GoN-MoEST

Tribhuvan University
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Kathmandu University

Localization of Sustainable Development Goals (SDGs)

Himalayan Knowledge Conclave

ABSTRACTS

5th Graduate Conference on Environment and Sustainable Development (GCESD)

Kathmandu University, Dhulikhel, Kavre, Nepal

April 05-06, 2019 (Chaitra 22-23, 2075)

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ISET-N
Institute for Social and Environmental Transition - Nepal

SchEMS
School of Environmental Science and Management
Affiliated to Pokhara University

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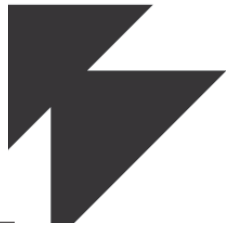
Institute for Social and Environmental Transition-Nepal, Lalitpur



Conference at a Glance

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.

In 2015, Tribhuvan University Institute of Science and Technology-Central Department of Environmental Science (TU IOST-CDES), Resources Himalaya Foundation (RHF) and Institute for Social and Environmental Transition-Nepal (ISET-Nepal) came together to create the yearly Graduate Conference on Environment and Sustainable Development (GCESD) known as Himalayan Knowledge Conclave (HKC). Recently, Kathmandu University (KU) and School of Environmental Science and Management (SchEMS), an affiliate of Pokhara University (PU) joined the mission.

The Government of Nepal Ministry of Education, Science and Technology (GoN-MoEST) has generously patronized and supported the initiatives.

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 the first week of April every year.

Conference modality

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

Modality

An advisory board provides overall guidance and supervision. Management team coordinates scientific and logistic aspects of the conference. Resources Himalaya Foundation (RHF), as the conference secretariat, takes care of logistics and conference management for 2019.

Conference Theme (2019): Localization of Sustainable Development Goals (SDGs)

Thematic Areas

a. Pollution and health

- Air, surface water and land pollution
- Ground water pollution and control
- Environmental pollution and public health
- Waste management
- 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
- Economics of climate change and DRR

c. Ecosystem, biodiversity, and agriculture

- Ecosystem-based adaptation
- Water and wetlands
- Plant and animal diversity
- Protected area and people
- Biological invasion
- Climate change and biodiversity
- Agriculture and livestock
- Gender and livelihood
- Ecotourism in and outside protected areas
- Ecology & restoration

d. Energy for development

- Energy, livelihood and infrastructure development
- Energy supply and demand
- Energy diversification and energy use efficiencies
- Alternative energy, constraints, and opportunities

e. Economics and management

- Public spending
- Social Marketing
- Capacity development/building
- Good governance
- Rural development
- Public administration and small business entrepreneurship
- Labor relations & human resource management
- Information technology management

f. Innovations and technologies

- Innovative technologies for industry, health, household, and companies
- Electrical, electronics and computer
- Civil engineering and architecture
- Mechanical and industrial engineering

Conference Advisory Committee

- Er. Ganesh Shah, Former Minister for Science Technology and Environment
- Prof. Dr. Pitamber Sharma, Former Vice Chair, National Planning Commission, RHF
- Mr. Krishna Raj B.C., Secretary, Ministry of Education, Science and Technology (GoN-MoEST)
- Prof. Dr. Subodh Sharma, Registrar, Kathmandu University
- Prof. Dr. Ram Prasad Khatiwada, Dean, Tribhuvan University-Institute of Science and Technology (TU-IOST)
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Management Committee

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- Mr. Rupesh Shrestha, RHF
- Ms. Anustha Shrestha, ISET-Nepal
- Prof. Dr. Chhatra Mani Sharma, CDES-TU

Message from the Chair

It is my great pleasure to inform you that Tribhuvan University-Institute of Science and Technology (TU-IOST) is organizing its Fifth Graduate Conference on Environment and Sustainable Development (GCESD) on April 05 and 06, 2019 at Kathmandu University, Dhulikhel, Kavre. Also known as the Himalayan Knowledge Conclave (HKC), the annual conference is being coordinated with the cooperation of the Government of Nepal Ministry of Education, Science and Technology (GoN-MoEST) with the joint support of the Central Department of Environmental Science (TU-CDES), Resources Himalaya Foundation (RHF) and Institute for Social and Environmental Transition-Nepal (ISET-Nepal). Recently, we also have Kathmandu University (KU) and School of Environmental Science and Management (SchEMS) join this mission.

This conference, similar to the previous four conclaves, aims to encourage leadership in young researchers focused on issues related to the environment, resource conservation, natural science, management and economic development incorporating innovations and technologies, by getting them involved in an interdisciplinary knowledge-sharing platform on those specific topics. HKC will be seeing approximately 34 oral presenters and 17 poster presentations this year.

After four successful years, I am excited for the HKC to achieve new heights. I hope it can inspire budding researchers, and help them develop practical leadership skills and find other like-minded folks with whom they are able to share their experiences and have a dialogue related to the environment. On behalf of the organizing team, I would like to express sincere gratitude to all the organizations, individuals, and HKC members and delegates for their continuous support and cooperation. May the conference be motivational, productive and memorable.

Prof. Ram Prasad Khatiwada, PhD
Dean
Institute of Science and Technology
Tribhuvan University
Conference Chair-HKC-2019

Contents

5th Graduate Conference
on Environment and
Sustainable Development

CLIMATE CHANGE AND DISASTER RISK REDUCTION

Landslide Vulnerability Assessment of Bhatkhola Sub-Watershed, Panchase Region, Syangja

ARJOO KHADKA[1], DINESH RAJ BHUJU[2], BHARAT PRASAD BHANDARI[3]

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Landslide induced vulnerability was studied in ward numbers 3 and 4 of Phedikhola Rural Municipality of Syangja. The study area is highly vulnerable to landslide hazard. The research aimed to measure landslide induced vulnerability. This approach used four different vulnerability indicators: physical, social, economic and environmental. The study area covered total 6.63 km^2 of area which was categorized into 7 different polygons for identification of vulnerable areas to landslides. Household survey of 80 households, six Key Informant Interviews (KII) and two Focus group discussions were conducted. Vulnerability value for different indicators were calculated using Maximum and Linear Method. For map preparation, the value was standardized. The value was calculated within a range between 0 to 1, representing 0 for no loss and 1 for complete loss. Based upon these calculations, the physical vulnerability of the study area was moderate, with roof and outer wall housing index as good to regular whereas the foundation housing index was found weak. The Social Vulnerability of the study area was low. The study area was economically moderately vulnerable. The study area was environmentally moderately vulnerable. The vulnerability index value was between 0.05 to 0.84 and was classified into five classes as very low, low, moderate, high and very highly vulnerable classes, occupying 19.56%,55.98%, 13.84%, 0% and 10.62% of the study area.

Keywords: landslide, vulnerability, indicators

Spatial Distribution of Debris Thickness from Remote-Sensing and Meteorological Data in Ponkar Glacier, Manang, Nepal

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Debris-covered glaciers are very common feature in the Himalaya. It is well known that debris affect ablation of debris-covered glacier differently than debris free glacier. Therefore, it is important to know the distribution and thickness of supra-glacial debris and to monitor its change over time to model scenarios of the reaction of glaciers to climate change and its contribution to river discharge. This research aims to estimate debris thickness distribution over the lower part of Ponkar Glacier, Manang, Nepal. The methodology of this research involves estimation of surface temperature using thermal band of remotely sensed imagery Landsat 8 (L8 OLI/TIRS) and energy balance components using meteorological data from an automatic weather station on the glacier surface at an elevation of 3890 m a.s.l. Temperature at different debris thicknesses (0 cm, 15 cm, 30 cm) is measured on site to calculate effective thermal conductivity. The derived surface temperature and energy balance components along with an effective thermal conductivity was then utilized to calculate debris thickness. The calculated debris thickness is validated with field debris thickness measurements. Both ground and remotely sensed data predict well the thick debris cover at the terminus and decreasing at the upstream. The maximum estimated debris thickness found at terminus is 49 cm and minimum is 5 cm at the upper part of the ablation area of Ponkar Glacier. Using the debris thickness computed in this study, the melt of the debris-covered glacier can be estimated using different techniques such as hydrologic and debris energy balance methods.

Keywords: debris-covered glacier, energy balance, glacier mapping, remote sensing

Assessment of Run of River (ROR) Hydropower Potential in Tamor River basin, Nepal using GIS and Glacio-Hydrological Degree-day Model

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This study assesses the Run-of-River (ROR) hydropower potential of Tamor River in the east Nepal. Tamor River originates from Mt. Kanchenjunga and its elevation ranges from 256 to 8424 masl with an area of 5786.45 km^2 derived from 30 m × 30 m ASTER DEM considering the Mulghat hydrological station. The Tamor river basin is glaciated with 8.99 % which is categorized into debris covered glacier and clean glacier of 1.27 % and 7.719 %, respectively. A Glacio-hydrological Degree-day Model (GDM) is used to simulate daily discharge with contribution of snow and ice melt. The land use type was derived from reclassifying the land cover types from GLOBELAND30 and ICIMOD glacier inventories 2010 for daily discharge simulation. Daily temperature and precipitation data from meteorological station at Phidim, Panchthar are used to calibrate the model with temperature lapse rate of 0.6 ^oC per 100 m. A critical temperature of 2^oC is used to separate rain and snow from the precipitation. The model is calibrated from 2001 to 2005 with Nash Sutcliffe Efficiency (NSE) and volume difference of 0.715 and 1.2 %, respectively and validated from 2006 to 2010 with NSE and volume difference of 0.705 and -21.97%, respectively. Contribution of snowmelt and icemelt in discharge is 16.08 % and 7.96 % in calibration period and 12.79 % and 10.91% in validation period. The basin is divided into sub-basins of 100 km^2 catchment area and river networks are generated in each basin in the GIS platform. The head difference in river of each sub-basin is accessed again in GIS and daily discharge is simulated for the individual sub-basin using GDM for theoretical hydropower potential calculation. Using design discharge corresponding to 40th percentile flow with the hydraulic head, total power potential of the basin in Megawatt (MW) is to be determined. Impact of climate change in the future power potential up to 2100 by using HI-AWARE data of RCP4.5 and RCP8.5 scenarios will also be attempted in this research.

Keywords: Glacio-hydrological Degree-day Model (GDM), Geographical Information System (GIS), Climate Change, Percentile.

Livestock and Vegetation Dynamics Under Changing Climate in Olangchung Gola, Eastern Himalaya, Nepal

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Nepal is an agricultural country and livestock sector forms an integral part of the economic system. The livelihood of its people is highly vulnerable to climate change impacts. A study was carried out in Olangchung Gola, Kanchanjunga area of eastern Himalaya, Nepal to assess the changes on transhumant herding and vegetation composition and documenting adaptation practices under changing climate. Methodologies for primary data included questionnaire survey (33 households) and focus group discussion (one). Interviews with the herders' (two) were carried out to know vegetation preferences by livestock. The data of district meteorological station presented increasing temperature (0.03°C annually), which matched with the perception of local people. The study found that there was a decreasing trend in total number of livestock from 1191 in the past to 981 in the present with the exception of yak along with increment in livestock mortality and problem of production insufficiency. The local herders reported various factors such as changes in climatic parameters, increase in livestock mortality and diseases/pests, shift to non-livestock practices, food insecurity and out-migration, to be responsible for the changes. Changes were also observed in rangeland such as decrease in production, decay of grasses and growth of non-preferable plants. The local people related these changes with erratic rainfall, decrease in snowfall, degradation in range soil quality, increase in non-preferable and invasive species, upward shift of vegetation, and shift to other occupation (business, medicinal plant trades). The vegetation survey and herders' interview showed that the total coverage of non-preferable species was highest in the transect 4000 masl with 53.5% cover which was higher than that of preferable species accounting to 45.33%. Non-preferable species had significant coverage and relative frequency as compared to preferred species. The herders were concerned that the increase in non-preferred species could lead to shortage of forage for their livestock. Local people were found practicing various adaptation measures such as bush clearance, controlled burning, dung clearance, rotational grazing for rangeland management; afforestation, gabion wall construction, track maintenance to prevent landslide whereas migration and shift to other practices were adopted by herders to minimize the risk associated with climate change.

