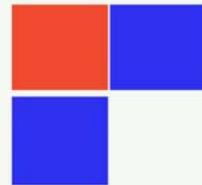


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Impact of Rural Hill Roads on Agro-Hydrology and Livelihood Transformation of Chakkhu Khola Sub-Watershed, Bhaktapur, Nepal

Shahi Bakhat Bahadur; Devkota Laxmi Prasad; Shukla Ashutosh

The study was carried out with the aim of establishing the links of rural road development to the livelihood transformation and changes in the water demand and supply in different locations of the Chakkhu Khola Sub-Watershed, Bhaktapur, Nepal, and also the downstream consequences resulting thereto. The study area was divided into head, middle and tail reaches. Various tools of inquiry such as Focus Group Discussion, Field Observation and Key Informant Interviews were conducted.

Development of the rural road had played a central role in changing the demography of the study area due to migration and population changes. Limited settlement at the tail reaches in 1992 had expanded to the middle and head reaches by 2006. Dramatic increase in the area under intensive vegetable cropping from 1992 to 2006 was noted. Major change in the area under intensive cultivation was noted after the road expansion in the middle and head reaches in 1997. The flow in Chakkhu Khola had declined due to land use and land cover changes that affect the local hydrology. The underlying reason was increased water extraction on the middle and head reaches to support the irrigation needs in the area under intensive vegetable cultivation. The frequency and events of flooding, landslide and mass wasting and soil erosion were increased. Use of chemical fertilizers and plant protection chemicals was increased though the rate of increase was the highest in the tail reach. Significant change in the agricultural productivity and on-farm income resulting from agricultural transformation was observed. This implies that agricultural intensification and increase in the crop productivity and return to the households is inherently connected with the improved access to transport services and market. Agricultural intensification in the study area not only contributed to improving the livelihood of the people but also produced adverse impacts on those living in the tail reaches due to changes in brought to the water access and availability. The increased trend of intensive cropping that was essentially possible with the introduction of high water demanding crops at middle and head reaches promoted increased water extraction for irrigation in these areas. This was found to have resulted to reduction in the dependable water supply at the downstream. While there has been decreasing trend of water availability on the tail reach, there has also been competition for water with brick industries at the tail reach of the study area. This competition has forced the farmers to explore alternative sources of water for agricultural and domestic uses. Increasing trend of direct pumping of water from the streams and investment of the farmers in the development of water harvesting ponds was noted in response to the increasing water scarcity in the tail reach.

Water Induced Livelihood Impact and Adaptation Strategy of Farming Households in Manohara River

Thapa Hari Bahadur; Pokharel Anil; Shukla Ashutosh

Degradation of the land and land based resources are crucially linked to the livelihood of the people of flood plains. People develop their own adaptive strategies to respond to flood and flood induced land degradation. This study stems from the argument that the land and land based resources degradation processes in the flood plains of the rivers and people's responses to degradation from each damaging event go simultaneously. The study was focused on 5 km long stretch of the Manohara River from Karki Gaun Bridge in Mulpani Village Development Community (VDC) to Magar Gaun on the upstream of Sanothimi Bridge in Madhyapur-Thimi Municipality. The study involved both qualitative and quantitative approaches in collecting and analyzing relevant information. An important part of the study methodology was analyzing the shift in the river course for three different periods of time - 1992, 1998 and 2006 on available maps of the area.

Eight damaging flood events were identified by the people in the area between 1923 and 1989 that had caused significant damages to crop lands and properties and resulted to major shift in the river course. The average lateral shift in the river channel was observed 121.60 m between 1992 and 2006 indicated that the channel width of 80 m set by cadastral map of 1964 was unrealistic. A lateral shift thus observed resulting 59.28 ha of land subjected to degradation; however, the land area actually found degraded in the field observation was only 14.84 ha. Though the river was found active in bank cutting, the alignment of the river channel had rather become more stable than in past, which was substantiated by the peoples' observation but the damage to the land due to stream bank erosion was more intensified. Rampant sand mining from the river bed in the past, which is also continuing at present despite increased restrictions on the river bed sand mining, was found to have resulted to deepening of the river channel, intensified the bank erosion and land degradation. People were found to start the reclamation and restoration efforts soon after the passage of the damaging events. While the practices of soil management and crop rotation alone were adequate to restore the degraded land in the past, the efforts and investment made by the people in the reclamation and restoration was found to have increased due to deepening of the river channel and consequently increased intensity of stream bank erosion and land degradation. Delineating the river waterway and defining the boundary of the private property along the river course was identified to be most important initiative in order to maintain river ecology. Enforcing restrictions on river bed sand mining and regulating the mining of sand from the pit reserves along the river course was found to be desirable initiative to minimize environmental damages in the area that would be crucial in maintaining the river ecology.

Losing Ground of Collective Action: Case Study on Operation and Management Challenges in Mahadev Khola Rajkulo Emerging from Urbanization and Livelihood Changes

Adhikari Keshav; Sharma Khem Raj

This study was undertaken with the aim of understanding and analyzing the impacts of urbanization on the governance, and operation and management of irrigation infrastructures and services in the irrigation systems of Mahadev khola Rajkulo, located in the urban fringe of Kathmandu and Bhaktapur. Exploratory case study approach was used in the study that involved collection of pertinent information through focused group discussion organized at the head, middle and tail reaches of the irrigation system and substantiating the information through the key informant's interviews. Long history of Mahadev Khola Rajkulo constructed during the reign of Malla rulers in Bhaktapur, which has undergone physical, social and institutional changes over time, provided ideal case for the study.

Rapid trend of urbanization in Kathmandu city and its neighbouring urban areas in the period after 1995 was noted to have produced stressors of different dimensions and magnitude that have been responsible for transformation in the irrigated agricultural system and livelihood of the people in the command area. Large change in the population in the middle (184 %) and tail (807.5 %) reaches over a period of 20 years, were found to be responsible for significant transformation from the agricultural to housing plots due to higher land value for residential plots. The farmers in the area were found to be shifting from traditional cereal based farming to commercial vegetable production. More frequent and dependable irrigation needed for the vegetable farming, which was not possible with the traditional canal irrigation, made farmers to invest in groundwater development. This had reduced the dependency of the farmers on Mahadev khola Rajkulo for irrigation needs resulting progressive reduction in the available supply at the source. Other reason was increasing diversion of water from the source to meet the drinking water needs of the people living in the command area of the system and also in the vicinity. The trajectory of collective action of people in the operation and management of the irrigation system was noted to have eroded over time. A phenomenon of 'worker-peasant' was noted to be evolving rapidly in the study area with the people increasingly involved in alternative occupation alongside of farming. The study identified the need for looking into alternative institutional arrangements for the governance and management of the common poor resources. Privatizing the operation and management of irrigation services in the urban areas with the service provider responsible for maintenance and upkeep of irrigation infrastructures and delivery of irrigation services was identified to be alternative option. The study identified the need of recognizing the prior water use rights while developing other water infrastructures and services from the same source. The findings of the study led to conclusion that conservation of agricultural areas and open spaces in the urban fringes are immensely important to continue maintaining the environmental services crucial for human habitation in the urban areas.

Changes in Ecosystem Services Resulting from Land Use Changes in Manamatta Micro-Watershed

Paudel Shrijan; Sharma Khem Raj; Pathak Mahesh

The study carried out in Manamatta Micro-Watershed, located in the north-east edge of Kathmandu Metropolis, attempted to look into pattern and direction of land use changes, the resultant stresses to ecosystem services and their livelihood consequences. The study involved time series analysis of land use changes between 1992 and 2006, involving three time slices, 1992, 1998 and 2006. The study methodology involved a combination of geo-spatial analysis and use of participatory tools of inquiries in identifying, documenting and evaluating the changes in the land use, ecosystem services and their consequences on the livelihood of the people. The entire area of watershed was divided into three reaches- upper, middle and lower, in order to account spatial differences in the pattern and direction of land use changes and stresses to the ecosystem services.

The study noted increase in the area under forest cover in the watershed between 1992 and 2006. This increase was possible as a result of government led forest conservation program in the upper reach of the watershed and initiation of community forestry in the middle and lower reaches after 2000 A.D. The overall increase in the area under forest cover was 72.63% during the stated period. The increase in the area under forest cover was found to have contributed positively in increasing the flow in the spring and stream sources, reduction in the rates of erosion and land degradation and crucial for maintaining carbon dioxide concentration in the atmosphere. The area under crop cultivation in the middle and lower reaches of the watershed was found to have decreased significantly during this period, which resulted due to increased conversion of agricultural land into build-up area. The proximity of the study area to Kathmandu has encouraged people to buy land for housing plots, which was primarily responsible for accelerated conversion of agricultural areas into settlement. There was also increasing trend of land developers buying tract of land and keeping it for speculation of land prices. This trend has been more prominent in the middle and lower reaches of the watershed due to proximity of this part of the watershed to the road and better connectivity to the Kathmandu. The study noted increase in the population and changes in the occupation of the people primarily responsible for land use changes, especially in the middle and lower reaches of the watershed. Despite this increase in the stream flow, the farmers in the middle and lower reaches were found facing increasing constraints to irrigation supply due to increasing irrigation demand as result of increase in the area under intensive vegetable cultivation in the middle and upper reaches of the watershed. In responding to constraint to irrigation supply, the farmers had adapted water saving irrigation practices and technology, such as drip and sprinkler irrigation and development of rainwater harvesting ponds. In context of the study area, government led conservation program has been one such event that resulted to increase in the area under forest cover in the subsequent years. The study also pointed to the need of looking into the change in the demand for ecosystem services while accounting the ecosystem services to be able to identify and account the ecosystem services more accurately.

Assessing Water and Sanitation related Vulnerability and Adaptive Strategies of Urban Poor: A Case Study of Informal Settlement of Pragatinagar along Manohara River, Madhyapur Thimi

Aryal Lama Mela; Adiga Poorna Bhadra; Dongol Robert

Urban poor are characterized by poverty, low income, inadequate living conditions and sub-standard facilities. Pragatinagar settlement, one of the slum and squatter settlements of Kathmandu lies along the bank of highly polluted Manohara River. Almost 4000 plus people (as of August 2010 estimate) are living there. This study tried to find out the 'water and sanitation' related vulnerability of the people living there and the adaptive measures they follow to get over the vulnerability. Different participatory research tools such as questionnaire survey and Focus Group Discussion were used for primary data collection. Water samples were collected and analyzed and microbiological tests were conducted of stool samples of the residents. A general health camp was also carried out in collaboration with the local Lokanthali health clinic.

The study revealed that the state of Manohara River is degrading day by day. Having been dumped with various household wastes and toilet wastes the river is getting more and more polluted. The other water sources including *Dhungedhara* (stone spouts), tube-wells and dug-wells were also found to be contaminated with pathogens. However, the settlers were found to be continuously using the polluted water for drinking and other purposes and practicing open defecation. In addition, the toilet users were found disposing their toilet wastes directly into the river. The personal hygienic practices were found to be ignored. Only 30% were found using soap to wash their hands after defecation and majority were found using soil and water. Rodents and disease transmitting insects were found to be abundant in the locality. The observations, interviews and interactions, laboratory tests, and health camp outputs conclusively indicated a high incidence of water borne and sanitation related diseases in the settlement. Thus, the vulnerability to water and sanitation related diseases in the settlement were found very high for an urban community. Even as the majority of the respondents accepted that they were exposed to a high level of vulnerability to diseases, it was noted surprisingly that 60% of them mentioned 'electricity' and 'road' as their top two priorities for outside help and intervention. On further analysis of the outputs of the study, it was concluded that their priority choice for electricity and road was based on their need for the status of legal residents and a proper recognition from the municipality and the government. Provision of electricity from the national grid and government investment on improvements of existing roads and pavements would support their claim of land tenure. Till such time, they seemed to be prepared to live there with whatever adaptive strategies they could think of. It was noticed that the common denominator of all adoptive strategies was the attitude of indifference, strengthened possibly by a higher level of immunity to enteric diseases. This attitude being undesirable, future development programs in such locality should be able to induce motivation to act proactively for a healthy life of dignity.

Agricultural Intensification, Agrochemicals Use and Water Pollution Interlinks in Manohara Basin: Situational Analysis

Dhakal Shova; Sharma Khem Ra; Shukla Ashutosh

Population growth led agricultural intensification is going to increase in Nepal. Cereal crops were the increasing demand for agricultural intensification led to decline fertility of existing agricultural lands, and insufficient agricultural production. To maintain soil fertility and high productivity, farmers need increasing doses of organic and inorganic fertilizers. However, negative impacts on soil and water quality are likely to occur with injudicious use of chemical fertilizers and pesticides. The adverse impacts of intensified agriculture on surface and ground water quality are an issue of concern worldwide, but studies on the effects of agriculture on surface and ground water quality in Nepal are limited and mostly focused on water chemistry. Therefore, this study was conducted in Manohara watershed, which has agricultural intensification, to assess its effects on river water quality through chemical and biological indicators. Impact of agriculture intensification on surface and ground water quality was studied through chemical analysis of the water and correlation with the biota present in and around the river.

