used for drinking in the households that had ordinary toilets. Ecosan also provided a solution to manage toilet waste- the byproducts of which could be used in agriculture as high quality manure. Considering the water consumption and manure production, this study recommends that the Eco-san toilets be promoted in water deficient areas as an effective method to reduce waste.

Keywords: Latrine, Water consumption, Water deficiency, Water Stress, Tokha, Ecological

“Is Climate Variability Really Inducing Disasters?” (A Case Study of Rainfall versus Landslide in Lamjung District)

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Climate change has the potential to exacerbate weather-related hazards. According to NAPA (2010), Lamjung District is considered highly vulnerable to landslides, rainfall, temperature fluctuation and GLOFs. Landslide occurrence was highest in 2001 when it occurred 17 times and caused 16% of the total local population to die, 6% of houses to be destroyed and left 4% of people affected. From 2001 to 2011, landslides were the most destructive hazard. The objective of this study was to observe the correlation between climate variable (rainfall) and the disaster (landslide). Karl Pearson’s method of correlation coefficient was used in this study to obtain the relationship between rainfall and landslides as well as fire and landslides. Data collected over a period of 30 years was used. The results showed that rainfall and landslides had a correlation with each other and there was a positive relationship between them (according to data collected from the Kuncha and Gharedhunga station). When rainfall was more intense, the probability of landslide occurrence increased. Since the relationship wasn’t strong, fire was observed to be a problem of landslides in Lamjung. The correlation analysis of fire and landslides showed a positive relationship. The study of other variabilities that induce various hazards in Lamjung can be further studied which can be helpful for climate change and disaster adaptation and mitigation. Further investigation, with better spatial and temporal resolution, is highly recommended to better understand the patterns and consequences of extreme weather inducing disasters in hilly regions.

Keywords: climate, correlation, disaster, landslides, rainfall

Cloning and Overexpression of Mitochondrial Homolog of Cancer Hsp90 Chaperone

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Cancer has become one of the most deadly diseases of the 21st century, despite the advances on medical technologies. The disease owes complexity partly to its polygenic traits and is attributable to the underlying epigenetic regulations. Hsp90 has been termed as a cancer chaperone because of its pivotal role in the cancer cells. This chaperone helps in maintenance and regulation of various proteins that subsequently leads toward the clinical progression of cancer. This research aimed is to understand the role of mitochondrial homolog of Hsp90 and the Tumor Necrosis Factor Receptor Associated Protein 1 (TRAP1) in regulating the mitochondrial dynamics. A full-length gene of TRAP1 was cloned into pCDNA3.1TM (+) mammalian overexpression vector. Following the cloning, the vector was then transfected into various human cell lines viz., Human neuroblastoma cells (IMR32), Human lens epithelial cells (SRA01) and Human Embryonic kidney cells (HEK293T). Following successful stable transfection, the cellular morphology and mitochondrial dynamics was studied. Among the cells transfected with TRAP1, (1) SRA01 cells showed significant increase in cell volume with elongated morphology and enhanced cell-cell connections, (2) HEK293T cells did not show any morphological changes, and (3) IMR-32 cells exhibited slender elongated morphology. Upon over expression of TRAP1, IMR-32 cells showed enhanced mitochondrial circularization. More interestingly, cells transfected with TRAP1 showed enhanced mitochondrial fission when compared to the control cells. Unlike IMR-32, TRAP1 over expression in HEK293T failed to indicate significant changes in mitochondrial organization. Further studies are required to confirm whether these changes are related to mitochondrial fission or loss of mitochondrial integrity.

Keywords: cancer, Hsp90, TRAP1, molecular chaperones, mitochondrial dynamics.