Keywords: climatic variability, livelihood, rangeland, transhumance, tree-line

Mechanical Functions of *Thysanolaena maxima* and *Saccharum spontaneum* for Slope Stability as a Bioengineering Tool in Pharping, Kathmandu

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A Nepalese *Thysanolaena maxima* or Broom grass has been known to have a direct impact on preventing surface soil erosion on steep hillsides. Similarly, *Saccharum spontaneum* or Kans grass is planted for bioengineering purposes in Himalayan region. This research aimed to determine the mechanical functions of *Thysanolaena maxima* and *Saccharum spontaneum* in slope stability as a bioengineering tool as little is known about the mechanical functions of these grass species for slope stability. The study was carried out in the slope located on south-west of Dakshinkali, Kathmandu. This study used the Wu and Waldron model to calculate root tensile strength and root cohesion to determine contribution of roots to slope stability. Linear regression and Pearson correlation was performed to understand the relationship between morphological characteristics and mechanical functions of the roots of the species. The results showed that there is a significant difference of root tensile strength of *Thysanolaena maxima* and *Saccharum spontaneum.* Root tensile strength of *Saccharum spontaneum* was higher than *Thysanolaena maxima*. Two sample t-test showed that, there was significant differences in root tensile strength between the two species. Similarly, root cohesion of *Saccharum spontaneum* was significantly higher than *Thysanolaena maxima*. Therefore, the research concluded that there was a significant difference in root cohesion between the *Thysanolaena maxima* and *Saccharum spontaneum* and both the species can be used for slope stability. Comparatively, *Saccharum spontaneum* is more effective in maintaining slope stability due to its higher tensile strength and root cohesion.

Keywords: Bioengineering, mechanical reinforcement, root cohesion, tensile strength

Inventory and Status of Water Sources in Sami Micro Watershed of Dhand Khola Sub Watershed, Tanahun

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Water is one of the main resources for sustaining life on earth. Global demand for fresh water is increasing extensively with increasing urbanization and change in lifestyle of the people. Consequently, water sources are being depleted by land use change, ecological degradation, deforestation, natural disasters, and climate change. Fresh water sources such as springs are considered the lifeline of communities living in the hills and mountains are drying rapidly. Studies on water sources are essential to address the water scarcity problems aggravated by climate change. As a step towards conservation, this study was carried out to develop the inventory of water sources and to identify their status and potential use of those sources in Samdi micro-watershed. This watershed is one of the most critical micro-watersheds of Dhand Khola sub-watershed of Tanahun district. Different methods like field observations, discharge measurements, participatory resource mapping, beneficiary household survey, and key informants' interview were conducted for the study. Results of the study showed that there are 29 water sources (14 streams, 10 springs, 3 marshes, and 2 wells). The locals shared about the gradual decrease of water sources and reported that some have completely dried up a few years ago. People are facing water scarcity mainly for irrigation and livestock. Average discharge in February measured by bucket method was found to be 17.168 liter/min. It was found that people have been using different indigenous water source management techniques like cleaning the sources, planting different species of trees, conserving forest near water sources. People in study area were highly interested in water-based economic activities such as irrigation and fish farming. Rainwater harvesting, construction of water tanks near sources and prioritizing eco-friendly infrastructural developments could help to combat the water scarcity problems.

Keywords: water sources, springs, inventory, status, discharge, indigenous knowledge

Projection of Future Hydrological Regimes Using Glacio-hydrological and Glacier Dynamics Modelling

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In Nepalese Himalaya, rise of uncertainty in cryospheric and hydrological regimes is inevitable due to climate variability and paucity of hydrological and meteorological data. Large amount of river discharge comes from snow and glacier ice melt in Nepalese river basins, therefore, incorporating cryospheric dynamics and its contribution to stream flow is of utmost importance to fully understand present and future anthropogenic and climate induced changes in glacierized river catchments. The major objective of this research was to assess and quantify future glacier dynamics, glacio-hydrological simulations and water balance in Koshi River Basin. The study was carried out in Sunkoshi and Dudhkoshi sub-basins of Koshi River Basin located in both Chinese and Nepalese territories. This research was carried out using Open Global Glacier Model (OGGM) and Glacio-hydrological Degree-day Model (GDM). Output from OGGM is provided to GDM as input data along with other hydro-meteorological and spatial data. The GDM is a distributed gridded model that has been used to simulate future runoff using grid size of 1 km^2. The model was calibrated from 2000-2007 and validated from 2008-2014 in both sub-basins. High resolution climate data (25 km^2) from HI-AWARE for RCP 4.5 and 8.5 scenarios was used from 2021 to 2100 in order to simulate future glacier dynamics and glacio-hydrological conditions. The Nash-Sutcliffe Efficiency (NSE) was found greater than 0.7 and Volume Difference lesser than 1% for both calibration and validation periods. The results from this study showed that the selected sub-basins of Koshi River Basin are largely dependent on snow and ice melt and this contribution is in decreasing trend due to reduction in snowfall amount and retreating glaciers. Runoff is estimated to increase until mid-century following a slight decrease until 2100. The coupled glacier dynamics and glacio-hydrological modelling approach will help strengthen our understanding of cryospheric processes and their contribution to river discharge.

Keywords: Koshi river basin, glacio-hydrological modelling, glacier dynamics, future projection, climate variability

Observed and Perceived Climate Change Analysis in the Terai Region, Nepal

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Climate change, one of the global concerns could affect temperature and precipitation patterns. Such change could affect the crop production and threaten the livelihood of the farmers in the coming days. Scientific studies along with documentation of local perception on climate change are essential to understand the impacts and threats of climate change. This research intends to determine the extent to which climate change has caused spatial-temporal changes in temperature and precipitation on annual time scales in the Kailali, Chitwan, and Rautahat districts of Nepal. Three indigenous groups (Chepang, Tharu, and Musahar) and 180 households were interviewed during the field visit. Secondary data were collected from the Department of Hydrology and Meteorology (DHM), Nepal. Mann-Kendall and Sen's estimator of slope test were used to detect possible temperature and precipitation trend and its magnitude respectively. The findings of the study showed that the trend of minimum and maximum mean temperatures indicate significantly increased 0.0182˚C/year, 0.001˚C/year, and 0.012 C/year at 5 stations of three districts. Similarly, the precipitation of the post monsoon (0.120 mm/year) seasons is increasing at 6 stations of three districts. How- ever, pre-monsoon, monsoon, and winter precipitation have the significant decrease of (-0.0098 mm/year) annual average rainfall at three districts stations. These finding results were verified with the people's perception. This study could be used for the formulation of effective adaptation plan and policy of climate change in this region as well as applicable to other related areas.

Keywords: adaptive capacity, exposure, vulnerability, precipitation, temperature

Dam Break Modelling of Thulagi Glacial Lake, Manang, Nepal

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In recent decades, Himalayan glaciers have experienced a widespread mass loss. As a response to climate change, retreat of glaciers in the high mountain has resulted the frequent development of big glacial lakes. These glacial lakes dammed by moraine are inherently unstable and their failure due to some triggering event can lead to glacial lake outburst flood (GLOF) by releasing large volumes of water and sediment. Such GLOF event have significant impacts on downstream settlements and infrastructure and may also result in significant loss of life. The potential hazards associated with GLOF can be estimated by a dam break modelling. In this study, NWS- BREACH Model was used for dam breaching analysis of Thulagi Glacial Lake, Manang, Nepal. The input parameters for the dam breach analysis in model were lake surface area, lake depth, dam top and bottom elevation, inside and outside slope of dam, crest width and length of dam and properties of dam material. Breaching of unstable moraine is governed by the inflow into the lake. Dam breach analyses was carried out in four different scenarios i.e. dam breach by 5m, 10m, 15m and 20 m. Results shows that total inflow of 12.74 m^3/s, 25 m^3/s, 45 m^3/s and 60 m^3/s were required to breach 5m, 10m, 15m and 20 m respectively, of Thulagi Glacial Lake end-moraine dam. The total time for the peak outflow were found to be 1.25, 1.29, 1.11 and 1.14 hours at the outlet of the end-moraine with the outflow of 1377.60 m^3/s, 3888.65 m^3/s, 7109.20 m^3/s and 11114.89 m^3/s in four different scenarios, respectively. This indicates that with the increase in the outflow of dammed water, the normal flow depth of the river water will increase resulting in the flooding of downstream areas. Furthermore, damaging settlements, infrastructures and lands. However, flood inundation mapping and hazard assessment of downstream regions of the lake was not carried out in this study.

Keywords: GLOF, dam break modelling, hazard assessment

5th Graduate Conference
on Environment and
Sustainable Development

POLLUTION AND HEALTH

Comparison of Vermicompost Quality Using Different Food Beds

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Organic waste management have been one of the great problems in urban areas. There are various efforts carried for managing the organic waste. Vermicomposting is one of the efficient efforts and have been effectively undertaken in household level. There are studies on vermicompost and have been approved for better quality compost and higher percentage of nutrient contents. However, based on the solid waste type and organic materials available in the waste, comparative study on the vermicompost is limited. Vermicomposting in this study was carried using red worms (*Eisenia foetida).* The study was conducted to compare the quality of vermicompost using different organic wastes as food beds. Vermicomposting was performed in seven different rectangular containers having dimensions of 14×18 inches. Cow dung (1), tea leaves (1), vegetables (1), mixed tea leaves and cow dung (1:1), mixed cow dung and vegetables (1:1), mixed tea leaves and vegetables (1:1) and mixed cow dung, vegetables and tea leaves (1:1:1) were separate food beds types in seven containers fed to red worm. The harvested composts after seven weeks of composting experiment were taken for laboratory analysis to determine physical parameters and soil organic matter contents such as pH, Moisture content, Electrical Conductivity (EC), and C: N ratio, Nitrogen (N), Phosphorus (P) and Potassium (K). Organic matter contents of compost of different combinations had similar value. However, the organic matter content with tea leaf yielded the highest value of Nitrogen (4.22%) and Phosphorus (1.66%) with a lower concentration of Potassium (0.19%) while compost of mixed cow dung and vegetables have more Potassium (0.85%) with mild Nitrogen (1.89%) and less Phosphorus (0.92%). The study suggests vermicomposting is effective in all the food beds and compost produced bear equal organic matter content unconcerned with food beds.

Key words: Eisenia foetida, vermicompost, food bed, physical parameters, organic matter content

Physicochemical and Bacteriological Analyses of Groundwater in the Periphery of the Bagmati River in Kathmandu Valley

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Groundwater is one of the important sources of water for daily purpose in Kathmandu valley, that has been rather polluted to harmful extent and a number of people suffer from water-borne diseases. The objective of this study was to assess the physicochemical and bacteriological quality of groundwater samples. A total of 34 samples were taken during the time period of 6 June 2016 to 21 June 2016 from groundwater sources, located in the periphery of Bagmati River, from Chobhar to Sinamangal with approximate distance of 12 Km. Sites for study, sample collection, transportation, preservation, and processing (bacteriological and physicochemical analyses) were carried out following standard protocols of water sampling and analysis by the World Health Organization (WHO, 2006). Membrane filtration technique was employed for enumeration of Total coliform test (*Escherichia. coli*) and biochemical tests for its identification.