Trend of cropping system from recent years to 40 years back was reflect that, in irrigated lowland Rice-Potato-Potato/Wheat, Maize-Potato-Wheat are in use between them former cropping system was popular where as in non-irrigated upland, Tomato-Broad Leaf Mustard-Broad leaf Mustard was in practice. Vegetable cultivation practice was used after 20 years back, it shows that cropping intensity was increased from 10 years back. Chemical fertilizer use trend shows that Di-ammonium Phosphate and Urea application in monsoon Rice, Tomato, Wheat, Potato and Broad Leaf Mustard was increased after 10-20 years. People in the study area use more chemical fertilizer in Tomato, Potato and Broad Leaf Mustard. Urea and DAP application is highest in Tomato which shows the commercialization in the study area. Farmyard manure (FYM) application trend is different than three chemical fertilizer application trends, which shows that decrease in FYM application from 30-40 years. Trend of pesticide application in different crops shows that people in the study area had started applying pesticide like Metacid from 20-30 years ago. All the households apply pesticide in Tomato, Broad Leaf Mustard, Potato and Rice. Increase use of agro-chemicals and agriculture intensification had led to increase the occurrence intensity of disease and insect on cultivated cereals. The weed species had changed due to agriculture intensification and new species appeared in all the crops. No fish species are found in water at present year that clearly indicated migration or disappearance of fishes due to agrochemicals led water contamination. Chemical content of water sample taken after agriculture intensive areas were followed by within and before agriculture intensive areas. Similar trends also occurs in water pollution by different agrochemicals expect chloride and Nitrate content. In contrarily to Pesticide Act 1991, the banned Metacid was found in use 2011. The agrochemicals to be imported, distributed, traded and used should be friendlier and less hazardous to health and environment. More emphasis has been given to use organic pesticides as an alternative of chemical pesticides to control crop pests.

Forecasting Model of Manohara River Flood Levels Using Neural Network: Assessing Livelihood Loss and Agricultural Impacts

Sayami Sarbin; Shrestha Hari Krishna

Flood is one of the water induced disaster which hits every part of the world. Its consequences are so serious that most are affected tremendously physically and mentally in such a way that they require lot of time and patience to come to a normal life style. This thesis tries to find out a way out in predicting extreme flood events such that appropriate precaution can be taken to save lives. However, it has always been a challenge to incorporate different probabilistic methodologies in forecasting the flood levels and it is even more challenging in the case of ungauged rivers. This thesis focuses on the study of the one of the ungauged river i.e. Manohara River located between latitude $27^{\circ}40'45''$ to $27^{\circ}43'34''$ and longitude $85^{\circ}20'10''$ to $85^{\circ}26'50''$ which is a boundary between Kathmandu and Bhaktapur districts. Since it is an ungauged river, lots of uncertainty and non-linearity was seen between the parameters pertaining to flooding event. Thus to suppress the curse of uncertainty and non-linearity an approach known as Artificial Neural Network was implemented to forecast the flood levels. These flood levels were then processed in HEC-RAS to delineate the affected areas with the increased flood levels to access the Livelihood loss and agricultural impact.

Trajectory of Degradation of Bagmati River: Roles of Social, Institutional and Political Processes

Shrestha Mon Devi; Dixit Ajaya; Sharma Bharat

Like other civilizations flourished in the river valleys in different parts of the world, Bagmati and its tributaries supported the growth of human settlements in Kathmandu valley and nurtured the evolution of rich civilization. Bagmati has special social, cultural and religious significance among predominantly Hindu population in Kathmandu valley. The sacred river is degrading. The study was conceived on the ground that social, political and institutional dynamics have been important determinants of the degradation processes over time and therefore understanding of these dynamics would provide important insight in the conservation and restoration of the river environment. The study was primarily based on review and analysis of secondary sources of information. Shared Learning Dialogue used in documenting the perception of the people, living at five locations along the river, relating to factors, processes and trends of river degradation and the consequences faced by them as a result of river degradation were substantiated by interviews of the key informants representing people from different walks of life.

Although the processes of Bagmati river degradation started in 1970s, the rates of degradation were rapid after 1990s. The study identified four important river degradation causes i) lack of land use and land development policies responsible for haphazard urbanization and infrastructure growth along the river course, ii) continued prevalence of political uncertainty in the country after 1990s and weak governance and administrative infrastructure, failing to execute and regulatory provisions and programs for conservation and restoration of the river environment, iii) continued political interferences in the functioning of the government departments and High Power Committee on Integrated Development of Bagmati Civilization entrusted with the responsibility of conservation and restoration of the river environment, and iv) reliance on short sighted engineering and technical solutions for Bagmati conservation rather than focus on broad based social, institutional and political initiatives. The study identified three prominent groups of actors involved in the process of Bagmati degradation who also have roles in the conservation and restoration efforts. The opportunists, who essentially include elites, industrialists and big political actors, see Bagmati as an opportunity, both in its degradation and also in the initiatives towards conservation and restoration. Oppose to them has been the role of egalitarians, who essentially include the citizens of Kathmandu and civil society activists, who maintain that the degradation of Bagmati will undermine the civilization of Kathmandu valley. The administrative infrastructure of the government, and bureaucrats involved thereto, maintain rather a role between these two extremes. The politics, policy and institutional dynamics of Bagmati degradation revolves around these three groups of actors and their thinking processes. Unless thinking and actions of these three groups of actors converge, a meaningful policy initiative is less likely. The study supports Bagmati Action Plan for envisioning a broad based approach to restoration of the river environment.

River Degradation and Livelihood Impacts: Analysis of Solid Waste Disposal in Hanumante River in Bhaktapur

Wenju Rabi; Manandhar Dinesh Raj; Dongol Robert

Degradation of river stands as the prominent problem in most of the urban areas in Nepal. Among the various causes for the degradation, haphazard and rampant disposal of solid waste along the river have become the common picture in most of the urban areas in Nepal. This study was carried out to examine the impacts of solid waste disposal along the banks of Hanumante River, one of the tributaries of Bagmati River and resultant livelihood on the people. The methodologies in the study involved physical and chemical water quality analysis from five different location (Sudal Village, Hanumanghat, Chupinghat, Sallaghari and Srijananagar) where dumping of solid waste has taken places at various time period, walk through and mapping of river reach degraded from continued solid waste dumping , semi- structured interview, and key informant interview. Apart from the water quality, perception analysis of people on the impact on livelihood due to degradation of the river was carried out in four clusters of settlements (Tinkune, Libali, Hanumanghat and Bhelukhel) along the river course.

The water quality analysis shows that the level of pollution has been progressively increasing from upstream to downstream. The pattern of variations of water quality parameters clearly follow the intensity of solid waste dumping along the river course from upstream to downstream. The analysis of water quality parameters from the five sampling locations clearly revealed Sallaghari and Srijananagar. According to the people, lack of municipality's concern on haphazard dumping of solid waste along the bank was one of the major causes of river degradation. Apart from that the mixing of untreated sewage in the river was another. Due to the disposal of waste, the river has congested increasing the incidences of flooding during rainy season. People living close to the river frequently face floods during monsoon and foul smell during the dry season. The foul smell from the dumped waste has impaired the aesthetic environment making the area unhygienic. The foul smell becomes excruciating in the evening with the blow of winds. People feel uncomfortable to carry out their daily work. Headache, vomiting and dizziness were some of the health problems people face due to the bad smell. The respondents, in general, identified increased incidences of four diseases- diarrhea, skin diseases, headache/dizziness/vomiting and fever and believed that the cause of increase in the incidences of these diseases has been increased solid waste disposal along the river course. The place has been the vector breeding ground specially mosquitoes and flies creating nuisance to the local homestead. To overcome this problem people were seen using mosquito nets, coils and mats which possess threats on people's health. Apart from that, the monthly average cost of the family was increased.

Processes and Consequences of Degradation of Hanumante River: Religious, Cultural and Livelihood Impacts

Sada Rajesh; Shukla Ashutosh; Dongol Robert

Degradation of rivers in the urban areas has become a serious problem around the world. This study was carried out with the aim of evaluating the factors and processes leading to degradation of Hanumante River and the cultural, religious and livelihood consequences resulting from continued process of river degradation and the livelihood adjustments in response to the river degradation. The methodology used in the study involved assessment of river water quality from eight different locations along the river course to establish spatial variation in the water quality, focused group discussion with different livelihood groups and key informants' survey in developing the understanding on the processes and dynamics of river degradation and the livelihood, cultural and religious consequences resulting there from.

The study identified four important causes of river degradation; i) upstream water extraction, ii) disposal of untreated urban sewerage and solid waste, iii) development of urban infrastructure and services with complete disregard of the river environment, and iv) insensitivity of Bhaktapur municipality, and other agencies, and lack of recognition of river conservation and restoration as an important element to urban planning. Analysis of river water quality at seven different locations along the river course- *Sudal, Hanumanghat, Sallghari, Srijananagar, Dadhikot, Kaushaltar and Lokanthali*, revealed progressive degradation in the river water quality as the river passes through the city core due to increasing pollution load. Of the 55 respondents, all of them stated the water quality of Hanumante River to be very poor, which was, to them, very good some 40 years back. Farmers at the middle and downstream were found practicing wastewater irrigation. Among them, 64% of the 55 farmers were using wastewater from Hanumante River for the whole year irrigation whereas the remaining use only during the monsoon. Furthermore, most of the farmers of more than age group of 30 were involved in wastewater irrigation. Disregard of the age group and gender, only 15% of farmers were found using protection measures such as separate clothes, gloves and shoes. The most common health problems noted were skin diseases, headache, cough and cold, fever, diarrhoea and eye infection. Young generations were conscious of possible health risks from wastewater irrigation therefore restrained from handling wastewater for irrigation. Increasing river pollution was found to be impacting negatively on religious rituals performed on the banks of Hanumante River for example the number of people using river water for all kinds of religious and cultural uses have been declining over time. Hanumante River has been facing the "*Tragedy of Commons*". Bhaktapur Municipality has been dumping untreated sewage and solid waste in Hanumante River at different locations. People of Bhaktapur have organized river cleaning campaigns in the past and also resisted attempts to further draining wastewater and untreated effluents into the river, either by the municipality or by people in newly developed areas. Although these campaigns and initiatives have been spontaneous and unorganized, these do reflect upon the sentiment of the people and their appreciation of religious, cultural and livelihood importance of Hanumante River.

Sand Mining in the River Terraces of Manohara: Analysis of Consequences of Social and Institutional Response

Dongol Urmila; Gautam Upendra; Shukla Ashutosh

This study undertaken with the aim of developing understanding on the dynamics of sand mining in the river terraces of Manohara River and identifying and analyzing the environmental and livelihood consequences emerging there from had chosen three sand mining sites- *Khadkadil* and *Hasilobesi* in Duwakot Village Development Committees (VDC) and *Sarkigaun* in Jhaukhel VDC where active sand mining along the river terraces prevail since early 1990s. These two VDCs have 18 out of 29 licensed sand mining sites in Bhaktapur District. The study essentially involved case study approach, making use of focused group discussion, key informants' interviews, direct observation and informal interaction with the people in the area, as the tools of collecting relevant information.

District Development Committee (DDC), VDC, Department of Mining and Geology (DMG), mine operators, land owners and local social groups and political entities were the key stakeholders controlling the decision making related to the sand mining. DDC is responsible for controlling the decisions related to issuing the license and DMG evaluates the submitted proposal of sand mining and recommend the DDC for license issuance. The mean annual revenue of the DDC collected through royalty and taxes paid on truck loads of sand extracted and transported from the mine sites for five years (2007 to 2011) was Rs. 6.17 million. In the Fiscal Year of 2010/2011 alone the revenue was nearly 22% of the annual development budget of the DDC. Due to illegal extraction and transport of sand from the area and mode of collection of tax by the DDC, the actual generated revenue to DDC from sand mining was much lower than the potential revenue of Rs. 39.64 million per year. The interest and actions of the mine operators, land owners and local communities relating to sand mining in the study area were found conflicting to each other. The interest of the mine operator was always in extracting as large volume of sand from each mine site as possible in order to maximize their gains. The land owners who lease out their land for sand mining are paid based on the truck loads of sand extracted and transported from their land on a daily basis, therefore they were also found interested in maximizing the monetary gains by allowing extraction of as large volume of sand reserve from their land as possible. The observed environmental consequences, from sand mining in the area were those resulting from the loss of vegetation cover, accelerated erosion and sediment wash and deposition of sediments in the agricultural land in the downstream areas. Most noticeable change in the area, due to sand mining, was the change in the landscape due to flattening of the hillocks. The rate of sediment movement from the mine sites was noted to be rapid even with the rainfall events of small intensity causing damages to the agricultural lands and standing corps on the foot hills along clogging of the natural waterways and drainage systems used by the people for irrigation and removal of excess water from the area. Unsustainable and unfriendly sand mining in the study areas lies in the northern groundwater recharge zones and the extraction of sand reserves in the area which is currently taking place from as deeper layers as 100 feet or more.

Electricity Outage in Kathmandu Valley: Implication to Livelihood and Adaptive Strategies

Parajuli Sunil; Shukla Ashutosh

Country endowed with abundant water resources has been engulfed with the dire electricity crisis for a period of more than two decades. Electricity outage has hit all the sectors of Nepal from household level to industrial, commercial and institutional sectors. There has been an instance of adding power plants in the national grid as a remedy for instantaneous solution to the problem of electricity outage which has been rightly characterized as “Flood and Drought Syndrome. Political instability and lack of resources were found to be the major reasons behind the failure of policy and plans implementation. This entire situation provokes the need to find out the reason behind the prolonged outage, its impact on people of various spheres and its way out. The study also tried to find out why outage has taken such grave situation and what propagates state agencies to become a failure. Intensive literature review was done to find the reasons for outage in Nepal. Sector wise approach made to analyze the impact of electricity outage. Sectors were randomly chosen on the basis of involvement of public or relation to those institutions. Moreover, household survey was carried out to find out the impact of electricity outage and adaptive strategies to meet their electricity requirement at household level. Household samples were also chosen randomly, covering different parts of Kathmandu Valley and across different occupation to find the loss of livelihood in that sector.

Many institutions were found managing to provide continuous backup system so except for financial burden and stress at management level other stakeholders of such institutions do not face problems due to electricity outage. But in case of household level, especially female involved at household level found more difficulties due to continuous electricity outage. Electricity outage though has impacted largely in all sectors however there are some sectors which were making benefits from this situation. This does not mean that it can continue. But the fact was that such groups which benefit from outage never want the outage to end. So, it has been concluded that rather than working in flood and drought syndrome, specific targets has to be made and plans has to be made such that they meet the target on time. Moreover, rather than looking for foreign support, hydropower projects should be developed from different approaches like Public Private Partnership (PPP) which may lead to the success of a project.