Geospatial Analysis of River Channel Shift of Babai River

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Channel shifting is a dynamic physical process of rivers that involves the lateral migration of a river channel over time within a river valley. River channel shift is an outcome of natural and anthropogenic activities. Bank line migration and consequent channel shift is a common phenomenon of the mighty river like Babai. The Babai River, located in Bardia District, has shifted its channel because of natural causes. The area from Babai Bridge, Ratna Highway (28°21'25" N and 81°42'47" E) to 15.5 km downstream (28°23'23" N and 81°38'00" E) was studied. The study analyzed the channel shift of the Babai River. Topo-map of 1996 and Google map of 2017 were used to reconstruct the channel's change in the study area. Georeferencing and digitization was done to extract the layer of 1996 and 2017 A.D. image of the study area using Arc GIS 10.2.1 and address the extent of bank-line migration along with erosional and depositional areas. The result indicates that river channel shifted towards the northern side but southward movement was also observed at some locations. A total area of 309179.62 m² had eroded, among which an area of 141164.62 m² had eroded on the left bank and an area of 168015 m² on the right bank. Similarly, an area of 552556.9 m² was deposited, among which an area of 272548.30 m² was deposited on the left bank and an area of 280008.60 m² on the right bank. Floods during monsoon, lateral erosion and deposition were the main factors for the river channel shift. Toe-erosion and earth cutting had increased due to the geological structure along the river.

Keywords: Arc GIS, digitization, river channel.

Estimation of Carbon Stock of Nil Barahi Community Forest, Bhaktapur, Nepal

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Increased concentration of the carbon dioxide in the atmosphere is considered a major factor responsible for global climate change. The tree can store carbon as biomass in different parts of plants and transfer carbon from atmosphere into the soil and hence act as the interference between the atmosphere and soil. The forest can act both as a sink and source of carbon depending on management activities. This study aims to quantify the amount of carbon stock in community managed forest of central midhills. The Nil Barahi Community Forest, which is a coniferous pine forest, was selected for study. The research is based on random sampling with circular plot method (as per the guidelines by GoN, 2010) for measuring carbon stock in community-managed forests. The result showed that the total carbon stock of the forest was 2806.495 tonnes. The average carbon biomass of above ground trees, below ground roots and leaf litter, herbs and grass were 111.1608 ton/ha, 22.23216 ton/ha and 1.4698 ton/ha respectively. The average percentage of soil organic carbon was 1.054588% in the forest. The average carbon stock of the forest was 134.8628 ton/ha. The CO₂ equivalent of the forest was 618.387 tonnes CO₂/ha.

Keywords: climate change, carbon sequestration, biomass carbon, soil organic carbon, REDD, carbon stock.

Pesticides Use Practices and Its Impact on Human Health: A Case Study of Rapti Municipality, Chitwan

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The use of toxic chemical pesticides, to produce higher quantity of crops, is very extensive in Nepal these days. This has caused the health of farmers to be at greater risk due to improper handling practices. To find out information regarding pesticide use practices and its impact on human health, the study was carried out in Rapti-3 Municipality of Chitwan. Direct field observations and answers to structured questionnaires from a random sample of ninety farming households showed that all the farmers use chemical pesticides in the crops. Herbicides, insecticides and fungicides were the major pesticides used. Most of the farmers were observed to be more focused on high crop yields rather than healthy food production. They were found to have several acute health problems with symptoms like eye irritation (60%), headaches (40%), dizziness (33%), skin irritation (30%), and sleepiness (12%). Many of them were found to apply pesticides to the fields without wearing proper protective equipments. They used normal clothes which absorbed the pesticides solution during spraying. It was also found that farmers disposed the pesticide containers/packages haphazardly in the field/rivers/irrigation canal (63%), or burn them (35%), or bury them under ground (3%). The result showed that the awareness of farmers needs to be raised regarding the use of pesticides, protective equipments and proper practice when handling pesticides and disposing the containers.

Keywords: farmers, survey, protective equipments, disposal, awareness.