The temperatures of the water sample ranged from 19.6°C to 24.6°C and pH from 6.9 to 7.8 during early afternoon of different sampling days. Electrical conductance varied from 20 µS/cm to 890 µS/cm showing a positive correlation with the total dissolved solids (TDS) values. The samples were found to contain higher turbidity that ranged from 5 NTU to 14 NTU. The dissolved oxygen values were within the WHO limit, ranging from 5 mg/l to 7.9 mg/l. The water samples didn't have problems regarding the chloride, nitrate or phosphate levels. The levels of ammonia and iron were found to be higher than the standard values. Out of 34 samples, only three samples (9%) were total coliform free and the rest of the samples contaminated. *E. coli* isolates were obtained from six of the samples (18%), ranging from 2 cfu/100ml to 5 cfu/100ml. Thus, 31 samples were found to be unfit for drinking having tested positive for coliforms. Overall, samples from Chobhar to Balkhu, specifically nearby Manjushree area were found to have better quality than other water samples, but still none of the samples have an unquestionable quality. For drinking purposes, appropriate water purification methods should be applied before consumption and proper drainage and sewage system should be maintained to protect the water from contamination.

Keywords: groundwater, contamination, coliforms, membrane filtration

Parasitic Contamination of Commonly Consumed Raw Vegetables of Kathmandu Valley

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Vegetables are quite easily contaminated with parasites at different stages of production and distribution. When consumed raw, they are likely to serve as a potential vehicle for the transmission of intestinal parasites. However, the prevalence of parasitic contamination in raw vegetables and their consequent outbreaks are often underestimated in developing countries like Nepal. The aim of this study was to determine the parasitic contamination of raw vegetables in Kathmandu valley of Nepal. Six different types of vegetable samples (n=125) were collected randomly from farm, local market and stock market of Kathmandu valley from April to June 2018 and processed in the laboratory of Goldengate International College for the parasitic assessment using standard protocol. The parasites were detected and identified by direct microscopy and modified Ziehl-Neelsen staining after concentration. Of the total sample assessed, 61(48.8%) samples were found to be contaminated with *Entamoeba coli* (48.78%) and *Hymenolepis nana* (30%) being the most common protozoa and helminth detected. The highest rate of contamination was seen in the samples collected from Jorpati (24.59%). Among all the contaminated vegetable types, *Coriandrum sativum* (38.88%) had predominant contamination rate. The detection of parasites and their parts in raw vegetables indicates the potential source of infestation to the consumers if consumed uncooked. The regular monitoring is essential for the surveillance and proper treatment.

Key words: vegetables, Kathmandu, parasites, *Entamoeba coli*

Quantification and Composition of Solid Waste: A Case of Birtamod Municipality

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This study has assessed the status of solid waste generation and composition of Birtamod Municipality Ward No 4. Day wise data of biodegradable and non-biodegradable household wastes were collected from 103 households for 15 days. Households were selected using convenient sampling method along the transect road. The average waste generation was found to be 0.76 kg/day in which biodegradable 0.57 kg/day and non-biodegradable 0.19 kg/day. The major composition of solid waste generated in Birtamod Municipality Ward No 4 were Biodegradable 78.31%, Plastic 8.78%, Paper 4.33%, Bottle/Glass 2.59%, Tin/Iron 0.45%, Textile 0.93%, E-waste 0.55% and others 4.07%. Per capita household waste generation was found to be 0.171kg/capita/day. Total household wastes generated in Birtamod Municipality Ward No 4 estimated to be 1.96 ton/day. Amount of waste generated was found to be varying with family size with rank correlation 0.35, p = 0.001075.

Key Words: biodegradable waste, characterization, household, waste generation

Green Space for Noise Reduction: A case of UN Park, Lalitpur, Nepal

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Noise is regarded as a form of environmental pollution. Its impact can be fatal to human health and well-being. Green space has been proved to mitigate noise in the urban area. This paper investigates the effects of green space in noise reduction and explores the association of green space and human wellbeing.

To achieve this objective green space of UN Park and road along the park was sampled to monitor the noise level and compare with heavy traffic area of Gaushala with no green space. Grid method was applied to record the noise level uniformly through the sample area in which 22 line transects were laid down inside the park at a distance of 20 meters. Each transect were again divided into 5 point at 10 meters apart. The average sound pressure level was measured during morning rush hour and day time for two days. The average sound pressure of busy road along the UN Park was found to be 69.51 dB during rush hour and 66.44 dBA during day time which exceeds the WHO standard for human acceptance level of 50-55 dBA. The highest reading reached to 84 dBA and exposed to such noise can cause hearing impairment. However, the reading inside the park was found to be 53.92 dB during rush hour and 52.45 dB during day time which falls in line within the standard. The reading at heavy traffic area of Gaushala was found to be 73.2 and is far beyond the acceptance level in absence of green spaces nearby. Since the road along the park is just at the distance of 10m, large difference in the noise level is a clue that the green space helps to minimize the noise pollution. The validation of this finding was done by considering the perception of the people who regularly goes to the park for their morning exercise by conducting semi-structured questionnaire survey. It was found that this area is largely supporting in reduction of noise pollution as well as in physical and psychological well-being of the urban people.

Keywords: sound pressure level, well-being

Are mistletoes indicators of air quality?

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Mistletoe is a group of highly specialized diverse angiospermic flowering plants that exploit or parasitize a wide range host plants. Mistletoes have a very wide range of host trees adversely affecting their growth, leading to stunting growth pattern of infested host branches. The present study aimed to find the mistletoe diversity at three different locations attempting to develop understanding whether mistletoes can be used as an indicators of air quality by comparing leaf morphological features.

Based on the frequency of vehicular movement and emission of pollutants, Mistletoe inventory method (Walk on survey) was adopted to collect mistletoe leaf samples from poor, moderately poor and comparatively less poor air quality locations form the different areas of Kathmandu Valley. In each study area, 20 mistletoe leaf samples from 20 host tree species were collected. Fresh leaf weight of 20 leaves was weighted and leaf area was calculated immediately after harvesting the leaf from the host. Similarly, dry weight of leaf sample was determined by oven drying the samples.

Present study recorded 3 different mistletoe species (*Scurrula parasitica*, *S. pulverulenta* and *Helixanthera ligustrina*) at three different areas Balaju-Kalanki Ring Road (poor air quality), Kapan area (moderately poor air quality) and Godawari area (comparatively less poor air quality). The morphological features of mistletoe leaves – total area and moisture content were found to be different according to their collected location. Leaf size of mistletoes from Godawari were found to be much larger than that of Kalanki and Kapan areas. Similarly, mistletoe leaf weight was also found to be more in less poor air quality locations compared to poorer air quality areas. Prominent differences in the different values of total leaf area and dry weight of mistletoe leaves has clearly indicated that mistletoes can be used as an indicator of air quality.

Key words: air pollution, leaf morphology, moisture content

Toxic Heavy Metals on Children Toys: A Study of Compliance with National Standard

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Toys are the most favorable things for children to play. But these children toys are not safe from toxic chemicals too. The standard values for 12 toxic heavy metals such as cadmium, chromium, lead, mercury, zinc, antimony, arsenic, barium, bisphenol A, bromine, selenium and phthalates, came into effect from July 15, 2017. The study focused on the compliance of toxic heavy metals in children toys with the national standard. For the study, total 52 toys were collected from different places of Nepal: Bhaktapur, Kathmandu, Lalitpur, Chitwan, Janakpur and Nepalgunj from the local vendors to the supermarkets and they were tested in the lab of Nepal Handicraft Association of Nepal Bureau of Standard and Metrology (NBSM) by the X-Ray Fluorescence (XRF) technology. Among them, 37 toys were detected with multiple toxic heavy metals and only 15 toys did not have any heavy metals. The heavy metals detected in the toys were lead, cadmium, bromine, chromium, zinc and barium. Although most of the detected result is under the compliance, it is very serious issue that the non-compliance result of heavy metals like lead is very much more (4688 ppm) than the standard value (90 ppm) in the toy: tortoise. In the same way, 22 children toys have the labelling and rest do not have the labelling. But the labelled children toys like not suitable for children under 3 years or 6 years, choking hazards also don't have the labelling about the chemical safety. Labelling in the toys helps the buyers to be aware of the toxic chemicals present in the toys to preventing them to buy and ensure children's safety.

Though the national standard has been formulated the locals or the parents themselves are unaware about the toxic heavy metals present in the toys. As well there has raised a big confusion in the standard of the toxic heavy metals as the new standard has been published omitting the standard of the heavy metals as phthalates, BPA, bromine and zinc. Thus, these points should be considered in order to implement the standard effectively and to save the children from the chemical hazards.

Keywords: chemical Safety, children, standard

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PLANT BIODIVERSITY

Habitat Preferences and Bark Harvest Potential of *Daphne bholua* (Lokta) Along an Elevation Gradient in Madane Protected Forest, Gulmi, Nepal

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Daphne bholua Buch. - Ham. ex D. Don commonly called as Lokta or Baruwa is a potential non-timber forest product (NTFP), whose bark is extracted for making Nepali handmade paper. Studies pertaining to its habitat characteristics, bark yield potential, and population status are limited in Nepal. We evaluated its habitat characteristics, bark yield potential and regeneration potentialities along an elevation gradient in Madane Protected Forest (MPF). Altogether 108 plots (5m×5m) were established along three elevation bands at 200-meter interval with three canopy types-closed, semi-closed and open and a minimum of 50m inter-plot distance was maintained. Total elevation range of the species was 1900-2500m. The mean density of *D. bholua* is maximum in the highest elevation band (2300-2500 m) with less disturbance and minimum in the lowest band (1900-2100 m). Total and harvestable bark mass was found highest in semi-closed canopy followed by open and closed canopy. In majority of cases, regeneration was limited with root suckers and coppice outgrowth. In general, the flower production and fruit set were very poor in all study sites, and was the poorest at lowest band. In the study area, bark of *D. bholua* is harvested only for local use and yet to be commercialized. Meanwhile, *D. bholua* populations at lower elevation band were affected greatly by grazing and trampling effects and also by developmental activities. The present stock of *D. bholua* bark in MPF is in good condition with potential for sustainable harvest and management, which could serve as best income generating resource to the local people.

Key-words: *Daphne bholua*, bark potential, handmade paper, Madane Protected Forest

Phytotoxic Effect of Invasive *Ageratina adenophora* on Growth and Development of Native Shrub Species of Nepal

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Agaratina adenophora is one of the naturalized and invasive alien species in Nepal. It has created a severe problem in various types of ecosystems in Nepal by severe colonization including forests. Chitlang area of Makwanpur district of Nepal is also heavily invaded by this alien species. This invasive species affects soil microbial community, native diversity and native plant growth and development. Studies on its impacts on several native herbs, shrubs and trees are essential to document species specific impact and the impact mechanisms. This study was conducted in Chitlang Community Forest, in a village of Chitlang in the district of Makawanpur in Central Nepal, as it is also heavily invaded by this alien species. The main aim of this study was to know the impact mechanism of *A. adenophora* on two Nepalese native shrub species *Osbekia stelata* and *Elsholtzia blanda* of Chitlang community forest. 10% concentrated *A. adenophora* fresh leaf extract, root extract and litter extract were treated on the growing seedlings of the selected shrubs. Results show that both the root-shoot length and biomass were increased by the *A. adenophora* litter while inhibited by the root extract in *Elsholtzia blanda.* Similarly, the *A. adenophora* litter promoted growth and development of root and shoot in case of *Osbekia stelata* also but the leaf extract inhibited both root-shoot length and biomass. It shows that litter of *A. adenophora* have no negative effect while both the fresh leaf extract and root extracts are phytotoxic to the selected shrubs but the toxicity depends on native species type.