Pharmaceutical Wastewater Management in Kathmandu: Documentation of Practices, Regulatory Provisions and Health Impacts

Shrestha Bhintuna; Nakarmi Mahesh; Etter Bastain

Many of the industries in the country discharge their effluents in water sources than those set by concerned authorities. Furthermore, surface water bodies are used by people in the vicinity and on the downstream for various uses in/directly onto land or into small channels leading to nearby rivers. This necessitates compliance of environmental and public health standards even by the pharmaceutical industries and also education and awareness of the people using water from the sources known to carry pharmaceutical wastes. Therefore, the study was carried out to document and analyze the state of five pharmaceutical factories' wastewater disposal practices, their compliance with regulations and probable health impacts resulting from poor management practices. The study also intended to analyze wastewater and groundwater samples to understand potential linkage between water pollution and disposal practices. The methodologies involved were explorative survey, desk study, site observation, key informant interview at managerial and waste management practitioner level and semi-structured interview at household levels and basic physico-chemical parameters for water quality analyses from pharmaceutical companies (including production and deep boring) and eighteen groundwater samples from household level.

Haphazard and rampant disposal of pharmaceutical effluents and non-water pollutants within the factories were noted. Only one company was treating their effluent from non-penicillin section with alum and caustic dosing. However, water analysis of wastewater before and after treatment has shown significant efficiency of the method applied. The treatment plants in pharmaceutical manufacturing factories 'infrastructures were considered needless and not included in priority list. Similarly, legal flexibility of concerned authorities to control activities of proper effluents disposal was also found as a reason for haphazard disposal and management of by-products generated from such factories. It revealed some cases of water pollution: accidental spill of hazardous effluent into paddy fields nearby the factory and air pollution from open burning of plastics and other solid waste. Though affected residents were compensated for the accidental spill of hazardous effluent, soil quality degradation at the accidental site was also perceived. Water quality analysis of wastewater samples from five factories showed effluents being heavily polluted with chemical materials. The Chemical and Biological Oxygen demand concentrations from an expired drugs soak pit were 766 times and 300 times higher respectively than allowed by Government of Nepal Standard. It depicts urgent and serious need of regular monitoring of such wastewater before disposing them into nearby river or other sites. However, adoption of simple pH maintenance treatment with caustic and alum dosing techniques have shown clear pollutants load declination. Groundwater samples analysis from household nearby pharmaceutical manufacturers premise also indicated some deviations in values from what is permissible in National Drinking Water Quality Standard.

Livelihood Impact of Irrigation Development: Case Study of Naubisephant Irrigation Scheme in Kavrepalanchok District

Nepal Chiranjivi; Sharma Khem Raj

Agriculture is major activity in rural areas where, most of the population is engaged in small scale farming to maintain their livelihood. Significant percentage of labor force is active in this sector. With the purpose of increasing crop production, there are a number of interventions in agricultural sector. Improved seed varieties, chemical fertilizer and irrigation are major interventions in the context of Nepal. These interventions are intended to increase the production which could be sold in the market for making extra income. In this way, it helps to reduce poverty through accelerated growth in the agricultural sector. An example of this scenario was observed in Naubisephant of Kavrepalanchok District, where two siphons were constructed to irrigate the agricultural land. The study is focused to assess the impact of irrigation facility in the local area with the objectives to analyze the changes in agricultural productivity, income level, diversification of income opportunities and its implications to livelihood improvement and food sufficiency at local level. The relevant data was collected by conducting household survey and focused group discussion.

The study revealed that though with a good water management practice, farmers were still unsatisfied with the irrigation management. Equity perception is very low especially in spring season when water is less in irrigation canal and stream. Similarly, the study showed that the cropping pattern was changed from Rice-Wheat to Rice-Potato in monsoon. In winter season potato was dominant in the production. The area of potato-farming was increased by 589.61% comparing to time before the irrigation scheme. However, important crop wheat was decreasing in the area as no one grows this crop nowadays. The productivity of potato increased by 280.21% in year 2006 and 338 % in 2011, that of rice is 27.77% in 2006 and 16.96 % in 2011. It shows there are increasing trend of productivity over time. The food sufficiency to the family varies from household to household. The surplus condition has increased from 4.69% to 17.19%. The improvement in deficit condition has not decreased much as it was 64.06% in 2001 while it was only 54.69% in 2011. Consumption of some items also increased over time while locally prepared or produced items were being in the verge of replacement by new item. Income from farm activities and off-farm activities were also increasing in addition to increasing pattern of expenses. The spending capacity of farmers was increased over time. In the command area, there are visible changes before and after the irrigation scheme. Therefore, such interventions must be made in appropriate areas where livelihood really can have visible impacts.

State and Services of Private Water Tanker Operation in Kathmandu

Shrestha Dibesh; Upadhyay Surya Nath; Shukla Ashutosh

A spectrum of market solutions to water scarcity have emerged in Kathmandu, which range from local level water vendors to tanker water supplies and bottled water manufactured by water bottling industries differentiated by volume of water handled, size of business and complexity of technology and kinds of consumers served. The volume of water transaction by the tanker operators started escalating rapidly after 2000 due to water shortage. Considering ever increasing volume of water transaction by the tanker operators and their increasing roles in serving the water needs of spectrum of consumers in Kathmandu, it was found important to look into the mode of operation and tanker business, water and monetary transactions associated with the tanker water supplies and the perspectives of the consumers served by the tanker operators. It was in these premises that this study was undertaken in two most urbanized areas in Kathmandu Valley- Kathmandu Metropolis and Lalitpur Sub-Metropolis, with the aim of documenting and analyzing the state and performance of water tanker operation and their services to different groups of consumers. The methodological tools employed in the study included observation of water tanker operations from different locations, semi-structured interviews with the tanker entrepreneurs and the consumers served by them.

The study revealed involvement of several actors in the chain of tanker water supplies, with the water source owners and water extractors operating at the level of water source to water tanker operators and small scale intermediary water vendors who deliver water in smaller quantities based on the needs of the consumers. Majority of water extractors had been using dug-wells, shallow and deep boring installations, depth ranging from 6 m to more than 200 m, with simple water treatment plant or without any treatment. Besides, water quality tests conducted at water sources in different locations revealed contamination of faecal coliform, *E. Coli* and minerals as ammonia, iron beyond permissible limits that defies National Drinking Water Quality Standard. It was estimated 700-800 number of tankers of various sizes being operated on the streets of Kathmandu Valley. The tanker water operation was found to be dependent on the season: the tanker water transaction was found to reach to the peak for five months from February to June. The volume of water transaction by the tanker operators was estimated to be 25.58 MLD (million liters per day) in peak (dry) season and 15.36 MLD in off-peak season, together accounting to 7.06 million cubic meters of water annually which accounts to be 8% of the then water demand of 320 MLD. Of this water supply by tankers, more than 90% was estimated to be extracted from groundwater resources. The average price of charged to the consumers for tanker load of water was found to range from NRs. 1,300.00 for 6000-7000 liters tanker to NRs. 1811.00 for 12,000 liters tanker. Water tanker price was 4 to 5 times higher than the piped water supply of Kathmandu Upatyaka Khanepani Limited (KUKL), for the same volume. The rate of return on the capital investment was 36.3 % for the tanker size 6000/7000 liters if all the investment made by the entrepreneur without outstanding loan. Increasing acceptability and satisfaction water quality provided by tanker water was noted among the consumers. The study showed the increasing acceptability for tanker water supplies and willingness to pay for higher cost for tanker water supply; which signifies that the residents of Kathmandu shall be ready to pay higher tariff for KUKL's water supply provided the reliable water services by KUKL.

Study of Effectiveness of Water-Induced Disaster Risk Reduction Initiatives by INGOS

Manandhar Eva; Shrestha Hari Krishna; Sherani Ghulam Mohyuddhin

Water-induced disasters are the most common type of disasters in Nepal. Every year the country bears a lot of losses of life, property and infrastructures due to such disasters. Disasters risk has increasingly attracted global concern as they are directly related to development process. For this, a world conference on disaster reduction was held in Kobe, Hyogo, Japan in 2005 and adopted Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. As Nepal is one of the signatories of Hyogo Framework for Action, various works have been done by government as well as non-government organizations for fulfilling the commitment. Still, the impacts of disasters have not come to a manageable limit. This connotes that the approaches adopted are not up to the mark. Disaster risk reduction (DRR) needs a holistic approach to address the related aspects. This study aims at developing a way of assessing whether or not these organizations have carried out water-induced disaster risk reduction works in a holistic approach. The way of assessing the effectiveness of the works is developed in the form of a matrix, named as Effectiveness Measurement Methods (EMM). This matrix has aimed to quantify the works done by the organizations for water-induced disaster risk reduction (WIDRR). EMM was prepared by exploring the ways used by the organizations to assess their works and studying similar ways for assessing the works for DRR in the national and regional scale, such as Hyogo Framework for Action and Twigg's document of Characteristics of Disaster Resilient Community. The matrix has used five priority actions, i.e. institutionalizing disaster risk reduction works, enhancing early warning, preparation and use of knowledge base, relating development to disasters, and strengthening disaster preparedness, for weighing the works. Each of the priority action was further divided into specific indicators.

The matrix thus prepared was used to assess the work of two International Non-government Organizations (INGOs), Practical Action (work area: Nawalparasi district) and Oxfam GB (work area: Rautahat District). The scores were given to each of indicators as per the response of the beneficiaries during focused group discussions. The learning of the field works were also used for improvement of EMM. The field works revealed that the INGOs still have matters to work upon for WIDRR and also there are regions to work in more sustainable ways. As the matrix is able to include small details needed to be addressed for WIDRR, it is a useful tool to assess the works objectively in micro-scale work area, and with further improvement, it could also be used in larger scale by including required indicators as per the scope of the study area

Traditional Practices and Knowledge System in Integrated Wastewater Management in Kathmandu Valley: Case Study of Khokana Village Development Committee

Shrestha Jagam; Shukla Ashutosh; Dongol Robert

The problem of wastewater management in Kathmandu has been aggravating each day due to ever increasing production of wastewater with the expanding urban population and inabilities of the municipal and government agencies in expanding the sanitary sewerage systems to newly developed areas. Large centralized wastewater treatment plants have largely failed in addressing the problem of wastewater management in Kathmandu. It is established that sustainable wastewater management cannot be achieved through newer technology alone unless social issues are addressed and incorporated in its design, operation and management. Therefore traditional practices and cultural aspects of wastewater management need to be studied to understand the perception and practices of communities to wastewater and its management. This study was undertaken with the aim of documenting the traditional practices of wastewater management in Khokana of Lalitpur District and analyzing the value of promoting the traditional practices of wastewater management in the present context. The changes in the practices of wastewater management and peoples' changing perception were documented through household survey and participatory inquiries involving key informants' survey and Shared Learning Dialogue. Laboratory analysis was carried out for wastewater quality in the traditional systems, and compared with the modern system of wastewater management.

The study documented three systems of wastewater management existing in the study area: i) stand-alone system with individual household responsible for collection and disposal of wastewater, ii) community system with wastewater irrigation integral to wastewater management, and iii) community system with ponds integral to wastewater management. A very important element to traditional wastewater management systems observed was possibility of recovering water and manure that have important role in farming in maintaining agricultural production. *Sagaah* (Wastewater collection pit) was found in traditional households where all the grey water produced in kitchen and in sanitary uses together with organic wastes produced in the households are conveyed and dumped for composting. Annual removal of the sediments deposited in the beds of the ponds and the drainage channels used as soil conditioner in the farm lands. Wastewater irrigation, as another resource recovery, provided reliable irrigation in approximately 20.3 ha of agricultural land. Modern technology intervention such as piped drinking water, construction of pit latrines and changes in water use behavior were identified to change traditional wastewater management practices at the household level. Though, increased investments on educational attainment, construction of modern sewerage and increased awareness of the people on health and sanitary practices had reduced water-borne diseases and uplifted the environment to dwell in, but failed to recognize waste as resource that were being practiced in the local community for generations. Water quality analysis carried out in two traditional systems showed their effectiveness on removing harmful pathogens and contaminants when managed properly. The study revealed importance of looking into the traditional wastewater management systems and practices and their integration with the modern system in attempting to develop sustainable system of wastewater management in the context of the study area and promotion in other parts of Kathmandu.

Socially Differentiated Responses to Water Scarcity and Adaptation Strategies in Urban Areas: A Case of Sankhamul, Kathmandu, Nepal

Adhikari Muna; Udas Pranita Bhushan; Janwilliam Liebrand

Drinking water scarcity has become major problem in Kathmandu. The rapid growth in population and urbanization has resulted in high demand for water but the city water supply is not sufficient to meet this increasing demand. The unit responsible for the water supply services of valley, Kathmandu Upatyaka Khanepani Limited (KUKL) has started rationing the water supply in the metropolis area because of its limited capacity. Water is supplied by KUKL on every sixth day to most localities in the core area of Kathmandu and only for very short period. The continued failure of the city's water supply system to meet the needs of the majority of the people, have forced many people to search and adapt to different coping strategies. In the context of acute shortages of water for drinking and other household needs experienced by many people living in urban areas of Kathmandu, this study has looked into the coping behavior and strategies of the people who experience water scarcity. The study has compared and analyzed the coping behavior of the people of different social strata with special focus on income levels, ethnicity and gender.