Impact of Kunth (*Mikania micrantha*) Invasion in the Habitat of Wild Water Buffalo (*Bubalus Arnee* Kerr, 1792) In Koshi Tappu Wildlife Reserve, Nepal

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The Wild Water Buffalo (*Bubalus arnee*) is an endangered (En) species and the second largest bovine which is listed in CITES Appendix-III. It is only found in the Koshi Tappu Wildlife Reserve of Nepal. This study was conducted between March to April 2016 to assess the floral diversity, status and distribution of *Mikania* and its impact on the habitat of *Bubalus arnee*. To conduct this research Prakashpur, Madhuban and Kusaha were divided into three blocks and within these blocks 64*64, 20*20, 10*10 quadrates were randomly performed for trees, 5*5 for shrubs and 1*1 for herbs. The floral diversity was assessed using Shannon-Weiner index (H), Shannon-equibility index, Simpson diversity index (SI), Heterogeneity index and important value index was calculated with the help of Ms Excel 2013. An index of species reduction (ISR) was calculated to find out the impact of *Mikania* on different tree species and this showed that the tree *Dalbergia sissoo* was the most impacted. For habitat preference scan sampling was conducted and it shown *Bubalus arnee* preferred grasslands and avoided invasion.

Keywords: Mikania, Bubalus arnee, habitat.

Fire and Economic Risk Assessment of Petrol Pumps within Kathmandu District

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A Service Station (SS) is a facility that sells fuel and lubricants for motor vehicles. Their main objective is to provide fuels for motor vehicles. Kathmandu Valley has 102 active filling stations. These filling stations are prone to extreme accidents and are highly vulnerable to human made fire. In this study, 27 petrol pumps from Kathmandu Valley were investigated. Assessment of fire risk and economic loss of petrol pumps was carried out in these selected petrol pumps. ALOHA and MARPLOT software and questionnaires were used to gather information and carry out analysis. KII were also done to understand the view of expert's. GIS software was used to prepare a petrol pump distribution map. Impact of each parameter in the probability and severity of fire in the filling stations were determined. According to results, the risk area that can be affected by fire and explosion was determined to be 2.82Km² (at the highest) and 0.63Km² (at the lowest). It was determined that a total damage of Rs.53820.85 million could occur in the potentially lethal zones, if buildings were fully damaged. The study recommends that these pumps be well-prepared and have a backup plan in case of fire and earthquake. The risky aspects must be analyzed and determined before a disaster occurs so as to prevent catastrophe. Trainings to the station staff is also urgently needed.

Keywords: disaster, fire, impact, urban, vulnerability

Post-Earthquake DRR and BBB Activities on Restoration and Reconstruction of Damaged Heritage Sites: A Case Study of Dattatraya Durbar Square Area, Bhaktapur

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The Dattatraya Durbar Square is an important heritage site of the city with multi-roofed and rectangular temples exhibiting superb craftsmanship with stone sculptures, stone spouts, traditional water tanks and wood carvings. Along with Dattatraya, Bhimsen temple (the oldest temple of the city), water spouts, peacock windows, Maths, wood-carving museum, the bronze and brass museum, Salan Ganesh, Lamgal Pati and Sija Mahadev temple are the other major attractions of the square. The square was added to the list of UNESCO World Heritage Sites in 1979 A.D. The main objective of this study is to understand the ongoing activities of Disaster Risk Reduction (DRR) and Build Back Better (BBB) on the damaged heritage sites of the Dattatraya Durbar Square area and to access community knowledge on restoration and reconstruction of heritage sites. In this study, 105 households were selected from the Dattatraya Durbar Square area for interview. Along with this, key informant interviews, municipality staffs interviews and focus group discussions were conducted. The finding of the study showed that conservation of individually owned private homes, with archeological value, plays an important role in the sustainable livelihood of the community. This study found indigenous practices, in collaboration with building codes, will help develop software for structural analysis of traditional buildings. It can be concluded that Dattatraya Durbar Square area has the potential to attract maximum number of tourists with the introduction of a sustainable disaster resilient community which ensures a more sustainable and safer environment.

Keywords: DRR, BBB, damaged heritages, restoration, reconstruction, sustainable

Ecotourism Potential of Sailungeshwor Village Development Committee, Dolakha

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The Sailungeshwor Village Development Committee (VDC) of Dolakha District is a potential site for ecotourism. This study explored the degree of ecotourism, natural attributes and tourist flow in the Sailungeshwor VDC. The degree of ecotourism was obtained from five parameters: environmental sustainability, economic sustainability, interaction with nature, interaction with people and action towards conservation. Key informant interviews, group discussions with Community Forest User Group and interviews with DDC officials and hotel owners were applied to collect primary data.