Key words: *Ageratina adenophora*, invasive species, native species, phytotoxic

An Assessment on Herbivory Damage in Invasive Alien Species of Kirtipur, Kathmandu, Nepal

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Invasive and naturalized alien species in Nepal have become a great problem. They are highly problematic near the construction sites and human settlements. Additionally, they are responsible to cause severe damages to our ecosystem and contribute a huge amount of economic loss. It has been considered that the invasive species spreads rapidly because they are comparatively less damaged by herbivores than the native species. *Ageretina adenophora, Ageratum conyzoides, Bidens pilosa, Parthenium hysterophorus* are some of the problematic invasive species distributed along road side, fallow land, agroecosystems and forests. This study was conducted in Chobhar area of Kirtipur Municipality. This is a historical place and affected by such invasive and naturalized alien species. The main aim of the study was to compare herbivory damage among four problematic invasive species (*A. adenophora, A. conyzoides, B. pilosa* and *P. hysterophorus*) in the site. The study was conducted from September to November, 2018. Quadrats of size 1×1 m^2 were laid in fallow land, forest and along road side of north and south side of Chobhar, Kirtipur, Kathmandu. 22 quadrates were laid in each site. Three plants were selected from each quadrat to count number of healthy and herbivory infected branches and leaves. Insect bites in leaves, leaf rolling, galls, leaf spots, and blights were considered as the damage, and percentage of damaged branches and leaves were calculated. Damage was found maximum in *B. pilosa* in fallow land. Similarly, *A. adenophora* inside forest was highly damaged by herbivores. In case of *A. conyzoides* severe damage was found in the road side north but the highest level of herbivory damage in *P. hysterophorus* was found maximum in road side south. It concludes that the invasive alien species are also damaged by herbivores but the damage level is affected by aspect and habitat types. Further studies are recommended for additional information.

Key-words: alien species, herbivory damage, aspect, habitats

Analysis of Vegetation Distribution and the Effect of Edaphic Factors on Plant Distribution of Chameli Community Forest, Bhaktapur, Nepal

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Soil, chemically is a store house of nutrients on which the plant growth. Soil color, temperature, moisture and texture are the important factors to determine the vegetation and fauna type. This study aims to assess the vegetation distribution and the effect of edaphic factors on plant distribution. The study for the vegetation distribution was conducted in the Chameli Community Forest (CCF) of Biruwa-9, Anantalingeshor Municipality, Bhaktapur in October 2016 to February 2017. Soil samples were taken from east, centre and west regions of lower (1400m), middle (1495m) and higher (1590m) elevations of hill using V shaped notches up to 15 cm deep. During this study, *Schima wallichi* and *Rhododendron arboreum* were found dominant species and had less effect of edaphic factors because they were found abundant in all areas of forest. Similarly, climber plants like *Smilax aspara, Smilax lancaefolia, Smilax ovalifolia* and *Dioscorea bulbifera* were absent in western aspect of top region which might be due to low content of moisture, pH, and phosphorous. *Scutellaria, repens, Sida cordifolia, Solanum nigrum, Tripterospermum volubile, Carex baccans, Heteropogan contortus* etc. were absent in west areas of middle region which might be due to the effect of high percentage of sand, phosphorous and moisture content and has low percentage of silt, potassium and pH. Herbs were more dominant in bottom, trees in middle and shrubs in top region. The east area of bottom, middle and top region had more diverse vegetation. The average of organic matter percentage, nitrogen, potassium and phosphorous content was maximum in middle hill which supports the highly diversified tree species and dense forest. Phosphorous showed the most effective factor on plant distribution. Therefore, for the proper growth, functioning and abundance of plant species, edaphic factors had a significant effect and play an important role on plant distribution. During the study, a total of 152 plant species under 127 genera and 67 families were recorded Among them 110 dicotyledons, 26 monocotyledons, 15 pteridophyta and 1 gymnosperm were recorded. 83% plants were found to have medicinal value.

Keywords: vegetation distribution, edaphic factors

Plant Micro-Communities and Severity of Biological Invasion

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Various types of invasive alien species (IAPS) have invaded different ecosystems of Far-West Province, Nepal. The province is less explored in terms of the IAPS and therefore, there is an urgent need to carry out studies related and address the problems created by them. A study was carried out in Kalika community forest of Kailali district, Far-west Province. A total 43 plots of size 10×10 m^2 was established in the forest. Species richness and severity of IAPS invasion was measured. In the forest, six types of plant micro-communities were identified by cluster analysis. A total of 104 species of vascular plants were recorded in the study site belonging to and 45 Families. Among them 34 species were Trees, 13 species shrubs, 55 species herbs, and 1 species was climber. The species such as *Termanilaia alata* and *Shroea robusta* were the common tree species in all types of communities and 4 species were the major IAPS (*Cassia tora, Ageratum conyzoides, Argemone Mexicana* and *Ageratum* houstonianum). Among them *C. tora* and *A. houstonianum* were more problematic in the forest. *Terminalia-Shroea-Trewia nudiflora* mixed community was highly invaded by IAPS in comparison to the other communities. Anthropogenic disturbances such as selective logging, forest fire, forage collection, looping and deforestation in the forest were the causes of infestation of IAPS. As these IAPS might have created adverse impact on soil, native diversity and livelihood they should be controlled and managed by the communities and other authorities.

Keywords: Kalika community forest, micro-communities, IAPs

Conservation Ecology of *Pterocarpus marsupium* Roxb. in Community-Managed Forest, Kanchanpur, Western Nepal

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Pterocarpus marsupium Roxb. is a highly valued threatened tropical tree with a restricted range to the western Tarai plains. Prioritizing threatened species for conservation requires knowledge of its population size and structure, regeneration pattern and understanding its ethno-ecological perspectives. However, in-depth ecological research pertaining such information on *P. marsupium* is lacking. The current study was proposed to look at the size and structure of target tree, environmental and anthropogenic impact on it and understand its ethno-ecological perspectives at the community forest of Krishnapur Municipality, Kanchanpur. Data on population size and structure, distribution and regeneration pattern were collected from total 132 quadrats (10 m × 10 m) along 6 vertical transects, each 1km long using stratified selective sampling method. Seed production was estimated by counting the fallen seeds using 1m*1m quadrat within 20m of vicinity of each mother tree. Moreover, ethno-ecological survey was carried out among local people. Results revealed that the overall population structure, indicating few seedlings because of very slow and less percentage of seed germination due to its hard seed coat and seedling mortality because of ongoing trampling activity. Few trees in higher size classes indicated selective logging which affected seed production. A significant positive correlation was found between tree size and seed production. Higher percentage of young tree (pole) was observed indicating stable adult population in future unless selective logging is practiced. Also, a bottleneck progress from regenerating trees to adult trees was observed, which may be due to slow growth. When environmental variables were examined with respect to recruits, lower grass cover & reduced parent canopy cover is associated with more seedlings suggesting competition for light. Also, ethno-ecological survey revealed the dependence of local people on this species for curing various diseases. Finally, it is concluded that the species is affected by both poor germination as well as trampling which may result in its extinction. It is recommended that similar ecological studies should be conducted to closely monitor *P. marsupium* population for any anthropogenic and environmental cause, which would negatively influence its health. Local communities also should be encouraged to be involved in its conservation.

Key-words: *Pterocarpus marsupium,* threatened, conservation, population structure, regeneration

Carbon Stock and Soil Respiration Measurement in the Neelbarahi Community Forest, Bhaktapur

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A forest can be both sources and sinks of carbon. Carbon is captured not only in tree biomass but also in forest soils. Similarly, soil is the largest pool of terrestrial organic carbon in the biosphere storing twice more than vegetation and two-thirds more than the atmosphere. Soil respiration is one of the processes in the ecosystem that comprises root respiration, decomposition of soil organic matters by microorganisms and efflux of CO_2 from the animals. The study was carried out to estimate carbon stock and analyze the effect of environmental factors like soil temperature, soil water content and plant biomass on soil respiration to understand carbon emission of the Neelbarahi Community Forest of Madhyapur Thimi, Bhaktapur. A closed chamber method was used to measure Soil Respiration.

The result showed that soil organic carbon (SOC) decreased with the increase in the depth of soil. *Schima wallichii* is the dominant species and has the highest value of carbon stock. The total carbon content was 235 t/ ha excluding the carbon stock by herbs, shrubs and foliage. Other associated trees are *Castanopsis indica, Engelhardia spicata, Myrsine capitellata,* and *Betula utilis.* The average Soil Co_2 emission in the forest was 286 mg Co_2 m^{-2} h^{-1}. The average soil respiration was measured highest in July 2018 and lowest in January2019. The average soil temperature was measured highest in July 2018 and lowest in January 2019. Similarly, the soil water content was measured highest in August and lowest in February. The litter collected in the forest was highest in July and lowest in February. The seasonal variation of Soil respiration was significantly affected by soil temperature and soil water content (SWC). Soil respiration in the wet season (June–October) was influenced by Monsoon rain whereas in dry season (December-March) was constrained by seasonal drought.

Key words: carbon stock, soil respiration

Ecological and Socio-Economic Impacts of Invasive Weed *Ageratum houstonianum* in Gokuleshwor Village of Darchula District, West Nepal

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Biological invasion is a major component of pervasive global environmental changes, challenging the conservation of biodiversity, natural resources, agriculture production and human health. Threat from invasive species to global agriculture production and food security is substantial. Among invasive agriculture weeds, *Agetatum houstonianum*, a native of the Central America, has been spreading in Nepal with multiple impacts on agriculture production and livestock health. In this study, we assessed the agriculture weed flora and weed community structure in the sites dominated by *A. houstonianum* followed by socioeconomic survey in a remote village of Darchula district, north-western Nepal. We inventoried weed flora of the study area which was followed by quadrat sampling in three crop *Macrotyloma uniflorum*, *Vigna mungo* and *Vigna angularis*. We recorded 76 vascular pant species belonging to 29 families as agricultural weeds and among them, 9 species were invasive aliens. The highest number of species belonged Asteraceae (18 species) followed by Poaceae (10 species), Malvaceae (5 species), Fabaceae and pteridaceae (4 species), Acanthaceae (3 species), Amaranthaceae, Apiaceae, Commelinaceae, Convolvulaceae, Euphorbiaceae, Lamiaceae, Linderniaceae, Oxalidaceae and Phyllanthaceae (2 species) and other families have the single species. *A. houstonianum* contributed the highest importance percentage (IP) in all the three crops. The social survey revealed negative impacts of *A. houstonianum* on livestock health. Effective management of this weed is needed to prevent further spread and improve crop production as well as protect livestock from the negative impacts of *A. houstonianum*.

Keywords: biological invasion, *Ageratum houstonianum*, community perception, weed biomass, weed flora

Effect of Slope Aspect in the Formation of Galls by *Procecidochares utilis* (Gall fly) in Invasive *Ageratina adenophora* (Kalobanmara) in Chandragiri

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Invasive alien species have become one of the major threats to native biodiversity. One of the reasons behind invasion success of alien species is the enemy release i.e. they lack their natural enemy in their invaded range. *Procecidochares utilis* is a natural enemy of invasive plant *Ageratina adenophora* (Kalobanmara) in its native range. This insect has been considered as an established insect in Nepal. However, its impact on the *Ageratina* is considered not significant in Nepal. Visible signs of this insect infestation are galls or swellings in the stems of *Ageratina*. In this regard, a study was conducted in 2018 in Chandragiri Community Forest of Chitlang in Makwanpur District, Nepal. The community forest is heavily infested by *Ageratina.* An assessment on galls formed by the insect in *Ageratina* was done by sampling 20 quadrats of size 1×1 m^2. The quadrates were laid in transects made in southeast-facing and north-west facing slopes of the forest. In the study, total individual of *Ageratina* per plot and among them, individuals having galls were counted. Moreover, galls per plant per quadrat was also counted. Results showed that the gall plants per plot was the highest in south-east facing slope than the north-west facing slope although there was no significant difference in case of galls per plant per plot between these slopes. This study indicates that the infestation by *P. utilis* depends on slope aspects. The study was novel to know the effect of slope aspect in the formation of galls by *P. utilis* (Gall fly) in invasive *Ageratina adenophora* in Nepal. The result might have significance in application of biological control agents to control and manage invasive alien species in Nepal.