The impact of water scarcity are not homogeneous within a society, it varies from person to person, i.e. it has differentiated social impacts based on gender, age, disability, ethnicity, geographical location and many other factors so this problem must be addressed differently. For this identification of differentiated response is necessary, which is the objective of this study. This study was conducted in two stages- one is exploratory phase which includes observation, informal talks and questionnaire survey and other is case study. The study revealed different methods the people of this area adopted to get adjusted in such supplied water deficient condition. Among them the major strategies were the search for alternative sources, conjunctive use of water from different sources, restarting the use of traditional sources like stone spouts and shifting rented houses. Some of the people were found buying tanker or bottled water also, and many families were found using one common source of water. Many people have changed water use behavior which was observed through their food habits and choice of clothes. But these strategies differed from person to person, or it can be said from group to group based on income level, ethnicity and gender. The study finally opens the door for further research- Are these adaptation strategies sustainable?

Evolution of Groundwater Market in Kathmandu Valley: Analysis of Actors, Market and Regulations

Bajimaya Shreya; Gautam Upendra; Shukla Ashutosh

Denizens of Kathmandu have been resorting to alternatives based on their own capacity and resources to meet their water need. This has created an avenue for the entrepreneurs to invest for groundwater market in Kathmandu Valley that involves different scales of business, sophistication and the actors. As such, the extraction of groundwater in Kathmandu Valley has been spontaneous and irrational. A rational approach in responding to these issues must begin with an understanding on the evolution of groundwater market in the Valley and state of existing regulatory provisions and their adequacy. Therefore, the study was carried out to study the characteristics of the groundwater markets evolving, forces responsible for its expansion, the actors and transactions involved, the consumers served by them, perspective of the water entrepreneurs, the state and the water service providing agencies, market's contribution in easing water scarcity and above all, use it as a basis to analyse existing regulatory provisions and to assess the role of the state in regulating groundwater market as well as recommend the essential elements in regulatory provisions related to groundwater market. Different research tools such as reconnaissance survey, semi-structured interviews and key informant's interviews were used to trace out the locations and understand the market mechanisms of groundwater market operating at different scales along with intensive review of secondary information and in-depth case studies to substantiate the information and document the characteristics of groundwater market.

This study identified three forms of groundwater market being operated at different levels based on the volume of water transactions involved and level of investment made in the development of infrastructures and services for water extraction, storage and distribution: i) 87 Small Scale Groundwater Vending being operated in Kathmandu Metropolis, ii) 41 community owned Community Based Groundwater Market in Kathmandu Metropolis and Lalitpur Sub-metropolis; these two levels of market were found to be addressing low-income residents of the valley by selling small quantity of water needed for consumers on daily basis and at acceptable price and iii) 30 Commercial Scale Groundwater Market being operated in the outskirts of the valley largely in the form of private water tankers. The investment scale in commercial scale groundwater market mechanism based on private water tankers is high compared to level of investment in former two water vending. Groundwater market at commercial scale was found to be constant in past two years while small scale and community based water vending were observed to be increasing rapidly over past two years. The reason is high profit margin except in case of community based groundwater vending where prime motive is to serve the community people. Besides, increasing water shortage, presence of groundwater potential zones, absence of implementation of regulatory provision in relation to commercial use of groundwater and acceptability by consumers despite of the high price charged by water entrepreneurs are the other factors that are responsible for expansion of groundwater market. Contemplating the current escalating trend of water market, it becomes essential to scrutinize the issue of sustainability of groundwater resources. Neither these flourishing groundwater market cannot be completely abandoned in realm of services provided nor can be encouraged arbitrarily looking from the perspective of sustainable use of groundwater resources.

Changing Pattern of Water Flow in Manohara River and the Livelihood Adaptation Strategy of People to that Changes

Byanju Rojee; Shrestha Hari Krishna

The Manohara River is the source of livelihood for people living along its basin. The ongoing changes in the land-use like conversion of forest to agricultural land, agricultural land to residential plots and bituminous road, etc have severe impact on river flow. These changing land-uses are playing vital role in changing the water flow pattern of Manohara River in various time periods. The changing water flow pattern is also generating the fluctuation in agricultural income of the people who directly or indirectly depend upon Manohara River for fulfilling irrigational water requirement.

The present study was conducted in Manohara River Basin with focus on agricultural livelihood. Different software like SWAT and ArcGIS Map were used to estimate the changes in river water flow in the Lapsephedi watershed which is a sub-catchment of Manohara River Basin. The agricultural livelihood study was carried out using sociological tools such as Focused Group Discussion and Key Informant Interview. These tools were applied in remaining portion of the study area i.e. downstream from outlet of Lapsephedi Watershed to the Puranothimi area in Manohara River Basin. Hydrological and meteorological data for three different periods 1979 to 1990, 1995 to 1997 and 2000 to 2006 have been used in SWAT for the simulation purpose. The output of the SWAT shows the negative slope of mean monthly discharge indicating the decreasing pattern of river flow. The decreasing depth of river water due to excessive extraction is the result of changes from Manohara River. Thus, the continuous declining of river flow has made the people to change their agricultural pattern which thereby affect their economy. The mechanism of extracting groundwater for irrigation purpose as well as directly pumping water from Manohara River prevails in this basin. So, people are now adopting the crops that demand less water, using chemical fertilizers, shifting their means of livelihood from agriculture to business, government and non-government services, labour works, etc so as to maintain their living standards.

Household Drinking Water Management in Squatter Settlements: A Comparative Study of Microbiological Contamination between Source and Point of Use

Lamichhane Samjhana; Tuladhar Bhushan; Manandhar Lajana

Water quality can change during the course of water collection, transport, and storage with the possibilities of increase in the contamination. This study aimed at identifying critical points of contamination, the reason behind such contamination and to find out the impacts of awareness/intervention programs on the water contamination by comparing the old intervened settlement (Buddhamarga tole, Shankhamul) with the new non intervened settlement (Paurakhi basti, Thapathali). In total, 66 households were visited, and 158 water samples from their current sources of water, transport vessels, treated water, and drinking vessels were analyzed. The quality of water was assessed using *Escherichia coli* as an indicator organism for faecal contamination. The female head of the household was interviewed where possible and information recorded on demographics, hygiene practices, sanitation facilities and water collection and storage practices, participation on intervention programs, knowledge of diseases. Water source quality analysis showed 25.8% had no coliform detected; remaining sources had coliform count more than 1 CFU/100 ml. At the point of use except 7 samples analysed, remaining are contaminated with coliform, the degree of contamination however varied from houses to houses. Hence the quality of water at the point of use has deteriorated than the quality of water at the source. The arithmetic mean *E. coli* load was 14 CFU/100 ml at the point of distribution, rising to a mean count of 408 CFU/100 ml at the household level.

Significant relationship was detected between the participation in awareness program and the water treatment ($\lambda^2=7.508$, d.f.=1, $p=0.008$). The chi-square test detected significant relationship between the water quality at the point of use and the economic status of the people ($\lambda^2=10.344$, d. f. =3, $p=0.016$). The socio economic factors and the participation in awareness/interventions program have positive changes in the quality of water at the point of use. These results are consistent with other studies that demonstrate substantial levels of fecal contamination of even safe water during collection, storage and access in the home. They point to the need to extend drinking water quality beyond the point of distribution to the point of consumption. The research pointed the need to extend drinking water quality beyond the point of distribution to the point of consumption. Simple intervention strategies would be helpful in order to improve the hygiene behavior, water handling pattern, purification of water to reduce the contamination at the point of storage and in overall improvement of health. And such interventions must focus on helping the poor to adopt healthier behaviors by removing the socio-economic and political barriers.

Competition for Groundwater in Agricultural, Industrial and Domestic Uses: Case Study of Jhaukhel Village Development Committee, Bhaktapur

Dahal Shankar; Shukla Ashutosh; Dongol Robert

This study was undertaken with the aim of documenting and analyzing groundwater extraction to meet competing uses of water among different groups of users and the resulting consequences in Jhaukhel Village Development Committee (VDC) in Bhaktapur District. The aim of the study was to understand the dynamics of contestation and conflict emerging from groundwater extraction. The study involved mapping of groundwater extraction and use among different groups of users based on the information collected from primary and secondary sources. The study mapped 98 spots of groundwater extraction in two wards- Ware Nos. 7 and 8 in Jhaukhel VDC.

The study noted accelerated increase in groundwater extraction over past one decade. Four types of users were identified to be involved prominently in groundwater extraction- i. domestic users, ii. Commercial extractors selling untreated water to the water vendors, iii. Water bottling industries and iv. Brick kiln operators. Except this people also use the groundwater for irrigating agricultural field if needed. Brick kiln entrepreneurs were the first to invest in developing bore wells in the private land to be able to extract water to meet the water demand for brick making during 1990. Seeing the possibility of groundwater extraction other groups of users started investing in the development of shallow and deep wells. The daily volume of groundwater extracted and sold by the commercial extractors and was estimated to be 0.225 million liters per day. If groundwater extracted by the water bottling industries, brick kiln operators and domestic users are added to this, the amount would become significantly large. The pressure on the groundwater extraction in the area was noted to have produced due to urban water demand. Rapid rate of extraction of groundwater in the area has started producing visible consequences, which are apparent in terms of depletion in the groundwater table rendering many shallow wells going out of function and also drying of several community water systems- stone spouts and springs. The domestic users of groundwater and those depending on community water systems were noted to be on the losing end due to increased extraction of groundwater. The study noted 'anarchy' in the groundwater extraction in the absence of regulation of any form putting limit on the extraction and use of groundwater in the study area. Contrary to this, people in the area were found campaigning against unregulated groundwater extraction. This has resulted to an agreement developed with the consensus among different groups of actors, involving VDC office, local political entities, commercial water extractors and domestic users, to start regulation on groundwater use in the area with the VDC office having active role in the process. Though the effectiveness and outcome of the regulated groundwater use is yet to be seen, this is a positive initiative in the area.

Inter-Linkage between Groundwater and Surface Water Sources along Dhobikhola River Corridor and its Health and Livelihood Implications

Maharjan Shovana; Karmacharya Amresh Prasad; Dongol Robert

Emerging trend of groundwater exploitation was noticeable in Dhobikhola River Corridor which has gradually converted into a sewer drain. It is because the surface water and groundwater are interconnected resources and their occurrence is linked to the hydrologic processes at the local level. Depending upon the hydraulic effect, groundwater may supplement water to river as well as surface water may replenish water to nearby aquifer. In such condition, if river water is polluted, then there is higher probability of groundwater being contaminated. Consumption of such water may cause negative effect on health. River water and groundwater within 100 m buffer on both sides of the river at various zones were analyzed along with the household survey. The study carried out along the Dhobikhola River corridor showed that the river is highly polluted as it flows down the course. The groundwater samples were also found contaminated. Due to hydraulic effect of the river coupled with the hydro geological formation of the area, polluted river water has higher probability to percolate into shallow groundwater aquifer. Along with this, external factors found for groundwater contamination are leakage of leachate from solid waste, infiltration and percolation of contaminants and chemical fertilizer from upper surface. About 53% of the groundwater samples collected during all seasons contained fecal coliform, which was counted in number above 8000 CFU/100 ml. Only one sampling site contains zero fecal coliform during all sampling season. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), nitrate, ammonia and iron exceed the WHO water quality guidelines. Fecal coliform level was found higher in Dug well than in other sources, which may be because wells are only occasionally covered and the unhygienic practice of people around well. A weak relationship between groundwater and surface water has been observed in the study; however, the higher permeability and transmissivity of the land surface along Dhobikhola River may have created avenue to replenish the aquifer with river water. On an average, people living along Dhobikhola River extract 1091.91 liters of groundwater daily to supplement the water needs. People are extracting more groundwater and their dependence is increasing as it is more cost effective than buying private water tanker for water in the study area. No health impact due to groundwater use have been reported from the people.

Drinking Water Contamination Linked to Handling and Consumption Behaviour at Household Level in Dharan Municipality

Bhattarai Ujjwal; Rajbhandari Kabir Das; Dongol Robert

In the absence of water safety plan, although the water may be supplied well treated at the treatment plant, it might be highly contaminated at the supply point due to recontamination in the distribution points and handling behaviours of the household members. This study aimed to identifying critical points of contamination and the behaviour that could have led to this contamination. The comparative study among the agency supplied system (NWSC) and community managed systems (KTSUS and JDWSG); and among the households collecting water from private taps and public taps was also done. Moreover, the effect of scarcity of drinking water and awareness programs was also tried to find out on the household drinking water handling and consumption behaviour. Water quality at the intake, reservoir, treatment plants, distribution points, storage vessels and consumption vessels were analyzed. The quality of water was assessed using fecal coliform as an indicator. Household survey, focused group discussion and participant's observation were conducted.

The water contamination was found to occur in many distribution points, even though the quality was good enough at the treatment plants and reservoirs of the drinking water supply system. However, this was the case only for the Agency supplied drinking water systems. For the community supplied drinking water system, due to the lack of proper treatment system, the quality of drinking water at the distribution points were comparatively poorer than that of Agency supplied system. Inside the house, water contamination was found to occur from source to storage vessels but only for those samples which had zero coliform in the source. When the source itself was highly contaminated, it was found that the level of contamination rather decreased from source to the storage vessel. Similarly, the level of contamination increased from storage vessel to consumption vessel in the absence of point-of-use (PoU) treatment, which was found effective and efficient. Narrow mouth vessels were found to be more effective in lowering the likelihood of contamination and thus maintaining better microbial quality of water than the wide mouth vessels. Similarly, it was revealed that the practice of pouring or using extraction utensil to draw needed quantity of water from the storage vessel maintained better quality of water than the practice of dipping the consumption vessel into the storage vessel for water extraction. Among the various types of consumption vessels, use of steel glasses and plastic bottles possessed higher risk of contamination than ceramic and mud cups. High risk of contamination in water at the storage and consumption was noted among the households who belonged to poor or very rich income categories. Similarly, the level of contamination resulting from water handling practices was found to be high among those households where family members involved in water handling were illiterate or had lower level of educational attainment.