The degree of ecotourism was found to be 2.856. This figure shows that most people were not involved in ecotourism activities. The types of naturalness were found to be 23 fall under the type II by assigned different attributes of naturalness indicates less disturbed area suitable for nature based ecotourism like trekking, birding, cultural and research. It is important for religious and natural touristic areas where people visit Sailungeshwor Mahadev or come to observe the pleasing green hills. The area is also famed for having the best sunrise in Nepal, with a 180-degree panoramic view of the mountains and a 360-degree view of the surrounding area. This area is also famous because of the presence of the natural view tower and because of the rich Tamang culture. Sailung trekking is one of the best trekking destinations where 53 groups of international tourist have visited from April to December 2016 alone. Sailung which is a perfect destination for trekking, cultural visits, rare flora/fauna as well as adventure sports (paragliding), scenic landscapes, religious importance and cultural diversity, bio-diversity potentials attracts tourists and contributes to upliftment of local people.

Keywords: Sailung, naturalness, degree of ecotourism, cultural diversity

Impacts of the Gorkha Earthquake 2015 on Occurrence, Distribution and Illegal Trade of The Chinese Pangolin (*Manis Pentadactyla* Linnaeus, 1758) in Chautara Municipality of Sindhupalchowk, Nepal

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Pangolins (*Manis* spp.) are nocturnal, shy, non-aggressive, solitary and burrowing mammals. Among the eight species of Pangolins in the world, two species are recorded in Nepal: Chinese pangolin (*Manispentadactyla*) and Indian pangolin (*Maniscrassicaudata*). Though the Chinese pangolin is internationally enlisted in Appendix-I of CITES and categorized as Critically Endangered in the IUCN Red Data Book, the detailed information on occurrence and major threats that drive the species to extinction is still lacking in Nepal. Based on reconnaissance survey, after one burrow was found, taking that burrow as a reference point, a line transect of 500m were laid out. Three plots (100m*100m), each at an equidistance of 100m, were drawn in each line transect. 25 line transects were surveyed so all together 75 plots were made. The number of burrows within each plot was then counted. If the burrows contained less compact and loose soil, recent digging, footprints and pellets at their entrance then they were classified as active burrows and if the burrows contained compact soil, and were mostly covered with dried vegetation, spider nets and did not have scratch signs at their opening they was classified as inactive burrows. Inactive burrows were further sub- classified as inactive (old) burrows before the earthquake (Burrows one year before earthquake) and inactive (old) burrow after the earthquake (Burrows one year after earthquake). Questionnaires were also administered to District Forest Officers, Community Forest Officers and local people regarding pangolins.

Within the 75 plots, 96 burrows were new, 90 burrows were formed after the earthquake and 121 burrows were formed before the earthquake. The average density of active burrows was two burrows per hectare and the highest number of burrows was distributed between the altitudes of 1201m to 1400m (with major vegetation of Chilaune (*Schima wallichii*)). According to the logistic regression model, burrows distribution were highly affected by the Gorkha earthquake 2015 ($p<0.05$) and distance to settlement ($p<0.05$) but associated with south facing slope ($p<0.05$) and farmland ($p<0.05$). Two illegal trade routes for selling pangolin scales and its products had been identified as Rasuwa and Kodari highway and estimated that a total of over 24kg- 27kg of pangolin scales were sold to the Chinese market after the earthquake with average price being Rs. 35,000 per kg.

Keywords: Chinese Pangolin, Gorkha earthquake, active burrows, inactive burrows

Livelihood Improvement and Respiratory Problem by Stone Quarry: A Case Study of Agra River, Dhading, Nepal

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Rivers have been a means of livelihood and are widely used by humans to meet their needs. Marginalized and poor people are highly dependent on rivers for their livelihoods. Stone quarries are one of the income generating activities of people living along river banks. According to Park (2007) individuals working in such dusty environment have a higher risk of inhaling particulate materials like silica, which may lead to the adverse respiratory problems such as bronchitis, lung cancer, acute and chronic silicosis etc. In this study, household surveys were conducted in 30 households along the banks of the Agra river to explore the dependency of people on river resources.. It was found that all of the sampled households (100%) were engaged in the stone quarry for income generation. The average income of the quarry workers was found to be 513 rupees per day. Most of the quarry workers (73.34%) were found to be suffering from respiratory problems like regular coughing, chest pain, sore throat, dryness of nose and mouth, difficulty breathing etc. Many of the respondents also had back (23.33%) and digestive problems (3.33%). It can be concluded that the dust released in stone quarries cause adverse impacts to the health of the workers. However, such occupational hazards have not been addressed as of yet.