Key-word: *A. adenophora*, control and management, gall fly, invasive alien species

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BIODIVERSITY CONSERVATION

The Lowest Elevation Record of Royle's Pika (*Ochotona roylii*) Presence in Nepal Himalaya

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Several studies reported the presence of Royle's pika (*Ochotona roylii*) in the high-altitude mountains in Nepal. Royle's pika was reported in different locations from Lantang National Park, Manaslu Conservation Area, Api Nampa Conservation Area, Annapurana conservation Area, Sagarmatha National Park, Makalu-Barun National Park, Gaurisankar Conservation Area and Somdang in between an elevation of 2650 masl to 5950 masl. Through the prior studies, the lowest elevation record of Royle's pika was reported from 2650m asl at Seti Gompa in between Phaplu and those based on the fecal pellets' deposition, suggested pika are not found in the lower elevation. However, Pikas (*Ochotona sp*.) have been recorded at an elevation of 2180 masl at Ulleri but the study lagged defining pika species particularly as Royle's Pika and support as the lowest elevation record of Royle's pika in Nepal Himalaya.

This study was conducted for understanding Royle's pika population distribution in Parvati Kunda Groundwater Complex in Gatlang village of Rasuwa district observed small number of Royle's pika population at an elevation of 2605 masl in the proximity of Parvati Kunda Wetland. Five pika habitat sites were delineated around the study area with head count of twelve pika individuals from set vantage point from three habitat sites. Field study was conducted in February and October in 2017. Minimum of two individuals of Royle's pikas were observed at an elevation of 2605 masl dwelling in the talus groove adjoining to the Parvati Kunda to maximum of seven individuals at an elevation of 3000 masl beneath the Tshumer hill. Small population of Royle's pika sighted at an elevation of 2605m asl is the new lowest elevation record of Royle's pika presence in Nepal Himalaya referring all the evidences mentioned in prior studies. Only two pika were directly sighted in the periphery of Parvati Kunda wetland. However, population is estimated to be more.

Keywords: occurrence, lowest elevation record, Parvati Kunda, Nepal Himalaya

Role of People and Community Forests in Biodiversity Conservation of Far-western Chure Region, Nepal

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Chure region contains about 60% of the forests of Nepal which have high economic and ecological values. Being a sensitive area, it is prone to several kinds of natural disasters. Moreover, anthropogenic activities have accelerated the degradation of tropical forest along with the loss of biological diversity. This research was carried out in Alital and Jogbuda VDCs of Dadeldhura district in Far-western Chure region with the aim to assess the baseline information on forest status and practices adopted for biodiversity conservation of the Chure forest. Systematic sampling with 20×20 m^2 quadrat size was carried out to find the ecological parameters of community forests (CFs). One community forest each was chosen from both the VDCs. The total density in Shree Shiva Shankar Community Forest of Alital VDC and Shree Sundari Community Forest of Jogbuda VDC were found to be 381.25 ind/ha and 429.17 ind/ha respectively. On the basis of Important Value Index (IVI), *Shorea robusta* was found to be dominant tree species in both of the CFs. A total of 40 tree species belonging to 22 families were found in both CFs out of which only 10 ($1/3^{rd}$) species were common to both of the CFs. Besides this, through user's mass meeting it was found that people were actively involved in the management activities such as silviculture, plantation, etc. of their CFs recognizing its importance. From direct and indirect survey, different species of animals such as leopard cat, boar, monkey, white rabbit, deer, peacock, etc., were known to be found in the community forest of both VDCs. Despite being fragile region, Chure is still able to serve as a habitat to diverse range of flora and fauna.

Key words: community forest, diversity, silviculture, species

Distribution, Nest Trees Preference and Nesting Success of Heronries in Rupandehi and Kapilbastu Districts, Nepal

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There is sparse research conducted on heronries in agricultural areas in South Asia, and especially in Nepal. The location of these heronries and the factors affecting their distribution and breeding success are largely unknown. This study focused on the distribution patterns of heronries, nesting tree preference and nesting success of three species, namely, Lesser Adjutant Stork (LAS), Asian Openbill (AOB) and Pond Heron (PH). The study was carried out from August 2014 to January 2015 in Rupandehi and Kapilbastu districts of lowland, Southern Nepal. Discussion and interaction with local people and intensive surveys using road network were carried out to locate heronries. A total of 222 random points were visited to determine the availability of trees on this landscape. Tree species, girth at breast height (GBH) and height of tree were recorded at the random points and additionally, details of the nesting bird species and nests were recorded at heronries. A total of 75 heronries of eight species were recorded, of which 13, 35 and 4 were heronries of AOB, LAS and PH respectively. Variance Mean Ratio revealed that these heronries were randomly distributed. AOB and PH were distributed in three and two Rural Municipalities of Rupandehi District respectively, while LAS was distributed in both districts.

Mangifera indica (25%) and *Dalbergia sisoo* (27%) were the most abundant trees on the landscape, while *Bombax ceiba* (44%) and *Ficus religiosa* (35%) were preferred for heronries. The preferred trees overall had higher GBH (>200 cm) and height (>15 m) compared to trees at random points. The nesting success of AOB, LAS and PH was around 95, 82 and 57 percent respectively and the chicks fledged per nest were around 2.4, 1.5 and 1.3 respectively. There was negligible variation in numbers of chicks fledged per nest in case of AOB and LAS whereas PH had huge variation in numbers of chicks fledged per nest. The agricultural landscape of lowland Nepal provides excellent environment for nesting of a wide variety of large water bird species despite having an enormous human population living alongside.

Keywords: heronries, distribution, nest tree preference, nesting success

Assessment of Human-Fishing Cat Conflict in the Human-Dominated Landscape of Central Terai, Nepal

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There are critical threats to many globally endangered and vulnerable species especially large and rare mammals due to Human-wildlife conflict (HWC). Human-fishing cat (*Prionailurus vivverinus)* conflict is an emerging problem in the fishing cat habitat within human dominated landscape near protected areas. The study was carried out in Bodhban village, Bara district near Parsa National Park from 6th October 2017 to 10th march 2018. The main objective of the study was to assess the human-fishing cat conflict. Focused group discussions (FGD), questionnaire survey and photographs obtained from installed automatic infra-red camera traps were used to understand the intense of human-fishing cat conflict in the study area. The total of five transects were deployed each with 5-11 camera traps for 20 days. The frequency of the visitation of fishing cats to private fish ponds was analyzed to know the level of conflict. 100 respondents were interviewed for the questionnaire surveys. This unevenness in installation of cameras was due to technical error that occurred from the cameras. The total camera trap days were 156 and photographs of 14 mammal species were captured with 36 photographs of fishing cats only.

The result also shows the multiple visit of fishing cat in the month of December, January, February & March. The time with highest frequency of fishing cat was the time for harvesting the fishes from the private fish ponds so, almost all the fish ponds are dried during these months. Fish in the shallow water fish ponds is an easy catch for the fishing cat. According to the locals fishing cat and other species are responsible for occasional loss of poultry and herds of goat. The other major reason for poaching fishing cat is because of the belief that the consumption of meat of fishing cat cured tuberculosis, asthma and cramps during menstrual cycle. The study showed that the conflict between human and fishing cat is distinctive.

Keywords: conflict, fishing cat, human dominated landscape, fish

Trees Outside the Forests for Biodiversity Conservation and Local Livelihood

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Trees outside the forests (TOFs) are the key natural resources that contribute significantly to carbon stocks, biodiversity conservation and livelihood of the people. A woody perennial with a single main stem, scattered trees in permanent meadows and pastures, crop yielding trees, trees in parks and gardens, around buildings and in lines along streets, roads, rivers, streams and canals; trees in shelterbelts of less than 20 m width and 0.5 ha area come under TOFs. This study aimed to assess the biodiversity and peoples' dependence on TOFs in Buffer zone and outside the buffer zone area in Chitwan district, Meghauli and Khairahani respectively. Study was done during pre-monsoon season 2018. Interviews with local key informants, households and wood-based industries to find out the people dependence on tree outside forest (TOFs) species were carried out. 80 sample plots were randomly selected having 20*20 m square plots. All trees within the sample plot having height more than 1.3 m and Diameter at Breast Height (DBH) more than 10cm were measured. The top five tree species currently being cultivated and some of them were self-regenerated in farm land for fuel-wood or timber are *Melia azedarach*, *Atrocarpus heterophyllus, Dalbergia s*issoo, *Trewia nudiflora*, and *Magnifera indica*. *Melia azedarach* was the most used and cultivated plant species in both study sites because it was used as fuelwood, timber, fodder and is also of fast-growing nature. Bamboo was also multipurpose species used as fencing, handicraft, fuelwood and fodder. People were depended on TOFs as income source and in households. They are also important for ecological services they provide. TOFs help to minimize the local forest degradation and have strong role in species conservation, protection of soil and water resources.

Key words: TOFs, biodiversity conservation, livelihood

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CROSS CUTTING

Solar Water Pumping System in Nepal: Opportunities and Challenges

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Solar is a freely available natural source of energy that can be converted into electricity through solar photovoltaic (PV). Solar water pumping system is a process, where electricity is used to drive water pump produced from solar PV. It makes solar PV, a flexible device to be used in remote, hilly and mountainous region of the country where grid connection seems to be unavailable in many decades to come. The geographical belt of Nepal is in a very good solar region having about 4 to 5 hours of light source and more than 300 sunny days in a year. About 22% of irrgiable agricultural land in Nepal does not have access to irrigation round the year. About 15% population does not have access to drinking water supply, huge percentage of those having access to it, does not have safe drinking water and in many remote, hilly and mountainous region access to drinking water is very difficult to acquire. This shows that solar water pumping system has great boon in Nepal to meet the basic water rights of the people. However, the immediate challenges for mass dissemination of solar water pumping system is the capital cost of the system which is beyond the affordable range of small farmers and rural people who are in general below the poverty line. In addition, there are very few designers, installers and companies working in this area and are very few well trained technicians for the optimized system installation and operation. Awareness to the users and repair and maintenance services are not easily accessible to the people in remote areas. To improve penetration of the solar water pumping system, a conducive policy from the government along with mentioned inadequacy needs to be addressed.