Review of Performance of Institutions and Management of Deep Tube Wells Irrigation System between Buried Distribution Pipes and Open Channel Flow in Bhairawa-Lumbini Groundwater Project

Regmi Arun; Sharma Khem Raj

Irrigated area in 2010 by underground sources is four times greater than the surface sources and about five times target set for the second interim plan (2010/11-2012/13) clearly showed that the groundwater exploration for irrigation was being the central for the irrigation development in Nepal. In addition, policy of the government has emphasized the construction of new tube wells rather than investing on transferred tube wells system. It is in the context that the largest groundwater irrigation projects- Bhairahawa-Lumbini Groundwater Irrigation Project (BLGWIP) was chosen for the performance review of institutions and management of Deep Tube Well (DTW) irrigation system. Some of the tube wells are only depending up on artesian and some of them have already gone to non-functioning stage, the study tried to capsule all the different stages of the tube wells in the project's command area. The research comprised non-functioning open channel system of *Sakhuwani*, functioning open channel system of *Bihuli*, buried pipe distribution system (using artesian only) of *Nagasthan*, and completely non-functioning staged tube well of *Guljarnagar*. The study surrounded upon the comparative performance of tube well from non-functioning to functioning-staged tube well so that overall picture of the running trace can be understand. The study involves extensive study of literatures on ground water irrigation, conduction of questionnaire relating to deep well users of head, middle and tail regions of the command area taking 15% sample size for simple random sampling, focus group discussion with the committee members, and long discussion with agency personnel of BLGWIP.

It is realized that the farmers exercise their own institutions and search the way which include the minimum expenses on operation of the tube well system. If at higher altitude the valves are located, farmers have to be deprived from artesian flow (at higher altitude low artesian availability) and if it is kept in lower altitude, it is not possible to irrigate the land of higher altitude. It eventually lays the foundation for the proliferation of the alternative sources like diesel pump. The study also concluded repair of sudden engineered structures crossing bridge for example, over rivulets in distribution system, if not provisioned by government or respective organization, farmers have to be deprived from the DTW's irrigation, and hence they are forced to use expensive alternatives. Complete use of artesian water should be considered during the estimation of water charge collection from the pumped water before handing over the system to the local farmers. Farmers should be trained in relation to the protection of physical assets like transformer and equipment inside the pump house or respective organization should keep their own operator for the protection and operation of the pump upon the consent of local farmers. Once the system goes complete non-functioning stage, as soon as possible two ways meeting should be hold upon the participation of local farmers and respective organization for the current inventory of assets and further solution. Performance of institution and management of tube well can be effective only in those tube wells where there is no or very less availability of artesian and no cheaper alternatives sources of irrigation.

Assessing the Water Scarcity of Panchkhal Village Development Committee and Quantifying Water Requirement of Crop for Better Management

Subedi Aasha; Upadhyay Madhukar

Water is the primary medium through which climate change (CC) will impact people, ecosystem and economies. Water scarcity can impede development, food security, and human welfare and ecosystem services. Physical water scarcity will cause challenges for a developing and a mountain country like Nepal where its economy is substantially supported by agriculture. The concept of green water was first introduced in 1990s. However, it has not been extensively used in Nepal and it still considered as new concept in Nepal. This paper is just a realization of the fact that rainfall being the major source of irrigation, rainfall is still considered as a neglected resource. This thesis has tried to explore the adversity of climate change in water resources of the study area Panchkhal VDC. It has also tried to calculate the and also suggested some measures to reduce the ill effect less rainfall. Panchkhal lies in rain shadow area and receives less rainfall. Moreover climate change is accelerating the situation and Panchkhal is now not receiving the annual average share of the rainfall. Considering river water only as a source of irrigation has worsened the situation. Panchkhal is now trapped with less productivity.

The survey within Panchkhal VDC showed that people are convinced that temperature is changing and Panchkhal is not getting the share of rainfall it used to have in earlier years. The annual production is also decreasing. The annual rainfall pattern of Panchkhal (20 years data) shows the decreasing rainfall pattern. The ill effect of decreasing and irregular rainfall is already seen in agriculture of Panchkhal. Delay in rice plantation, insufficient irrigation, dry seeding of rice are major changes in Panchkhal. However, it was observed that people are more concerned in irrigation and bringing water from distant source rather than conserving rain water. The calculation of water footprint for rice potatoes, wheat and maize was done. The water footprint of Panchkhal shows that water requirement of Panchkhal higher than share of water it receives. So, unless some management measures are taken, water will become scarce resource in Panchkhal. Rainwater harvesting is the major step that should be considered in Panchkhal. The myopic focus of water resources management on blue water alone needs to be replaced by an approach to manage the complete water cycle, including both green and blue water. Traditionally, what is defined as renewable water resources is only that share of rainfall that runs off into rivers or recharges the groundwater. Thus use of green water in agriculture spares blue water and thus, helping to manage freshwater resource to meet domestic and other demands and that sustains aquatic ecosystems in rivers and lakes.

Emerging Trends in Groundwater Exploitation and their Impacts on Equity in Access to Drinking Water Supply among Various Communities in Jhaukhel Village Development Committee, Bhaktapur District, Nepal

Karki Kanchan; Kansakar Dibya Ratna

Groundwater is the only source of water for the people of Jhaukhel Village Development Committee (VDC), Nepal. Traditional groundwater sources like natural springs, stone water spout and dug wells are the common water systems fed from groundwater to meet the needs of the people in the VDC. The only piped drinking water scheme, the Changu-Duwakot-Jhaukhel community drinking water scheme, derives its supply from groundwater by lifting water from Manohara well field. Recent reports suggested unequal access to different communities of the study area and also cases of new trends in groundwater exploitation have been reported. As such, this study was carried out with the help of field visit, questionnaires and focus group discussions. It was found that Brahmin and Chhetri communities had higher level of access to this supply system compared to Newars, Janjatis and people belonging to Dalit communities. Privately owned groundwater sources like dug wells and tube wells were common among the Chhetri households. Although Newars were majority, they were noted to have lower level of access to the piped supply system and were dependent mostly on the community groundwater sources.

Along with domestic water need the use of groundwater in irrigation, industrial use (in brick kilns) and commercial use (tanker business and water bottling plants) were noted to have rising trend. Brick kilns were estimated to be extracting around 90 million liters of groundwater annually for the production of bricks. Similarly, around 90 million liters of groundwater was estimated to be extracted by the commercial water extractors for sale in the urban areas in Kathmandu and Bhaktapur districts. The total annual extraction of groundwater, inclusive of domestic demand and demands in the brick kilns and commercial water extraction was estimated to be 333 million liters per annum which was excluding the water extracted for irrigation uses. Availability of groundwater for irrigation in the area has increased the possibility of commercial vegetable cultivation to meet the urban needs. As a result, the area under groundwater irrigation has increased in the recent times, which has also increased the rates of groundwater extraction. Sand mining in study area was noted to be continuing since early 1990s. Extraction of sand in several patches was found continuing. Extraction of sand from deeper layer was found to be resulting to removal of aquifer materials, expected to produce negative consequences to groundwater recharge in the area. Visible consequences of sand mining, resulting to either depletion of volume of flow or drying of spring sources and water spouts were noticeable. Extraction of significant amount groundwater for commercial and industrial uses and unsustainable practice of sand mining was noted to causing negative impacts on the groundwater. If this trend of groundwater exploitation is continued, this would affect the local people who depend almost exclusively on community groundwater sources to meet their domestic and irrigation uses. Most of these people would be those belonging to Newar and Dalit communities. The study concluded the need of promoting regulated use of groundwater and increasing the vigilance and monitoring of groundwater use to ensure sustainable use.

People's Perception on Agricultural Water Security Emerging from Climate Change and Urbanization in Kathmandu Valley

Maharjan Monica; Shukla Ashutosh

It is well perceived that climate change and urbanizations adversely affect the agricultural water security. The rate of urbanization of the Kathmandu valley is rather high, and it is in this scope that a study was carried out to analyze the changes in the availability of water for agricultural uses in selected peri-urban areas of Kathmandu, emerging from climate change and urbanization. For this, Matatirtha and Lubhu which were considered representative to the peri-urban context and dynamics in Kathmandu valley were selected. The study involved two simultaneous approaches in the analysis of trend and variability in climate: (a) analysis of observed climatic data recorded at the most representative meteorological stations (Godavari, Khumaltar and Naikap), and (b) documentation and analysis of peoples' perception on changes in climate and the consequences on available water supply and agricultural practices at the local level. Linear trend analysis was carried out to establish the trend in rainfall and temperature (maximum and minimum). The perceived variability in climate was recorded by conducting Focus Group Discussions (FGDs). At each site separate FGDs were conducted with male and female respondents in order to generate gender segregated perception on climate change and adaptive practices of the people.

Large spatial differences were found in the mean annual and monthly rainfall across the three meteorological stations despite their location within the same geographical space and over short distances. Also, large temporal variability in rainfall was observed across the stations. However, no significant trend was noted on annual and monthly rainfall records. The number of extreme rainfall events, exceeding 50 mm/day, was found to have increasing trend at Godawari station. Contrary to rainfall, increasing trends were observed for both maximum and minimum temperatures. The number of days below 0°C (frost days) and the number of hot days with daily mean temperature exceeding 30°C showed increasing trend. The analysis clearly revealed warming trend both in summer and winter months. Variability in temperature perceived by people in the study areas matched with the trend analysis made however the perception of the people on the monsoon and winter rainfall contradict the observed variability and trend in rainfall. Springs and spring fed streams in the Lubhu and Matatirtha were found drying up. The occurrence of frost and fog was found decreasing. Less dependable onset and cessation of monsoon rainfall perceived by the farmers have brought changes in the crop calendar and crop cultivation practices to match with the uncertainty in the monsoon rainfall pattern. Increase in the incidences of insects and weed species were perceived by the farmers at both locations which they attributed to increased temperature and reduction in the available supply of water for irrigation. Increasing preference for the cultivation of vegetables instead of traditional cereal crops was noted across the two study areas, which was due to higher economic incentive with the cultivation of vegetables than the traditional cereal crops. Urbanization was noted to have dominant effect on agricultural water availability. Increasing warming trend and lack of initiative in the conservation and management of local level water resources was noted to further complicate the water security situation for agricultural uses in the peri-urban areas in Kathmandu. The study concluded need of policy focus on peri-urban agriculture with agricultural water security in the peri-urban areas getting special focus and development attention.

Impact of Climate Change on Variability of Water in Upper Kabul River Basin and Its Livelihood Consequences

Reshteen Sediqullah; Shukla Ashutosh; Mahat Tek Jung

Water resource is the hardest hit sector by climate change, and the upper Kabul river basin is no exception. Recent reports suggested marked variations in the water availability of the basin and its impact on livelihood of locals has been well covered in reports and media as well. It is in this scope that a study was undertaken with an attempt to look into variability in water resulting from climate change in the upper Kabul river basin and identifying the consequences to the livelihood of the people living within the basin. The study used long term temperature and rainfall records of the period 1957-1978 and 2003-2010 for Kabul airport and the stream flow records from Tang-i-Gharu from 1960-1980 and 2005-2008. The livelihood consequences to the people living in the basin were inferred from the review and analysis of secondary sources of information because it was not possible to conduct field survey due to deteriorating security situation in the study area at the time of this study.

The study revealed departure in the monthly temperature pattern observed for the period 2003-2010 than those for the period 1957-1978, which showed warming trend though the rates of warming was noted to be higher during spring season (March-May). The mean annual temperature and mean minimum temperature showed an increasing trend in the basin with the rate of increase of 0.096°C and 0.112°C per annum respectively. The trend of increase in the minimum temperature of day was noted to be larger than the mean temperature for the day. Increasing trend in all the four seasons with more convincing trend in spring and summer seasons was observed, similarly, increasing trend in mean and minimum daily temperature was more convincing than the increase in the maximum temperature of the day in all the seasons. The trend of increase in the mean daily temperature across the four seasons was noted to be 0.089 , 0.102 , 0.069 and 0.094 $^{\circ}\text{C}$ per annum for winter, spring, summer and autumn seasons respectively, with the mean of the temperature increase in the four seasons to be 0.088 $^{\circ}\text{C}$ per annum. This is close to the increasing trend of 0.096 $^{\circ}\text{C}$ per annum noted in the mean annual temperature. The analysis of rainfall revealed decline in the annual rainfall amount by 0.279 mm per annum. Again the rate of decline in the spring rainfall was noted to be larger (1.115 mm/annum) than winter rainfall (0.127 mm/annum). Decline in the spring rainfall has serious implication to water availability in the basin because spring season extending from March to May is the major period of rainfall in Afghanistan. The analysis of stream flow records at the gauging station revealed decline in the stream flow at the rate of 0.538 m^3/s per annum. Although rainfall variability in the rainfall alone is insufficient to explain the decline in the stream flow, this has nevertheless important input in maintain the hydrology of the stream flow. The most important consequence resulting from climate change on livelihood is expected to be on the already stressed out water supply system of Kabul city. Shift in the peak flow of Kabul river due to early snow melt as a result of temperature increase was noted which would be crucially linked to groundwater recharge and thus maintain groundwater for sustainable use. The study also noted decisive effect of temperature and rainfall changes on cropping system and crop productivity. The study noted that maintaining the balance between supply and demand would be crucial to responding to the variability in water emerging from climate change. This will require improvement in water infrastructures and services together with the improvement in the water use efficiency. This will ensure economical use of water in the basin while attaining high productivity.

Analysis of the Provisions under the Gandak Treaty and the Associated Local Movement

Sharma Shristi; Upadhyay Surya Nath; Pokharel Dina Mani

Amongst many bilateral treaties between Nepal and India on sharing of water resources, the Gandak treaty was signed in December, 1959 for the execution of a project called the Gandak project. In this scope, this research analyses the various provisions articulated under the Gandak treaty and the associated local movement in the Gandak project. The study was conducted in the six affected Village Development Committees (VDCs) of Nawalparasi district in Nepal. Various literatures were reviewed and participatory tools of inquiry such as Focus Group Discussions (FGD) and Key Informant Interviews (KII) were organized to analyze the problem.