Keywords: quarry worker, occupational hazard, income generation, migration

Status and Ecological Correlates of Occurrence of Leopard *Panthera Pardus* (Linnaeus, 1758) in Bhaktapur District, Nepal

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Understanding and conserving wildlife species outside protected area is challenging. Large cats like leopards wander into human dominated areas due to loss of habitat. This has caused human animal conflicts which have resulted in human injuries, livestock depredations and retaliatory killings of leopards. The objective of this study was to correlate the occurrence of leopards with ecological parameters like distance from water bodies and settlement area, ground cover, number of vegetation strata, canopy cover, presence of prey, mean height of trees and density of tress. Three different forest patches (Nagarkot, Suryavinayak and Telokot) were examined and eight different ecological variables were recorded from each site. Questionnaire surveys were conducted to investigate conflicts in human-dominated landscape. The result showed that the habitat of leopards correlated positively with the presence of water bodies, canopy cover and density of trees while presence of settlement areas and wild prey showed less correlation. Similarly, the conflict was higher in areas with high vegetation cover. In such conflict areas leopards mostly attacked stray dogs followed by goats.. Most of these attacks occurred during the night time. Preventing domesticated animals from grazing in dense forests, using dogs as deterrents for predators and practicing afforestation to ensure that leopards have a corridor during migration from one forest to another is suggested by this study.

Keywords: occurrence, corridor, conflict, stray dogs, afforestation

Economic Valuation of Drinking Water Supply Services from Panchase Protected Forest in Chitre VDC, Parbat

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Water is an important substance that can sustain life. The quality of water is a powerful environmental determinant of health and of vital concerns for mankind since it is directly linked with human welfare. Among many ecosystem services provided by protected forests, water supply services have benefits that are provided not only at the local level but also at the regional and global level. This study examines the economic value of domestic water supply as a service from Panchase Protected Forest, through water quality assessment and Willingness To Pay (WTP). Altogether, 15 water samples from different sources were examined as per the standard methods for examination of APHA (1998) and compared with the National Drinking Water Quality Standards (NDWQS, 2005). Contingent valuation surveys were carried out with 71 households (HHs) to evaluate the water supply service and their WTP. All the water samples were found within the NDWQS and World Health Organizations guidelines in regards to electrical conductivity (EC), pH, chloride, total hardness, nitrate, ammonia, phosphate, total dissolved solid and iron. Out of total users, 11.26% were willing to pay NPR 25 and less per HH per month, 42.25 % were in the range of NPR 25 to 50 per HH per month, 25.71% were in the range of NPR 50 to 75 per HH per month, 14.08% were in the range of NPR 75 to 100 per HH per month and 7.04% were in the range of NPR 100 to 200 per HH per month. The mean WTP of Panchase Protected Forest users was found to be NRs 55.98 per HH per month. Factors like distance of the HH from the water source, daily water consumption and age of the respondents were associated with the substantial differences in an individual's WTP. All the water sources were safe for drinking water in terms of physiochemical parameters. This study concludes that, there would be a high possibility of generating additional resources with the development of payment mechanism for water supply services.