Keywords: solar photovoltaic, solar water pump, drinking water, irrigation

Thermodynamic Analysis of R134a-DMAc Based Solar Powered Vapor Absorption Refrigeration System for Rural Cold Storage

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Now a days, people are searching for renewable energy system which is easy to implement, efficient, operates quietly, and has low maintenance cost. This paper explains the thermodynamic analysis of a lab scale prototype of such renewable energy system for a cold storage of agri-products. The designed system is based on the absorption refrigeration system which consists of one pair of working fluid i.e. refrigerant and absorbent. In this system 1,1,1,2 Tetrafluoroethane (R134a) is the refrigerant whereas Dimethylacetamide (DMAc) is the absorbent. Basically, the compressor in regular cooling system is replaced by a combination of generator, absorber and a small pump in vapor absorber refrigeration system. In this cooling system, the vapor refrigerant from evaporator is absorbed in the weak solution coming from the generator through an expansion valve. Formed strong solution is pumped to the higher-pressure generator where the solution boils due to the heat from solar collector. Furthermore, the heated refrigerant vapor from generator is condensed in the condenser by the rejecting heat. Here, to test the working of the system, it has been designed for 1/3 tons of refrigeration to cool 37kgs of fruit and vegetable in one hour. All the required thermodynamic properties of the system such as temperature, enthalpy, concentration, and mass flow rate and the thermal load of each component including generator heat by solar collector have been evaluated. The generator temperature is selected to be 80^{o}C (low temperature heat source), absorber temperature as 30^{o}C, sink temperature as 40^{o}C and the evaporator temperature as 5^{o}C. The theoretical Coefficient of Performance (COP) of the absorption system was found to be 0.8. The system also analyzed for various generator temperatures, absorber temperature and evaporator heat load. And we found that the generator temperature the COP of the system increases first and takes maximum value and decreases. R134a has been selected as a refrigerant as it has almost zero ozone layer depletion potential. Compared to the regular cooling systems the operation cost of the designed system is found to be lower.

Key words: renewable energy, cold storage, absorption refrigeration, thermodynamic properties, COP

Political-Economic Dimension of Energy Practices in Informal Settlements of Kathmandu Valley

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The informal settlement also known as *Sukumbasi Basti* in Nepali is among the deprived communities in Nepal. There is no updated data on the number of household and people living in the informal settlements, however, the people living in these settlements state that there are 79 informal settlements in the Kathmandu Valley. Informal settlers are deprived of many basic facilities, and among them, access to energy is the prime one. UN Sustainable Development Goals aim for access to affordable, clean and reliable energy for all, but the informal settlers in the Kathmandu valley are deprived of access to all these. This paper is based on the one-year long research project entitled "Energy on the Move: Longitudinal Perspectives on Energy Transitions among Marginal Populations (a comparative study)". The objective of the research is to understand the impact of the energy policy and the political decisions towards the energy practices of the people living in informal settlements. Both primary data collection in the peri-urban informal settlement sites namely Thapathali, Balkhu, Teku and Manohara, and secondary data from literature review were used. An in-depth qualitative household interview with informal settlers, key informant interview, and focus group discussions were carried out with the representatives of the Nepal Electricity Authority, local political leaders, mothers' groups, teenagers, older people, returning migrants and community leaders.

Informal settlements are considered as the threat to urban development and do not have easy access to government services like electricity. The informal settlers are compelled to either pay a high price than the people not living in the informal settlement or depend upon nearby natural resources and biomass for their energy need. The people living in the informal settlers are facing hardship in everyday life. Politically, the government seems to be in the dilemma position whether to remove them permanently or allow them to stay. Finally, the goal of 'energy for all' cannot be met without addressing the need for marginalized communities like informal settlements.

Key words: informal settlements, energy and poverty, political economy

Determination of Physico-Chemical Parameters of Meltwater of Ponkar Glacier, Manang, Nepal

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A detailed qualitative study of the meltwater draining from Ponkar glacier of Bhimthang Valley (3583 masl to 4100 masl) was performed to determine the various physico-chemical parameters prevailing along the sampling sites. A total of 14 composite samples were collected from 7 sampling sites in the Pre-Monsoon season (3 May – 8 May, 2017). Temperature, pH and Electrical Conductivity were recorded by digital multi-thermometer, pH meter and conductivity meter on site respectively. The samples were analyzed for different parameters in the laboratory according to the APHA, AWWA and WEF (1998) standards. The glacier meltwater was alkaline in nature with pH 7.86 (±0.47) and electrical conductivity was found to be 71.30 (±25.48) µS/cm.

The concentration of cations was found to be in the order of Ca^{2+}>Mg^{2+}>Na^{+}>K^{+} (17.58±2.92 mgL^{-1}, 6.39±1.06 mgL^{-1}, 3.65±0.35 mgL^{-1} and 0.82±0.42 mgL^{-1} respectively). Similarly, the order for major anions was HCO_3^{-}>Cl^{-}>SO_4^{2-}>TP-PO_4^{3-} (42.09±2.92 mgL^{-1}, 9.59±3.29 mgL^{-1}, and 6.38±2.12 mgL^{-1} and 0.17±0.07 mgL^{-1} respectively). NO_3^{-} was not detected in any of the sites. According to the Piper Plot Diagram, calcium carbonate weathering is found to be the major source of dissolved ions in the region. The trace metals were found in the order Fe>Al>Zn>Mn (0.74±0.84 mgL^{-1}, 0.245±0.035 mgL^{-1}, 0.10±0.11 mgL^{-1} and 0.085±0.035 mgL^{-1} respectively).

Key words: melt water, concentration, ions, Piper Plot

Lessons from Monitoring of Ecosystem Based Adaptation Interventions in Nepal

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Nepal is listed as one of the most vulnerable nations to the climate change impacts. To reduce the vulnerability of communities, GEF funded Ecosystem Based Adaptation (EbA)- South Project **"Enhancing capacity, knowledge and technology support to build climate resilience of vulnerable developing countries"** was implemented by Ministry of Forests and Soil Conservation between 2014 to 2018. One of the main objectives of the task was to monitor the climate resilient seedlings for reforestation and agro-forestry intervention implemented in three districts namely Lamjung, Gorkha and Tanahun.

Planted seedling were monitored by using quadrates of three different sizes, i.e., 5m x 5m, 10m x 10m and 10m x 2m, depending on the plantation areas. Sampling and direct observations were made during the transect walk in the plantation sites. The collected data were analyzed by quantitative as well as qualitative techniques and triangulated to validate the results. The assessment was held in November 2017, August 2018 and December 2018. More than 380,000 seedlings of climate resilient plants were distributed. Among them, around 60% seedlings survived during monitoring in November 2017. The average survivorship of seedlings was 45% in August 2018 and again it was found around 63% in December 2018. The survivorship of seedlings in Chiti was 1116, 447 and 1434 per hectare and Jita was 453, 1078 and 675 per hectare in Lamjung district for respective monitoring period. Whereas Gorkha (880, 830 and 740 seedlings per ha) and Tanahun (1600, 860 and 840 seedlings per hectare) had continuous decreasing survivorship. The survivorship was higher in private land than community forest where there was more care and replantation of seedlings. People's involvement in plantation is vital part, as result, there was higher survivorship of seedlings in private land and home garden. The approach of Ecosystem based Adaptation (EbA) is an excellent example of an effective nature-based way of tackling with the climate change impacts, as it uses both biodiversity and ecosystems.

Keywords: vulnerability, Ecosystem based Adaptation, survivorship

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POSTERS

Plants of Ramechhap: An Ethnobotanical Study

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Ethnobotanical study is important for the conservation of floral diversity and for their sustainable utilization. However, this knowledge is being declining in new generation due to lack of communication and written documentation. The principal aim of the study was to document the ethnobotanical knowledge of the major ethnic groups living in Majhuwa and Chuchure VDCs of Ramechhap district of Nepal. This study was conducted in Majhuwa and Chuchure VDCs of Ramechhap district. The ethnobotanical study has been carried out on the basis of semi-structured questionnaire survey in which PRA and RRA tools were used to acquire knowledge from local people regarding ethnobotanical uses of plants of their surroundings. The voucher specimens were collected with the help of local people. All the voucher specimens were scientifically identified in Tribhuvan University Central Herbarium. Quantitative data were analyzed through Use Value (UV), Relative Frequency of Citation (RFC) and Informant Consensus Factor (ICF). Total of 139 plant species of 77 families were reported to have ethnobotanical significance. The highest RFC was found to be 0.82 in *Ageratina adenophora*, *Curcuma domestica*, *Acorus calamus*, *Centella asiatica*, *Avena sativa* and *Allium sativum*, highest UV was found in *Zingiber officinale* (1.30) and highest ICF was found in gastro-intestinal disorder (0.50) ailment category.

Our study has revealed that there is an abundance of vast pool of ethnobotanical knowledge within the different ethnic communities of Ramechhap district of Nepal. Majority of people rely on plant-based remedies for common health problems. The ethnobotanical knowledge within the young generation is being declining due to the lack of communication and transformation of knowledge from generation to generation. The illegal collection, trade and marketing of high value medicinal plants have threatened the abundance and distribution of medicinal plants. It is utmost important to conserve biological diversity of important floras through the local participation for their better future.

Key Words: RFC, UV, ICF, medicinal plants

Local People's Perception Towards Vultures and Vulture Restaurant in Nawalparasi District, Nepal

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Vulture Restaurant (VR) is the safe feeding zone for the conservation of vanishing vultures. The main aim of the research was to explore the local people's perception towards critically endangered vultures and vulture restaurant in Kawasoti Municipality, Nawalparasi district, buffer zone of Chitwan National Park. Questionnaire survey of 100 households was drawn randomly in the periphery of the VR. The data were collected from January to April, 2018. Interaction and Focal Group Discussion was conducted by consulting a group of people working in the field of conservation such as members of community forest, vulture restaurant, youth club and community organizations. The respondents' attitudes towards vultures were measured in a Likert scale of agree to disagree (1-3). Attitudes toward vulture conservation were tested by 11 variables. The socio-economic factors were categorized into five groups: ethnicity, sex, age, education and occupation. Overall 89% showed positive response and education level was the major determinant of conservation attitude. 84% respondents were aware on the importance of vulture. Conservation of vulture was favored by 87% respondent. 94% respondent wanted to be a part of vulture conservation program. The study showed that there was a significant association between carcass disposal practice and mode of livestock death (Chi-square, χ^2=8.78, $p<0.05$). The study further revealed that local people were also benefited by vulture restaurant through tourism, participate in skill developing training and support poor people through fish farming to improve their livelihood. The study further revealed that out of total respondents, few respondents (30%) were suffered from bad fouling of carcasses and the response towards the increment in the number of feral was partially agreed. Again, next 18% were harmed with increased in feral dogs as they attack their livestock. Altogether, the perceptions of the local people towards the vulture and vulture restaurant have been changed as vulture restaurant is the key to develop positive thinking towards vulture conservation idea.

Keywords: carcass disposal, attitude, feral dog, conservation

Assessment of the Impacts of Livestock Grazing on Red Panda (*Ailurus fulgens)* at Singhadevi Community Forest, Ilam

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The present study was carried out in Singhadevi Community Forest of Ilam district, Nepal during autumn season (October) with the aim to assess the impacts of livestock grazing on red panda and explore the habitat preferences of red panda. The research objects to promote the adoption of appropriate conservation strategies to protect such endangered species from major anthropogenic threats especially livestock grazing. Questionnaire survey and Key Informant Interviews were carried out to evaluate the perception of local community on conservation threats and importance of red panda. Besides, in the community forest, five linear transects were delineated at an elevation interval of 100m. 10*10m plots were established both at the initial and end points of linear transects. Also, along each transect additional plots were delineated wherever signs of red panda and livestock droppings was discerned. Vegetation abundance and coverage percentage of different vegetation layers were determined from each plot to know the habitat preferences of red panda. Additionally, from the center of every plot, distance to the nearest water source was measured. Among 14 delineated plots, 29% of the habitat was shared by both red panda and livestock whereas remaining 71% was found to be dominated by only livestock grazing activities. *Litsea elongata, Lithocarpus pachyphylla* and *Rhododendron falconeri* were found to cover 60% of the shared plot habitat. 75% of red panda pellets were observed within 100m distance from the nearest water source suggesting water accessibility as one of the key habitat requisites for the Red Pandas. Presence of livestock droppings throughout the research area confirms that Red Panda occurrence/habitat is heavily disturbed by livestock grazing practices.