It was perceived that the provisions in the existing treaty are not reasonable and are not implemented as mentioned. Moreover, continuous problems of inundation, flooding and erosion persist, which had geared up the local movement in the project area. This study sheds light on the flawed provisions under the Gandak treaty, which includes the provision regarding water sharing, power development and navigation. The study concludes that the treaty was conceived, designed and implemented for fulfilling the irrigation needs of India only, whatever little benefits that are given to Nepal seem to have been given on the consideration of the land that was provided by the Government of Nepal (GoN) for the execution of the project. Lack of proper implementation of the treaty deprived Nepal from the little benefits that it should actually be gaining as per the treaty. In case of irrigation, the agreed quantity of water to the canal to feed the Nepalese territory from the Gandak river has not been provided. Failure in proper maintaining the infrastructure by the Government of India has created water logging and inundation every year in the project area. Due to this, there has been frequent local movement in the project area. The major actors involved in the movement and the process of mobilization of the people in the movement are also pointed in the study. It also attempts to highlight the outcomes of the movement and concludes that though the movement was able in signing the 21 points demand agreement, it was however not able to bring any changes in the Gandak treaty. This research suggests for renegotiation of the treaty in the present context by incorporating various factors such as the tenure of the treaty and principles of international law. Eventually, it argues that the problems caused due the Gandak project to the locals must be recognized at national level in both the countries.

Benefit Multiplication through Multiple Water Use System: Comparison of Single Functional and Multi Functional Irrigation System in the Mid Hills of Nepal

Gautam, Anand; Shukla, Ashutosh, Bhandari, Ram Prasad

In order to assessing the value of multiple use water service in producing multiple benefits by creating opportunity for improved livelihood of the users and contributing to irrigation system sustainability, the study involved comparative analysis of single and multiple use irrigation systems located in same geographic and socioeconomic context with similar development opportunities. Detail case studies were done on two irrigation systems i) Palung Khola Irrigation System (PKIS) – multiple water use services such as irrigation, operation of water mills and micro-hydropower, located in Chhisty Village Development Committee (VDC) of Baglung District and ii) Bhulke Pani Irrigation System (BPIS) – a single use water service located at Khadgakot VDC of Gulmi District. The analysis of the system sustainability against six selected attributes i) reliability of physical infrastructures, ii) responsive users' organization, iii) equity in the delivery of services, iv) connectedness of the system for external support, v) assurance of resources mobilization and vi) saving on cash for future expenditure were done.

More reliable physical infrastructure and more responsive user organization in PKIS have ensured reliable irrigation services than BPIS. The level of innovation in the choices of crops and cropping diversification was noted to be higher in PKIS. Higher production gains in PKIS was found attributable to more dependable irrigation services and innovations of the farmers in the adoption of improved crop cultivars and cultivation practices. Equitable irrigation services are pronounced in PKIS, whilst highly unreliable irrigation services exist in BPIS. The increased agricultural production was found translating to improvement of food security of the households in PKIS. The social and economic gains to the households were noted to be high in multiple systems in terms of increased access to information and communication, increase educational opportunity of children, reduced drudgery of women and improvement of homestead sanitation. The diversification of water use in the multiple water use was, therefore, noted to be possible with lower level of investment considering multiple services produced. Availability of electricity attributed on significant reduction on the consumption of kerosene for lighting at the households level. The savings created incentive for the household to invest in developing multiple use system. The study revealed the higher level of assurance in multiple water use system for continued operation and management of the system than in single water use system. This supported that multiple use system contributes positively to system sustainability.

Climate Change Impacts on Water Resources and Adaptive Strategies of Local People in Ghandruk Conservation Unit, Annapurna Conservation Area Project

Thapa, Lal Bahadur; Dongol, Robert

Climate Change is haunting countries from a distant with local level impacts on water resources sector which is directly linked with the tourism in Nepal. Ghandruk Unit, endowed with abundant water resources, is one of the most popular tourist destinations of the country, the need to assess the impacts of climate change on the local water resources triggered to develop understanding on how this phenomenon affects the local water resources. This study attempted to analyze the climate change pattern and the likely implications on the water availability as perceived and adaptation strategies followed by the local people. The study involved extensive review of literatures on climate change and resulting uncertainties on water and the adaptation strategies, trend analysis of 30 years period (1982-2011) meteorological data specific to the area (Ghandruk and Lumle Meteorological Stations) to assess the pattern of variation in the temperature and precipitation with best fit line. The study included semi-structure interview and focus group discussion to capture the people's perception on climate change and its associated impacts on water resources and strategies to adapt to changing climate.

Annual and seasonal temperature analysis at Lumle meteorological station showed increasing trend in mean temperature, annual maximum and minimum temperatures. In the realm of precipitation based on both the meteorological stations, the area still receives 80 % of the annual precipitation during monsoon season and the remaining is distributed over pre and post monsoon. Number of rainy days has gone down but the received rainfall volume is increasing indicating increasing pattern in number of extreme precipitation days. The dry spell during the monsoon and average precipitation has increased. These changes are found to be in correlation with the perception of the people. The number of drying springs, lowering of the dependable discharge in rivers and streams are the prominent local level impacts. The study also noted that the prominent water use area likely to be affected by climate change would be drinking water. The water induced disasters such as landslides and floods were frequent visitors, however the opinion such as climate change could have cumulative impacts on such disasters were documented from the people. People were found covering the water sources, taping and conserving water for future use, constructing water tanks, but these water management practices at the local level were found not well managed. The study clearly pointed the need of improving the existing water resources management in the basin in order to address the emerging uncertainty in the water supply. These local level initiatives need to be substantiated from the policy framework to ensure sustainable tourism in Ghandruk Conservation Area.

Local Adaptation Practices towards Water and Food Security resulted from Climate Change: A Case Study of Balkot Village Development Committee

Khanal, Rajeshwari; Shukla Ashutosh; Dixit, Ajaya

Balkot, a village in Arghkhanchi District, Nepal, was already a water scarce region and the consequences of climate change have further aggravated the scarcity of water faced by the people in the area. Subsistence farmers within the study area rely on rainfall for their agricultural production. In order to overcome such situation the people in the area were practicing spectrum of adaptive practices. This study: (a) explores the changes in the availability of water for domestic and agricultural uses as well as for food security due to climatic variability in the area; (b) attempts to capture the adaptive practices of the people in dealing with the scarcity of water. The study adopted focus group discussions and household survey as the methodological tools in collecting socially differentiated perception of the respondents towards climate change, changes in the availability of water for domestic and agricultural uses and their adaptive practices. Semi-structured questionnaire was conducted randomly to 5.4 % of farm households out of 933 households, divided into four strata – large, medium, small and landless farmers differentiated according to the landholding size. The study also comprised of analyzing observed climatic data recorded at Kanchikot climate station to establish the trend of temperature and rainfall considering more than 3 decades of observations (1977 to 2009 for temperature and 1971-2010 for rainfall records). Temperature records of the station were missing for 1990, 1998, 1999, 2000 and 2001.

Observed pattern and trend of climatic data revealed increasing trend in the maximum, minimum, and average temperature, both in the summer and winter seasons with the rate of warming higher in winter season. Similarly, observed trend of rainfall revealed declining trend in summer and winter seasons. This decline was noted both in the total amount of rainfall (1.8mm per year) and in the number of rainy days (0.19 days per year in summer and 0.13 days per year in winter). Farmer's perception on past 30 years revealed decline in the production of major crops and increase in the period of food deficiency nearly up to 8 months across the spectrum of farmers. Most farmers attributed the increase in the duration of food deficiency to increased uncertainty and variability in rainfall. In addition, increase in incidences of insects and pest, invasion of new weeds and fast growth in number of common weeds were revealed by the farmers, which were identified to be other reasons for decline in the crop yield. People of the area have been adapting to decline in the crop productivity by adopting high yielding crop varieties, inter-cropping of crops, conservation of residual soil moisture with the use of mulch and rainwater-harvesting for domestic and agricultural uses. The area has relatively lower level of access to the support services provided by the government agencies and development organizations. Such spontaneous adaptive practices of the local farmers are ineluctable for the understanding of conventional adaptation practices. Therefore, this study creates value for the understanding and developing local adaptation plan and action in building climate resilient society.

Irrigation System Performance of Mahakali Irrigation System

Adhikari, Ajay; Joshi, Naveen Mangal

Mahakali Irrigation System (MIS) is one of the large irrigation projects of Nepal in which Government of Nepal (GoN) has made considerable efforts in terms of technical and financial resources which targets to irrigate about 11,600 ha of Kanchanpur District. However, like other irrigation systems of the country, the MIS has not been able to harness its full potential. Overall cropping intensity of MIS is 189.77%. Major crops are monsoon paddy, wheat and maize. About 70 % of family members, 16-60 years age are involved in agriculture with only 47 % agricultural income of total income of a household. In this backdrop, this study presents physical, financial and production performance of the MIS. Irrigation Intensity and Relative Irrigation Supply were taken as physical performance indicators, while Effectiveness of Fee Collection, Financial Self-Sufficiency and Staffing Number per unit Area were taken as financial indicators. Finally, Cropping Intensity of major cereal crops, Output per unit area were selected as production performance indicators. Data were collected through household survey using semi-structured questionnaire, key informant interview and literature review. Irrigation Service Calculation of crop water requirement was done by the modified Penman's method.

It was found that the average irrigation intensity in the study area was 62.01%, which is lower than that targeted in the National Water Plan (NWP) which stands at 80 %, whereas the Relative Irrigation Supply values in every cropping season was found to be more than 1. This indicated surplus water which was rather not tapped. Average values of other indicators such as Effectiveness of Fee Collection Financial Self-Sufficiency and Staffing Number per unit Area were 40.63 %, 4.68 % and 0.027, respectively. The Effectiveness of Fee Collection and Financial Self-Sufficiency showed very low cost recovery, great dependency of the system to the agency for its operation and maintenance, and higher Staff Number per unit Area further increased operational cost of the project. Total cropping intensity of major cereal crops, in the command area was 177.14%, which is good against the targeted value in the NWP which stands at 129%. Average yield of paddy, wheat and maize was found to be 3.47 metric tonnes per hectares (MT/ha), 2.52 MT/ha and 2.08 MT/ha, respectively. However, maximum yield of paddy, wheat and maize of 5.30 MT/ha, 3.93 MT/ha and 2.33 MT/ha respectively was found in the study area. Performance from the farmers' perspective confirmed lack of water in terms of adequacy, equity and timeliness. Nevertheless, the water delivery record showed that there was adequate water being supplied to the field as compared to irrigation water requirement. Furthermore, surplus water was available for maintaining equitability within the MIS. Water management skill needed to be transferred to the farmers. Available water at border weir need to be divided between MIS, Stage I and II based on the area. It was suggested to form water user groups to distribute water based on rotational supply system in MIS, Stage I.

Local Level Impacts of Climate Variability in Ishaneswor Village Development Committee, Lamjung, Nepal

Subedi, Uttam; Sharma, Keshav Prasad

The study to determine local level impacts of climatic trend over last few decades on water availability and agricultural productivity, and thus to interlink these impacts with the human perception in the Ishaneswor Village Development Committee (VDC) of the Lamjung District was carried out, which consisted of two parts: (i) a hydro-meteorological analysis of 30 years climatic data and its associated impacts on water and food resources and (2) a study on human perception on climate variability and associated impacts on resources and adaptive strategies. Statistical analysis approaches for the climatic analysis, whereas Focus Group Discussions and household surveys to study human perception were carried out. The climatic variables such as temperature, precipitation, evaporation and river discharge were analyzed based on the available recorded data at four stations: Malepatan, and Lumle of Kaski District and Kunchha and Khudi of Lamjung District.

No significant changes in precipitation were found; but recorded precipitation showed the average increasing trend of 0.48 mm/year in all the four stations. Temperature at (Malepatan, Khudi, Lumle) showed statistically significant increase in maximum temperature. The average increasing trend of maximum and minimum temperature was 0.048°C/year and 0.036°C/ year. There was no significant trend in the river discharge but average annual decrease in discharge of Sisaghat station by 0.509 m³/sec. Not significant but increasing trend in evaporation rate was recorded 0.029 mm/year at Lumle. Regarding human perception, 74 % people perceived reduction in precipitation and 91% of people perceived temperature increment; both were concurrent with hydro-meteorological analysis of nearby stations (Kunchha and Khudi). Accessibility of water increased due to intervention made by NGO's and government organization. Some springs disappeared due to geo-morphological changes but increase in discharge of springs was perceived on some part of the area. Increased yield of major crops was due to modern crop management practices using improved varieties. Also, farmers have improved their cropping pattern, cropping intensity, crop diversification and planting time adjustment with new crop varieties to cope up with the adverse effect of climate variability. Recent development and uses of seasonal irrigation facilities contributed in increased crop production. Decreasing tendency of precipitation and discharge might create threat in water availability impacting food production in the long run. People perceived a less dependable onset of monsoon and accordingly adopted their planting strategy such as farming in patches. Besides agriculture, people are found mobilizing remittances from abroad to cope with the climate variability.

Role of Community-Based Organisations in Building and Enhancing Adaptive Capacities of the Communities to Climate Change: A Case Study of Madanpokhara VDC, Palpa

Koirala, Pratima; Dixit, Ajaya

Besides Governmental and Non-Governmental Organizations (NGOs) and multilateral agencies, small Community Based Organizations (CBOs) have been directly or indirectly supporting local community in planning and implementing adaptation strategies in the face of Climate change to reduce community's risk and vulnerabilities. However, their roles are less talked about and rarely documented, mostly in developing countries. This study appraises the existence of CBOs and their roles in improving the adaptation practices to reduce the impact of climate change in Madanpokhara VDC, Palpa. Hydro-meteorological data on rainfall and temperature were analysed and the participatory tools like focus group discussion and key informant interview were used along with extensive literature reviews.