Keywords: protected forest, water quality, water supply, contingent valuation, willingness to pay

Sero-Prevalence of Brucellosis in Pregnant Women Visiting Gyenocology Department of Kathmandu Model Hospital, Nepal

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A test to measure the sero-prevalence of brucellosis in pregnant women was conducted for the first time in Kathmandu of Nepal. Eighty sera samples were collected from pregnant women who visited the Kathmandu Model Hospital between September 2014 and February 2015. The patients were categorized on the basis of age, trimester and ethnic groups. The sera sample was tested using ELISA tests. The sero-prevalence of brucellosis among pregnant women was 11.25%. Madhesi ethnic group showed the highest (16.66%) sero positivity rates followed by Janajati (11.53%) and the lowest was observed in the Brahmin (8.33%) ethnic group. Similarly, the age group 31-35 years showed highest prevalence (29.41%) followed by the age group 26-30 years (13.33%). There was an absence of sero positivity among the age group of 16-20 years and 21-25 years. The highest sero-prevalence rate (12.76%) was observed in the third trimester followed by the first trimester (10%) and the lowest was seen in the second trimester (8.69%). During questionnaire surveys of 200 pregnant women, which was done to assess their knowledge, attitudes and practices regarding brucellosis, knowledge about the disease was found to be very poor. About 3% of them consumed raw milk directly after milking animals which is one of the main reason for brucellosis in pregnant women.

Keywords: ELISA, pregnant women, hospital, brucellosis, hospital

GIS and Remote Sensing Based Assessment of the Encroachment of Bagmati River Corridors in Kathmandu, Nepal

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The Bagmati River supports a population density of 20,288 people per square kilometer in Kathmandu Valley (World Population Review, 2017). Recently, efforts has been made to protect the river's religious, ecological, cultural and aesthetic characteristics. However, major point source problems need to be sorted for sustainable improvement of the river basin.

This study was conducted from Manohara Junction to Thapathali (Segment 6) and Thapathali to Balkhu Bridge (Segment 7), which covered 16.52% of the total river area, through the application of GIS and Remote Sensing. For this enquiry, geo-information and earth observation techniques were used for identifying and mapping the river territory and changes in Land Use and Land Cover (LULC) with the use of satellite images from 2006 and 2014. Features such as water bodies, vegetations, grasslands, open spaces, settlements and roads were measured. Analytical tools such as ArcGIS 9.3 and MS Excel were used for calculation, tabulation and map preparation. It was found that, within the interval of eight years, water bodies, vegetations and grasslands had decreased by 5.41%, 4.48% and 26.69% respectively, while open spaces, settlements and roads had increased by 28.29%, 6.32%, and 1.97% respectively. Settlement areas of 7325m² and roads of area 12259m² encroached these stretches. Thus, slums and squatter settlements, alongside river territory, were a major obstruction to the Bagmati clean-up initiative. The basic reasons behind river encroachment were weak legislative arrangements (lack of river demarcation and failure to ascertain river territory), social and economic factors such as poverty, the scarcity of land, the high valuation of land in Kathmandu and easy access to river lands.

Keywords: land use, land cover, change detection, Remote Sensing, GIS

Spring Water Status of Tarkeshwor Municipality, Kathmandu

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The major source of water for the people living in Tarkeshwor municipality is spring. They use spring water for drinking, cooking, washing and even in agriculture. After the 2015 Gorkha Earthquake, the major sources of spring water in that area were affected. Nine different sources of water that were the chief sources affected by the earthquake were traced. Then, their GPS locations were taken and projected in Google map. The study area consisted of around 250 households. To find out details regarding that area, three Key Informant Interviews were conducted. After the field visits, observations and Key Informant Interviews, it was found that water dried up after the disaster and people had to walk for about an hour to collect water. In contrary, some new sources had also formed in the nearby areas. With time, slowly the dried up sources were revived, but at other sources, the dried up springs were still dry. Furthermore, from the GPS projection analysis, it was found that, one area with abundant springs had suddenly dried up but at another area, where there were no pre-existing spring sources, new sources were formed after the earthquake. This might be probably due to earthquake-induced crustal deformations and ground shaking which can alter stream flow and water levels in wells through consolidation of superficial deposits, fracturing of solid rocks, aquifer deformation and clearing of fracture filling materials (DR Montgomery, M Manga, 2003). This was an inconvenience to a lot of people and many of them even left their places and settled in the water rich areas. Others, who were able to find alternative sources, sustained in the same place , somehow.

Keywords: disaster, earthquake, Key Informant Interview