Key Words: Red Panda, livestock grazing, key informant interview, conservation threats

Human Wildlife Interaction in Meghauli

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Buffer zones of Chitwan National park are the hotspots for human wildlife conflict (HWC) and interaction since majority of people living near CNP rely on agro-pastoralism. The study aims to study the spatio-temporal trends of HWC and people's perception towards wildlife conservation in Meghauli, Chitwan. This study was carried out in 2018 and focused on loss of livestock, crop depredation and property damage to analyze the economic loss caused by wildlife. The study also recorded loss of human life or injury. We compare the primary data to previous secondary data explore the correlation with other variables and trend of HWC. Semi-structured questionnaire was done with 250 interviewees, Key informant interview (KII) with park officials and three focal group discussion (FGD) sessions were carried out as primary source of data. The revealed that rice and barley are the most affected crop by wild animal. Herbivores such as Rhino, deer and boar damaged all types of crop production. Similarly, the ratio of wildlife attack to human was found to be frequently occurring. The frequency to human and fatality is found to be 3:1. Wild animal attacks were recorded higher during winter season (74.2%) and occurs mainly at night time (42.8%) or early in morning (49.3%). The entire households interviewed were affected by wild animal among them only 23% of them have received relief for human causality and 12% of them received compensation for crop or property destruction. 79% of interviewees are not satisfied with compensation scheme and 15% are not supporting conservation of wildlife. FGD and KII reveal that most of the human injury or fatality occurs when locals enter protected area such as buffer zone, national park or community forest illegally for fodder collection and strict laws have reduced impact of human wildlife interaction in past 5 years.

Key words: Chitwan National Park, buffer zone, human wildlife conflict, relief

A Comprehensive Evaluation of Buffalo's Inedible Byproducts and Management Practices in Kathmandu Valley

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The field of slaughterhouse has not gained much concern in Nepal. Lack of study about the extent of slaughter waste impact strategies and poor management practices of slaughterhouses along with ineffective utilization of byproducts have led the urgency of this research. The study was carried out in Kathmandu valley. The main objective of the study was to identify factors affecting the effectiveness of management practices and propose possible alternatives for improving management practices of inedible byproducts. For achieving the goal of this research, semi-structured questionnaire survey was conducted in 30 slaughterhouses (10 in each districts), 4 fat collection centers, 1 skin collection center, 2 bones and horns collection center, 1 legs and tail collection center, 1 buffalo market, and a quarantine. Moreover, secondary data were also collected for comparative analysis of past and present production and consumption rate. Also, Key Informant Interviews were performed with officers of government sectors of each districts to find the impact of waste management practices and problems faced during the management sector. The study revealed the main factor for the haphazard state of slaughterhouses was lack of space (17%). However, the key factor for the present state of management of inedible byproducts was economic benefit from its trading (25%). In addition, the inedible byproducts is found to have slightly equal percentage of production (47%) relative to meat (53%). Accordingly, a comparative analysis showed the daily production of buffalo meat and inedible byproducts is relatively higher in Lalitpur district (39%) than other two districts in the valley. Thus, positive management practices must be encouraged for better progresses in this sector, and other factors affecting the effectiveness must be urgently considered and given a stable solution.

Key Words: slaughterhouse, inedible byproducts, buffalo, management

A Case Study on Human-Leopard Conflict in the Kathmandu Valley

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Human-wildlife conflicts are common phenomena from the past and have become significant problem throughout the world with frequent encounters with human and their livestock have resulted into their retaliation killing. Among them human leopard conflict has been one of the greatest issues inside the Kathmandu valley since past times.

This study aimed at exploring the human-leopard conflict in terms of livestock depredation their nature, cause and the people's perception on the conservation effort of common leopard within the Kathmandu valley. For the study to be more effective, multistage sampling method was applied followed by key informant survey and questionnaire survey. On the basis of recommendation from District Forest Office (DFO) of Kathmandu, Bhaktapur and Lalitpur districts, 27 wards from 14 municipalities were selected on the basis of purposive random sampling. Among them 5% of households were interviewed during March 2017 to May 2017 with total of 206 respondents. Based on information from 126 respondents raising cattle's and dogs, 2 cows, 53 goat and 41 dog depredations were reported in total within three years (2071-2073 B.S). 15- 20% of depredation cases occurred during night hours. However, goat depredation cases reported to be high in day time with 21% while 20% dog depredation occurred at night time. About 44% of goat depredation cases was found to occur at open shed during the absence of an electricity. This study also showed people living far from forest have positive response towards conservation while others are negative.

The fact that local people still consider leopards as dangerous animals makes the conservation activities even more difficult in the area. Therefore, the conservation initiatives must be backed up by the needs and aspirations of the local people addressing the problem of livestock depredation.

Keywords: Human-leopard conflict, livestock depredation, people perception, mitigation measures

Pesticide Utilization in Vegetables and Poisoning: A Case Study from Eastern Nepal

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Noxious pesticide residue in vegetables has been the major issue in commercial as well as the subsistent farming of Nepal. The study is an attempt to scrutinize the burgeoning risk situation, poisoning effects of pesticide use and management that can be adapted to lower its risk. The pre-tested interview schedule was entertained among 40 commercial and 15 subsistent vegetable farmers at Jahada Rural Municipality, Morang during January- February 2018. The Koshi Zonal Hospital, Biratnagar and research reviews were inspected along with an analysis of trends on Rapid Bioassay on Pesticide analysis (RBPR) conducted at Kalimati Vegetable Market, Kathmandu on commodities transported from eastern Nepal. The results depict the awareness of the color-coding mark pertaining to the pesticide level was significantly different among commercial and subsistent farmers, and still, 91% (among total 55 farmers) use the pesticides. Tomato, cauliflower, and bean products were found to have the highest pesticide residue on RBPR analysis. Farmers those who had not taken IPM training are discouraged using IPM strategies because of its confounding procedure and lack of training; trained ones (21.81%) are more concerned while non-trained are neglecting the method and dose of application. In terms of pesticide use, 80% of farmers reported that the application of pesticides is higher in the winter season than the summer season. Similarly, the best time of spraying according to the 72% of respondents was found to be 10 am to 2 pm of the day. The pesticide poisoning cases were higher in farmers and reasons are mainly due to haphazard spray and consumption of pesticide residue. The discussion with concerned stakeholders, technical officers, progressive farmers, and wholesalers, it is suggested that IPM is one of the best tools to minimize the pesticide use in agriculture as well as to lower the negative effects of it to plant and human health.

Keywords: pesticide, farmer practice, poisoning, IPM, risk management, bioassay

Land Use Land Cover Change Analysis of Bagmati Watershed Area

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Rapid growth and expansion of urban centers, population growth, and unmanaged urbanization are among the many drivers of Land Use Land Cover Change (LULCC) that cause global environmental alteration and thus become the major concern to researcher and decision makers. The knowledge of LULCC is important for many urban planning and management activities including surface morphometry and watershed management. The study was carried out with primary purpose to insinuate the authorities for possible consequences on forests, agricultural land, and water bodies that can occur due to poor urban planning. In the study, land use change of Bagmati watershed at Devichour from 1995 to 2015 was analyzed using Landsat images on Arc GIS Environment. Multispectral image of Landsat 4, 5 and 8 of the year 1995, 2005 and 2015 were used for this study. Supervised image classification in Arc GIS was conducted for the land use classification. Five major land use land cover classes were classified in the watershed area i.e. Agriculture land, Forest, Built-up area, Open land and water bodies. Change detection analysis was performed to compare the land use land cover class and conversions between time intervals. The results revealed both increase and decrease of the different LULC classes from 1995 to 2015. Some land use land cover remained unchanged in the analysis time period. In 1995-2005 time period the maximum changed was seen in the forest area. Forest area convert into open land by 79% and built-up area by 74%. During the same time period, the smaller changed was seen in the water bodies. Only 1% of water body was changed into agriculture land and open land respectively and 2% into forest. Similarly, in the time period of 2005-2015, forest was the land use class with higher changes into open land (84%) and less area of water bodies was changes. While comparing the land use land cover classes of 1995-2015 the maximum changes was seen in forest and agriculture land. The minimum changes was found in water bodies and open land of the decades. Forest land was highly depleted and increased in the built-up area.

Key words: Bagmati watershed, land cover, land use change, supervised classification

Modelling the Future Hydrological Climate Change Scenarios by Using SPHY Model in Budhi Gandaki Basin, Nepal

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Climate change can have adverse impact on developing countries like Nepal carrying abundant water resources. Such changes in climate influences all major components of hydrological system. The future climate change can be assessed through simulation of hydrological conditions with the help of hydrological model and climate model outputs. The aim of this study was to evaluate the likely impact of climate change on water resource for Budhi Gandaki using a fully distributed hydrological model SPHY to simulate streamflow series for available hydrological data and future periods. The model showed a good Nash-Sutcliffe efficiency and coefficient of determination in calibration (0.73 and 0.82) and validation (0.8 and 0.83). This research employed daily precipitation and temperature output of three different CORDEX experiments namely RCA4 (ICHEC), CCAM (CNRM) and REMO2009 (MPI) for near future (2020s), mid-future (2050s) and far future period (2080s), each one under two different representative concentration pathways (RCPs) which were bias corrected against historical gauged data. The ensemble mean temperature predicts increase in temperature up to 1 ℃ and 0.9 ℃ during far future under RCP 4.5 and RCP 8.5 respectively. Increase in minimum temperature is expected to be much higher than increase in maximum temperature. The ensemble mean precipitation is projected to increase under both RCPs. The most increase is shown by MPI during 2020s by 18.4 % under RCP 4.5 and ICHEC by 16 % during 2080s under RCP 8.5. As there is variation in temperature and precipitation between three experiments along with time and RCP scenarios, river discharge also varies similarly. However, the ensemble mean discharge is expected to increase by 28 % and 20 % during 2080s under RCP 4.5 and RCP 8.5 respectively. Reservoir module is added to latest version of SPHY through which we quantified the changes in river discharge due to installation of reservoir. These outputs from the model can provide insight for future research and proper management of water resources of the basin under climate change.

Keywords: Climate change, hydrological processes, RCP 4.5 and 8.5 scenarios, SPHY Model

Assessing Climate Vulnerability in Langtang Valley Using Livelihood Vulnerability Index

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Nepal Himalaya is highly vulnerable to climate change and is one of the disaster-prone zones in the world. However, research as required, regarding the impacts of climate change and avalanches on livelihood have not been assessed especially in Langtang. The indigenous communities who primarily depend on natural resources for subsistence livelihoods are among the first and most affected due to climate change impacts. This research was objectively carried out to assess the livelihood vulnerability index in response to climate change and trends of climate variables of Langtang. Temperature and rainfall data of only 24 years between 1988 and 2012 were available from the Department of Hydrology and Meteorology which were analyzed through Mann-Kendell trend test. The livelihood vulnerability index (LVI) (Hahn et.al 2009) and LVI-IPCC of Langtang Valley were analyzed. The study area was categorized on the basis of altitudinal variation and distance from 2015 earthquake-induced avalanche impact zone, specifying Lower, Mid and Upper Valley to analyze livelihood Vulnerability Index. The questionnaire was prepared to gather the essential data on the basis of exposure towards climate variability, the sensitivity including livelihood, water, food, health, social networks, and natural disasters. The responses to these vulnerable factors were investigated among households in Langtang. Whole enumeration process was applied as only 112 households now remain after the 2015 earthquake. People's perception was documented through questionnaire survey, KII and FGD for adaptation practice and strategies.