Both annual and decadal rainfall has varied over a period of 1980-2009, 2000 decade being the driest period. Increase in annual mean temperature was at the rate of $0.05^{\circ}\text{C}/\text{year}$, which corresponds with the peoples' perception. To address the issues of climate change in agriculture and water resources, people have been practicing forests management, use of groundwater, altering agricultural practices, use of fertilizers and pesticides, water storage practices ultimately leading to improved livelihood. The study identified 45 CBOs working actively and voluntarily participating in combating climate change impacts by managing resources, whose activities were substantiated by institutions like Institute for Social and Environmental Transition Nepal (ISET-Nepal). The vegetable groups and forest user groups are the most active groups. The CBOs have already become a focal point for existing governmental/NGO's/INGO's programs and several adaptation strategies such as management of forest, water resource conservation and altering farming practices were implemented through them and are successful given the resources at hand. The study has identified and categorized access to resources, economical development, leadership, empowerment, transfer/sharing of knowledge and information and focus point for the external organizations as the strength of community organizations in building and enhancing adaptive capacity to climate change with some limitations such as extension of infrastructures, activity of community organizations, use of fertilizers and groundwater for vegetable farming. However their activities were subjected to technical and financial constraints for which sustainable actions were not fully included. It is recommended that bottom up approach of engaging CBOs in the process of planning and implementing adaptation measures is desired. Further these CBOs should be assisted with necessary technical and financial capacities from the government and other stakeholders to make adaptation processes effective.

Role of Water Users Association in Performance and Sustainable Management of Aandhikhola Irrigation System, Syangja, Nepal

Khanal, Ananda Raj; Sharma, Khem Raj

Aandhikhola Irrigation System, since after the handover to local beneficiaries in 1997, has been functioning well, unlike many other irrigation systems in the country. The organizational setup of water association, their participation in the management activities and institutional arrangements are some of the potential factors which affect their management quality. Therefore, the study was carried out to assess the role of water users association in performance and sustainable management of Aandhikhola Irrigation System, which has come up to 18 years of its operation. The participatory tools of inquiry such as field observations, key informants interview and focus group discussions were used. Review of literatures and associated documents were also done. The role and activities of water user's association was analyzed by using Norman Uphoff irrigation activities matrix and Ubels organization model.

The modalities of design and construction, water right share distribution, land pooling and redistribution are found instrumental to uplift the level of poor people. The unique concept of share distribution has not only inspired much farmer's collective contribution in the construction but also helped to establish an equitable water distribution mechanism. The major success of this project lies in getting some portion of land from comparatively large land-holders and distributing to land less and marginal farmers. The organizational setup of Aandhikhola Water Users Association (AKWUA) with collective participation of individual user's in irrigation activities has positive impact on its sustainable management. Water shares are distributed to the users in accordance to the labor contribution in construction activities. Water allocation and distribution schedule are maintained by the AKWUA according to the prior filled water demand form from the individual water users. A rotational arrangement of water distribution is intact at the time of water scarcity. Financial arrangement of the system is maintained through the collection of Irrigation Service Fee (ISF); technical and financial support from Butwal Power Company (BPC). The financial support from BPC (which is sharing the common water source for hydropower generation) has been increased to NRs. 400,000 from NRs. 250,000 per year. The year round irrigation intensity was unevenly distributed from the head to tail end of the system, mainly due to the losses in canal conveyance system. Average cropping intensity of the system was 271.3 % as water users have used three cropping seasons in a year. As such, this system is not only a good example of interdisciplinary water resources management but also leading example as a successful Water Users Association contributing to the sustainability of the irrigation system.

Valley Ponds from the History to the Present Context: Study of Stressors Associated with their Degradation

Adhikari, Prakash; Sharma, Bharat

Degradation and disappearance of ponds, constructed in and around the Kathmandu Valley during different eras in the history of Nepal for various purposes, are one of the major problems in Kathmandu Metropolitan City (KMC). Besides serving as water sources, these ponds carry immense social, religious and cultural importance. This study aims to make an inventory of the existing ponds of the metropolis and stressors leading to their degradation. The study included a spectrum of inquiry tools such as field observation to observe and document the present condition of these ponds; key informant interview with elderly people, historians, researchers and academician and focus group discussions to identify the cause of degradation and associated impacts. The study also included the pond water quality analysis for various quality parameters such as pH, Electrical Conductivity, Total Solid, Chloride, Nitrate, Ammonia, Total Phosphate, Total Organic Matter, Dissolved Oxygen, Biological Oxygen Demand, Chlorophyll and *Escherichia coli*.

The traditional ponds in KMC can be divided into two types: i) Inner settlement ponds, besides providing inner open space for the clustered settlements also beautify the landscape of the neighborhood and is used for bathing, washing clothes and rearing duck, acts as buffer to protect neighborhood from flooding during downpour, and ii) larger external ponds located at higher altitude act as reservoirs to feed the canals and convey water to irrigate fields along with groundwater recharging. A total of 9 ponds are documented in the study. The urban dwellers started manipulating ponds and converted into residential areas. The three prime stressors are categorized as physical, social and chemical stressors. The migration of people and rampant development works crushed historical channels (*Raj Kulos*) to block water flow along with sediments to flow in the pond and waste disposal. The overuse of groundwater and improper management of religious waste are other physical stressors. Ignorance of migrants to the norms of traditional ponds, wastewater management practices, lack of legislation, organization body and ineffective execution of policies, land encroachment and transfer of ownership, changes in professions and habits were categorized as social stressors that play equal role for the pond degradation. Water quality analysis highlights the presence of high organic matter and dissolved solids in water increasing biological oxygen demand. The higher count of chlorophyll indicates those ponds are in the state of eutrophication except the ponds which regulate water frequently. The ponds have also microbial contamination.

Issues of Delays in Adit Access Roads and Tunneling of Melamchi Water Supply Project

Marsini, Ganesh; Niraula, Rajendra

Water shortage problem of Kathmandu Valley can be solved by the implementation of Melamchi project, which is already a long due project. The study was focused to identify and explore general issues of delays in one of the components of the project: Adit Access Roads and Tunneling of Melamchi Water Supply Project (MSWP) with reference to social issues of demands and possible actions to be taken for addressing those demands. Two sets of questionnaires were developed and discussed with 8 clients and 42 society members along with key informant's interview to collect primary data. Direct observation of the tunnel adit points located in Ambathan, Gyalthum, Sindhu and Sundarijal and surrounding areas of the Tunnel alignment as well as residents of Melamchi valley were made. Review of the past studies and project documents, detailed assessment of relevant government documents, grey literature, policy notes (regulations) and news on the MSWP published in national media over the last decade were done. The data were descriptively analyzed.

The Adit Access Roads for Tunnel was mainly delayed due to public policy related issues, social opposition and inadequate institutional set up to handle the project in planning and designing phase. The initial delay in tunneling was mainly due to residual demands from adit Access Roads. The implementation stage delay in tunneling was mainly entitled to the parties to Contract. It was found mainly contractor related 21%, management related 16%, low bid 14%, engineer, material, employer and human related with 10% were causes of delay for tunneling. 58% of the respondents assumed tunnel excavation affect negatively. 80% people perceived inadequacy of budget. Financial expenses of buffer zone activities, health components, educational components, Income Generation and Community Development (IGCD) were in increasing trend annually where as financial expenses on infrastructure development was the highest with 35% among all expenses in the year 2010/2011. It is recommended that the Tunnel Contract should be given based on Technical competency and experience of the contractor in specified job; public opinion should be adequately understood; the bidder should be well informed about the socio-political situation, risk identification and management plan should be adequately prepared and implemented; Water Resources Act should be amended to provide provision related to Inter-basin Water Transfer with clear delineation of rights and obligation of water supplying and receiving basin. The contractor should strengthen the current management team by recruiting knowledgeable, experienced and competent Contract Manager, Construction Manager and Tunnel Engineer with communication skills and having expertise of FIDIC Contracts in international projects.

Assessment of Existing Working Methodologies and their Standardization for Community-Led Construction (CLC)

Lohani, Ashok; Sharma, Khem Raj

Local infrastructure construction is essential for the development of any community. Such constructions are of small scale and have relatively lower cost compared to larger projects. Also, the return is much quicker as the gestation period is shorter. Community Led Construction (CLC) approach has produced significant success in such cases. CLC approach is entirely based on the interest, effort and enthusiasm of the local community. In this approach, the community is voluntarily involved in all stages of the project in the form of Users Groups and User Groups' Committee. All problems felt during planning or construction or generating funds or management are handled with mutual understanding and co-operation. It has been widely felt that CLC approach needs to be more channelized and it is already a high time to develop the standards for its operations and management. The present study tries to dwell on this aspect and to suggest a tentative working methodology and timeframe for carrying out any CLC project. It has made an effort to understand the existing practices, positive aspect. Challenges, shortcoming and probable improvement areas regarding four case studies in Tinthana VDC in Kathmandu were assessed. The research intended to standardize the procedure for CLC projects and develop the general steps to be followed in executing such projects in future. The research is more qualitative in nature. Both primary and secondary data have been collected. Standard techniques like interview with 33 participants, questionnaire survey with 105 personnel, Focus Group Discussion and observation were used for collection of primary data.

At the end of the study, it was found that all the above projects were resounding successes. Most of the working steps were approved starting from problem identification to completion along with operation & maintenance. It was agreed that CLC is the best option for local infrastructure development in a resource stricken country like Nepal. But, it was recommended to reduce political and undue social influences, improve monitoring, evaluation and control situation by making an independent team and to improve documentation of the CLC project. From the present study, it can be concluded that CLC approach has proved more effective, efficient and economical. This approach has increased the social acceptance of these studied projects, as a result of which the community has benefitted from the project for the entire design period and the longevity of the project has been ensured. So, CLC approach provides win-win situation to all stakeholders in the projects under studied.

Effectiveness of Dispute Adjudication in Road Construction Contracts under Department of Roads in Nepal

Adhikari, Sujan; Niraula, Rajendra

Road construction contracts are so sophisticated and complicated that disputes are inevitable in the contracts and their timely settlements are desirable. Prolonged disputes may hamper the project implementation by cost overrun, time overrun and quality degradation. So, Dispute adjudication is an alternative dispute resolution (ADR) method for the out-of-court settlement of disputes to minimize dispute hamper without any delay. The study was focused to evaluate the success rate of dispute adjudication, to assess the familiarities of the contracting parties about dispute adjudication and its spirit and to assess the response of the parties in the adjudicator's decisions in order to examine the effectiveness of dispute adjudication. This study covers the cases of contracts under the road projects financed by Asian Development Bank (ADB) and World Bank (WB) in Nepal, available in Dispute Resolution Unit of Department of Roads (DoR) between May 2007 to April 2012. The study is based on the qualitative and quantitative data. The ten case studies were the major basis as a quantitative study for the assessment of effectiveness of dispute adjudication by assessing the success rate of adjudication. Also the familiarities of the parties about the provision and procedure of adjudication and its spirit/strength to resolve the disputes and responses of parties regarding the adjudicator's decisions were assessed based on the qualitative study. Questionnaires survey and discussions with the experts from Employers, Contractors and Adjudicators were the other tools for data collection followed by literature review. The content analysis in terms of percentage was the main tool for data analysis and the results obtained are presented as bar diagrams and pie-charts.

The success rate of dispute adjudication measured in terms of the percentage of disputed issues resolved by adjudication is only 6.67% which is very low, also as compared to other countries like India, US, UK, New Zealand, Singapore etc. being very low success rate of adjudication, not familiarization of spirit of adjudication by the construction industry and negative responses of the Employers regarding the level of moral of the adjudicators, adjudication has become ineffective and underutilized in road construction contracts. It is recommended for further study to assess the same for other construction contracts such as Bridge, Irrigation, Building, Hydropower, and Water supply & Sanitation. Effectiveness of other ADR methods for resolving disputes with comparative analysis in the respective issues in construction contracts are also recommended for further study.

Classification and Control of Spare Parts for Effective Inventory Management System: A Case Study in Heavy Equipment Division (HED), Kathmandu.

Timilsina, Prakash; Shrestha, Ashok Kumar

The study was focused to analyze the existing spare parts inventory management practice in Heavy Equipment Division (HED)-Kathmandu and recommend appropriate control strategy. HED-Kathmandu is one of the six large capacity maintenance workshops responsible for repair and maintenance of equipment and vehicles running under Department of Roads (DoR). Day to day work activities were closely observed during the study. The analysis was based on information from stock ledger book, spare requisition and issue forms, annual reports, observation and discussions with concerned persons. The classifications of spare parts were carried out with the help of secondary data gathered from the records of HED-Kathmandu. The data from FY 055/56 to FY 067/68 were analysed. Three types (27 pieces) of equipment out of 26 types (91 pieces) were selected on the basis of higher average utilization, availability of records and larger share of total equipment for the classification of corresponding spare parts. ABC classification based on annual consumption value, XYZ classification based on current stock value and FSN classification based on average stay and consumption rate were done for spare parts related to each of the three equipments. Then outcomes of ABC and XYZ classification were combined. For proposing a control strategy for existing spare parts inventory, ABC and XYZ analysis were merged to form a matrix with nine different categories.