The result showed that the temperature pattern of Langtang shows only two distinct seasons with a warming rate of 0.0414°C. The annual precipitation was in increasing trend with 8.45mm. As per finding, the overall LVI of Langtang was low i.e. 0.334. The Lower Valley Settlements has LVI of 0.352 while Upper Valley Settlements has 0.340. Comparatively, Mid Valley Settlements was more vulnerable than other two settlement with LVI i.e. 0.377 which is also a direct impact zone of 2015 earthquake-induced avalanche. In Langtang, various adaptation practices like the application of improve stoves, changed housing structures, changing crop varieties, shifting from agriculture to other services etc were applied to combat with climate change and to improve livelihood. The increase in tourism has diverted the dwellers towards tourism hospitality and expatriate which has abet improved the livelihood condition.

Keywords: climate change, livelihood vulnerability index, adaptation practices

Vegetation Composition and Regeneration Status of Inactive Landslides in Panchase Region, Western Nepal

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Landslides are inherent character of Nepal. The steep mountains, high population density, over grazing, deforestation, monsoon climate are the reasons that make the country prone to the landslides. Landslide also provides opportunities for plant colonization and succession. However, there are very few studies related to succession of vegetation in landslide area. This study was carried out in the Bhatkhola and Setikhola sub-watersheds of Phedikhola Rural Municipality of Panchase region, western Nepal. A total 18 quadrat plots of size 10m x 10m for tree species and 72 plots of 2m x 2m for shrub/herb species were laid down using systematic sampling method and foot trial as belt transect in different ages of inactive landslides. Identification, count and measurement of all the species were carried out. There was higher herb richness in younger inactive landslide i.e., Planted Inactive Landslide of 6 years and Naturally stabilized Inactive Landslide of 7 years. The Shannon Diversity Index (H') of younger inactive landslide was found to be higher (2.73). However, the shrub richness of inactive landslides was not significant. The older inactive landslide i.e., Naturally stabilized Inactive Landslide of 34 years had lower seedling density but higher sapling/adult tree density. The Shannon Diversity Index (H') of tree species of older inactive landslide (2.40) and Naturally stabilized Inactive Landslides of 7 years (2.44) were almost similar and found to be higher. There were many new regenerating species in younger inactive landslide and no regenerating species in older inactive landslide. The density diameter curve of selected dominant species *Schima wallichii* of older inactive landslide showed near reverse J-shaped structure. Soil parameter such as pH of inactive landslides was assessed to be slightly acidic ranging from 6.78 to 6.9. The soil moisture and bulk density showed inverse relation to each other with strong negative correlation. The present study unveiled vegetation succession of inactive landslides area.

Keywords: bulk density, Importance value index, natural and planted, species succession

Assessment of Headwater Streams/Springs of the Kathmandu Valley

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Increasing population and urbanization have increased the demand for freshwater in the Kathmandu Valley. Bagmati River and its tributaries are mostly polluted due to sewage and agricultural effluents. There is severe depletion of groundwater resources such as dug wells, stone spouts, etc. This has limited headwater streams and springs to be the only drinking water source of the valley. Despite its countless significance, baseline data of the headwaters is still scarce. As a result, its regular monitoring and management remains a challenge. To develop the baseline data of these headwaters, an assessment is important. So, this study incorporates an assessment of a total of 11 sites from headwaters of 9 different sub-watersheds of Bagmati river and its tributaries inside the Kathmandu Valley to know the status of the headwaters. The physico-chemical parameters like pH, water temperature, electrical conductivity and dissolved oxygen were recorded. Similarly, benthic macroinvertebrate community composition, richness and ecological status were assessed. Rapid stream assessment (RSA), stressors identification and habitat characterization were also done to assess the river water class and river stressors. Among 11 sites, 9 sites were under River Water Class I which indicated that these headwaters to be ecologically functional and less disturbed from anthropogenic activities and were major drinking water sources of the valley. Macroinvertebrate richness was strongly dependent on land use, with forested, agricultural and protected areas contributing highest macroinvertebrate diversity.

The findings suggest that forested areas and riparian zones if preserved from urban development might conserve the macroinvertebrates diversity and alleviate ecological disturbances and hence ensure river health. Headwater streams/springs, not being easily accessed by public are still in good water quality. Hence, there is a great potential for water tapping from these streams/springs to support the domestic water need of the Kathmandu Valley.

Keywords: headwater streams/springs, benthic macroinvertebrates, Rapid Stream Assessment

Water Source Assessment and Mapping: A Case Study of Khageri Khola Sub-Watershed, Chitwan District

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The study was carried out in Khageri khola of Chitwan District, Nepal with an objective to identify water sources/ stream, identify their condition and issues, prepare location map of the water and stream using the Google earth pro and recommend the best conservation and management for water source/stream protection. The primary data was collected through community consultation, preliminary survey, focus group discussion, key informant survey, water source/stream location survey, and household questionnaire survey.Similarly, the secondary data was collected through published reports, thesis, articles, books, Department of Soil Conservation and Watershed Management (DSCWM), literature work and websites. The GPS coordinates of each water source/stream were plotted in Google earth and the maps were prepared. The data was analyzed using MS-Excel. The result showed that there has been a gradual decrease in the water source. Local people felt that climate variability has an impact on the water source. They felt that the upstream sources must be conserved to save the downstream sources which are already experiencing change in its water amount. People meet their water demand through piped-water supply and ground water. The wildlife in the area is also dependent on Khageri Khola to meet their water needs.

Adaptive measures such as tree plantation, improved irrigation and solar planning (solar power for water pumping system) can be used. More emphasis needs to be given on land use planning, bioengineering method for decreasing the soil erosion in upstream causing flash flood in the downstream and conservation of water sources. Timely monitoring of water source,capital funding for water conservation,national policy that enforces mainstreaming of climate change are recommended.

Keywords: water source, mapping, conservation measures

Design and Development of Ducted Turbine for Low Head Application

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Nepal is known for its tremendous potential in hydro power energy generation. With its estimated economic feasibility of 43000 MW, it can surely drive Nepal in the course of prosperity in terms of both economic and living standard. There are several Hydropower Plants (HPPs) being constructed currently and many are in the course of licensing. The similarity between all those HPPs is that they involve massive investment, high lead time, and long payback period, all of these are exactly opposite to what people in the rural areas (without grid connectivity) need. With 81% of the total population residing in the rural areas, limited choices in energy sources make the life more complicated. Limited fuel source is also believed to be one of the causative agents for the degrading health condition in rural women and children. Since still 80% of the total energy comes from biofuel, mainly fire-wood. There are thousands of small rivers, irrigation canals yet to be tapped. These sources can be used to produce the energy that can be consumed by the local people. This model of energy production and consumption by nearby people is famously known as distributed generation model. With the increasing demand for energy a significant pressure is being posed to the government to build new and powerful HPPs. Not completely but to some extent, the application of this kind of smaller turbines can be useful to fulfill the local demand. The following system can also be used as the primary source to generate the power required during the construction of the plants. With smaller investment, low maintenance requirements, and simple control mechanism makes it ideal for the people with low information level.

This paper is mainly focused to the design and development of small hydrokinetic turbine for low head application. Blade Element Momentum (BEM) theory has been used to design the blades. The report only covers the preliminary study about the commercialization of the turbine and focuses more on the feasibility study and exploration of the application. Commercialization and manufacturing prospects will be studied thoroughly in the later phases.

Key words: Distributed generation model, HPP

Design, Fabrication and Testing of Synchronous Mud Slab Cutter

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The ceramic tile industries in Nepal employ traditional mud slab cutting techniques for tile production which requires some manual labor attending the process. The cutting process then becomes very inconsistent as well as ineffective. Producing large number of tiles calls for an efficient automated cutting process. This project aims at designing and fabricating a machine to automate the cutting process. This project conceptualizes a cutting process capable of cutting mud slabs continuously in definite sizes. A rotating cutting drum is used as cutting mechanism driven by an epicyclic gear arrangement. Planetary gear arrangement (sun 44T, planet 18T, ring 80T) of module 3mm is used so that the outer drum is free to rotate at its own speed, because of the planet gears capable of rotating as well as spinning on their axis, the outer ring gear where the cutting drum is mounted can then move in a same speed as the incoming mud slabs fed from the pug mill during which the blades will also cut the slab.

The machine was tested at Bhaktapur Ceramics and it was found that the machine cut the slabs in the required size of 7''x7''x1''. The cut profile is almost straight resulting in less error and it was found that it increased the productivity by increasing the annual production by 63,000 tiles while decreasing the operating cost to Rs. 0.083 per tile compared to the existing operating cost of Rs. 0.238 per tile. The outcome of the project is realized in terms of reduction of labor time attending the cutting process, automating the cutting process and increasing the productivity of the industry.

Keywords: ceramic tiles, Epicyclic Gear Train, automation

Design, Fabrication and Testing of Banana Fibre Extraction Machine

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Banana (*Musa paradisiacal L*) is the fourth most important crop in the world after rice, wheat and maize. Banana cultivation in Nepal is more popular like other agricultural products and has annual fibre production of about 1,977 tons. The thick, fleshy and fibrous pseudo stems that are left over after harvesting the bananas can be used to extract high quality fibre. Farmers usually throw away this whole stump because it is big, heavy and takes a long time to rot and the animals do not eat it. The cost of importing extraction machine from other country is expensive. The research and development of such machine with low cost, which ultimately provides opportunity of local entrepreneurship to farmers and helps in proper utilization of agricultural management, was felt necessary. The developed machine from this project, uses combined application of roller and a decorticator for fibre extraction. The machine can extract fibre from 1648 Kg of input which is about 100-160 banana pseudostem. The fibre production obtained was 54 Kg per day with NRS. 11 operation cost per 1 Kg of fibre. The production efficiency in comparison to available commercial machine is 180%.

Keywords: banana fibre, extraction machine, roller, decorticator

A Review on Advances in Maize-based Bioethanol Production and its Prospects in Nepal

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The generality of energy demands of Nepal is met by petroleum imports. Massive use of gasoline and diesel has raised the annual CO_2 emission (4.05mt) of the country. Thus, a search for the renewable, secure and sustainable energy source is imperative. Maize (*Zea mays*) has been widely used across the world for bioethanol production. It is the second most important crop of Nepal in terms of both area and production. The productivity and attainable yield of maize in Nepal is 2.55 mt/ha and 5.70mt/ha respectively. The huge yield gap and the scope of increasing productive area attest the possibility of increasing maize biomass production. The demand for maize is shifting from food to feed. The feed demand is increasing at a rate of 11% per annum. Out of the total maize used in feed production, 87% is imported each year. In this ambience, maize can be utilized in the bioethanol industry, generating ethanol for fuel and high-value co-products for feed. The production process involving starch fermentation generates co-products like distillers dried grains with solubles, corn gluten meal, corn gluten feed and corn oil that can be used in the feed industry. Cellulosic ethanol is derived from lignocellulose, a substrate highly recalcitrant to enzymatic breakdown. Molecular and genomic tools have been used to study the cellulose assembly and its deposition pattern, biosynthesis of the lignocellulosic machinery and reducing lignin concentration. Transgenic maize with green-specific expression mechanism has been developed to produce cellulase within their biomass. Tropical temperate hybrid maize producing high biomass with low inputs have been developed. The cellulosic ethanol has 94% lower greenhouse gas emission as compared to gasoline. It can be blended with petrol and used as transportation fuel. The entire production process is carbon neutral. For a developing country like Nepal, maize-based bioethanol can meet energy demands, sustain agricultural production and create entrepreneurship opportunity.

Keywords: bioethanol, energy, lignocellulose, maize, starch