There was no effective spare parts inventory management system being followed except to fulfil requirements prescribed by the financial rules and regulations. The major problems were found to be associated with lack of proper classification of spare parts. For the effective and efficient control of inventory, it is necessary to classify the spare parts based on the consumption rate, value and rate of flow combined classification of ABC and XYZ revealed that only 54% of total annual expenditure on spare parts was used for fulfilling the demand while remaining was stored and kept unused. Based on time period analysis, it was found that some spare parts had average stage of 13 years. The FSN analysis showed that 72% of total current stock value was absorbed by non moving spare parts. It was identified from the study that huge amount of budget was use for non value added activities in the form of non moving spare parts. The specific control strategy for each category can be used for improving the spare parts inventory management system. For the spare parts corresponding to each of the nine categories, appropriate control strategy and procedures were also proposed for the application.

Management Issues of Health Care Waste in perspective of Public Private Partnership Arrangement: A Case Study of Western Regional Hospital, Pokhara

Gyawali, Kapil Dev; Sharma, Bharat

The rising concerns of environmentally unfriendly handling and disposal of healthcare wastes at the Western Regional Hospital (WRH), Pokhara and success of appropriate healthcare waste management projects inside the country and neighboring countries in South-Asia region created the basis for the initiation of this research. The research has focused to analyse the present status of the healthcare wastes at WRH with reference to its composition and management approach (collection, transportation and disposal). Basically the research tried to identify proper system of healthcare waste management with respect to public and environmental health, appropriate equipments and infrastructure required for adoption of such technology and come up with practical PPP modal for the waste management at WRH. General information regarding the hospital was collected from hospital authority using questionnaires and a group discussion was conducted to identify appropriate methods and technologies for conducting waste management program.

The study revealed the WRH generates around 269 kg of healthcare waste per day, out of which around 27% is occupied by healthcare risk wastes (19.16% infectious, 1.2% sharps, 4.17% vials and 2.48% ampoules) while other general wastes account 73% of wastes generated. This quantity of risk waste is on higher side compared to the estimate of World Health Organization (WHO) of 10-25% in healthcare institutions throughout the world. The study found out that the waste disposal from the hospital does not follow any special framework; rather the wastes are disposed three times a day without any segregation and without wearing any Personal Protective measures. Uniformity in waste transportation was found as some wards were found using trolley while others were transporting the wastes manually. From the perspectives of waste treatment, the full fledged treatment option was found to be lacking completely. Upon discussion with the hospital staffs and looking at international and national good practices of Health Care Waste Management, two-tier segregation approach, collection frequency of once a day in specialized waste transportation trolleys, adoption of autoclave for treatment of infectious and burial of tissues and organs were identified as proper waste management approach for WRH. While analyzing the appropriate PPP modality, as the financial returns from the waste management program is very low, the PPP options requiring higher budget and longer time frame for the financial return would not be feasible. Since the low income PPP projects can not attract investment from the private operators, management contract PPP has been identified as the best suit PPP model for the waste management program at WRH. After all, the healthcare waste management program has the social and environmental concerns embedded in it; its necessity cannot be analyzed merely on the financial grounds.

Design-Build Procurement Process for Construction of Motorable Bridge in Nepal

Karn, Santosh Kumar; Jha, Prabhat Kumar

Design-Build approach, though common in different infrastructure sectors in several countries but for Department of Roads (DoR) in Nepal, this approach is new especially for motorable bridge construction. The study was focused to design-build procurement process followed by DoR for construction of motorable bridge in Nepal. The study analyzed the procurement process, assessed the provisions in the Public Procurement Act 2063, Public Procurement Regulation 2064 to implement the project and also focused on quality, cost and time related issues in the construction contract. DoR has developed standard bidding document for design-build contract. FIDIC conditions of contract for plant and design-build are one of the standard guideline for design-build contract. In the study, significant clauses of the DoR's Bidding document have been critically analyzed. Conditions of contract for design-build contract using by DoR and FIDIC have been compared. Questionnaires were administered to obtain relevant information like qualification criteria, provisions of acts and regulation, sufficiency of different contractual provisions of contract document from DoR personals involved in procurement works to make the procurement process effective. The major issues of DoR document and FIDIC document have been compared in the analysis. The views and suggestions of twenty five DoR personnel involved in the procurement process have been presented in the study.

Procurement process starts from the approval of estimate and invitation of bid for procurement of works. For Design-Build team selection, single stage, one envelop system (post qualification) approach is used and the lowest bidder that meets pre-set qualification criteria is selected. The pre-set criteria mainly used to select the potential bidder includes average annual turnover of the best three years in the last ten years, liquid assets criteria, general work experience of contractor, specific work experience, technical manpower available, equipments available to contractors. The lowest eligible bidder's qualification is verified to award the contract. After the three aspects of critical analysis, qualification requirement for contractor selection, provision of procurement act and regulation in different contractual issues, quality, cost and time related issues in contract, issues of maintenance, DLP, etc have been drawn and recommendations for the modifications in the clauses 4.5(e),4.5(f),37.1 of ITB, 7,13,58 of GCC, 7.1,46.1 of SCC and 7,13,14 of ACC of the DOR's bidding document have been made for better Design-Build Procurement Process.

A Case Study on Project Management of B. P. Koirala Memorial Planetarium, Science Museum and Remote Sensing Center

Bhattarai, Shree Ram; Adhikari, Rajendra Prasad

The project- B.P. Koirala Memorial Planetarium Science Museum and Remote Sensing Center (B.P.KMPSMRSC) is the first project of this type that is under construction in Nepal which has high scientific value and will play a significant role on scientific education. The project has been planned to complete in three phases. This study is of the first phase i.e B.P. Koirala Science Museum block which is under construction as of now. The objective of the research was to study the implementation status, the application of Project Management tools and methods in project planning and management in B.P.KMPSMRSC, located at Kirtipur, Kathmandu, Nepal. As per the schedule of the project the start date was on July 2, 2010 and completion date is July1, 2012. The contract amount of the first phase project is Rs. 481,426,773 which is considered as large investment in our context. Extensive literature reviews followed by questionnaire survey, group discussion, field observation and record study were done.

The study showed that till the monitoring data December 15, 2011 the project is delayed by 184 days. Late procurement of construction material, less number of manpower mobilized in project site, delay in hiring equipment, delay in site mobilization are the major causes that lead the project delay. From the earned value analysis of the project data it is found the extra 1 year and 11 months is required to complete the project if the situation remains as it is which means the total 3 years 11 months is required for the completion of this project. Resulting in increased overhead cost of the project due to market inflation the cost of every material increases causing dispute in the construction and the construction claim will arise which again lead to high will cost in project. Changes in the grade of cement, no test performed for the initial and final setting time of cement, use of poor quality construction materials (brick, sand, rebar, and cement), changes in design depth of pile contributed to the low quality of construction. However the advanced project management tool Primavera is found to have been used in the project, but the tool has not been used to take its advantages by meeting project objective effectively and efficiently. No planning and re-planning was done on regular basis as well as no resource planning and project constraint analysis was done by PRIMEVERA. The overall execution was carried under the presence of consultant project manager, in absence of contractor.

An Assessment of Development Project Management in Local Government: A Case Study on Road Projects under Decentralized Rural Infrastructure & Livelihood Project in Baitadi District

Yadav, Mohan Babu; Gelal, Mani Ram

Ministry of Federal Affairs and Local Development (MoFALD) is presently implementing a large number of donor-funded rural infrastructure projects like Decentralized Rural Infrastructure and Livelihood Project (DRILP) through its local institutions. The study was focused to make an assessment on project management practices of development projects in local government. The two road projects (Shreebhadar-Hat and Salena-Melauli) under DRILP, implemented by District Development Committee (DDC) Baitadi were selected. Primary data were collected through field observations, formal and informal interviews with DDC officials, technicians, local beneficiaries, Building groups, contractors and local leaders. Secondary data were collected through project description, project progress and completion reports from DRILP, Baitadi. Data and information collected were analyzed by contrasting the situation especially for the soundness of the project management and were presented in tables, charts and bar graphs. The findings of the research were summarized into the four phases of project management: formulation, planning, implementation and termination.

The studied road projects were selected through participatory and bottom up planning process. The roads were constructed by both BGs and contractors. The major works were earthwork excavation in cut and fill, gabion works, dry masonry wall, dry stone causeway, and drain works. The project was based on Labour based, Environment friendly and Participatory approach with good gender equity and social inclusion performance. Both roads have undergone time overrun and cost overrun. Cost overrun was due to time variation of estimated rate. The projects are not satisfactory to deliver services as expected because it had not prepared and followed quality assurance plan. Weak monitoring and evaluation also contributed for ineffective deliverables. Safety precaution and medical facilities were poor. A good transparency was found in decision making but poor in the budgetary and expenditure matters. Resources from the government and donor were the only source for maintenance. Operation and Maintenance plan had not been prepared yet. Time overrun in the projects should be overcome by timely release of budget, procurement completion and development of practical work plan and rational decision making. Cost overrun should be overcome by completing the projects on time. Preparation and implementation of quality assurance plan should be done to achieve quality. Quality awareness should be raised; strengthened monitoring and evaluation, properly constructed road bends, curves and road surface and regular maintenance to make the roads motorable in total road sections are recommendations of the study to make the project management more effective and sound.

An Assessment of Periodic Maintenance Practices of Strategic Roads of Lalitpur District Roads

Deo, Ram Kumar; Das, Rajesh Kumar

Department of Roads (DoR) of Nepal has well established institutional network throughout the country. DoR has developed planned maintenance program for strategic road network. Due to implementation of planned road maintenance, the strategic roads are expected to be in good to fair condition up till its design life span. There are different categories of maintenance out of that periodic maintenance is one of them. Based on the data of 2012, DoR has responsibility of maintaining 10,835.00 kilometers of strategic roads all over the country. Resource is always a constraint to meet maintenance objectives. At present the Roads Board, Nepal is the funding agency for different categories of road maintenance. This helps to maintain the roads in serviceable condition. The study was focused to assess the present practices of periodic maintenance system of DoR to assess the current scenario and to find the short-coming in selection of candidate roads and right surfacing for periodic intervention and propose a model for its improvement. Data collected through questionnaire survey, and past data on surface distress index, international roughness index and analysis of present practices along with literature review were carried out in three sections of strategic roads in the Lalitpur District.

The analysis showed that the existing practice to assess the need for periodic maintenance (generally resealing) is determined by comparing the period since the last resealing/surfacing to the recommended resealing cycle (5-8years). The Asphalt concrete overlay technique is better than surface dressing as periodic maintenance in strategic road network and strategic urban road network of Kathamndu Valley. Some specific parameters like international roughness index, surface distress index, and annual average daily traffic, soundness of sub soil, sub-base, base and record of routine and recurrent maintenance should be considered while selecting the candidate roads for periodic maintenance. The routine and recurrent maintenance which are huge influencing factors to periodic maintenance were less effective due to lack of productivity norms and attitude of length workers. For the effective periodic maintenance either the routine and recurrent maintenance should be done through the established institutional mechanism with assigned productivity so that small potholes can be addressed immediately to make pot hole free roads or the contract package for periodic maintenance should include routine and recurrent maintenance for up to next 5 to 8 years so that premature need of periodic maintenance cab be avoided.

Development and Management of Puspatal (Mid-Hill) Road in Nepal: A Case Study of Ghurmi-Khurkot Road Section

Sah, Rajendra Prasad; Das, Rajesh Kumar

Development and Management of Mid Hill Highway (MHH) is one of the integral parts of Strategic Road Networks. The study was focused to assess the present scenario of construction practices of Puspatal (Mid-Hill) highway (Ghurmi-Khurkot road section), to identify the proper system for sustainable operation of the road for better mobility of road users and to review the existing policy and legislative measures so that the appropriate and effective management system/technique could be proposed. This study looked into the development and management aspect of the Strategic Road network incorporating the construction practice of hill roads and its operational sustainability. A section of study has been carried out to understand hill road slope management that has direct effect on sustainable operation of the road. The study has reviewed the existing Acts, Rules and Policy provisioned for sustainability of the road operation. Data and information was gathered through site visit, surveys, interview and questionnaires.

The study has shown that in Nepal the Strategic Road Network is maintained by Planned Maintenance System for its sustainability. It comprises routine, recurrent, periodic and emergency works. The planned maintenance system is considered as the good maintenance practice for sustainable operation of roads, but the allocated budget for different types of maintenances is inadequate and planning is based on inadequate road management system. Smooth traffic flow throughout the year, safety, comfort and saving in operation and maintenance cost are the major indicators of sustainable operation of the hill roads for road users. The public Road Act – 2031, is not sufficient to protect the encroachment of Right of Way and excess vehicle axle load due to the lack of regulations which is vital for load control on the pavement layer. Conventional engineering measures of over load control, slope support, protection and surface drainage have been used to combat these problems to various effects. There is provision in the existing National Transport Policy, 2058 and Road Board Act, 2058 for development and management of the road for its sustainability, which needs to be reviewed and updated with regard to the implementation of Public-Private-Partnership approach and people's participation for the operation and maintenance of the road. In an attempt to suggest ways for improvement in the Mid-Hill road management, some improvement in the existing organization has been suggested.

Relation between Earthquake Safety Awareness of House Owners and Earthquake Safer Construction in Kathmandu Valley

Adhikari, Amod; Guragain, Ramesh

Nepal has experienced earthquake of various Richter scale, high to low, throughout its history. The UN has ranked Nepal as eleventh earthquake prone country in the world. And in such an event, Kathmandu is the earthquake prone city in the world for casualties. It is found the buildings are the main root for risk. Despite this danger, city has been growing without proper plan and proper design of buildings. So, the main objective has to faster safer building construction practices in Nepal and the main concern is how to achieve that. Numbers of efforts have been done to increase earthquake awareness in Nepal by different organizations but effectiveness of those efforts are not studied systematically. Proper relation of awareness Vs impact on implementation; awareness Vs design, awareness Vs Supervision, awareness Vs improved construction quality, can help to formulate better awareness strategy and thus was felt necessary to focus on this aspect. The main objective of the research was to find out relation between earthquake awareness of home owners with building construction management i.e. implementation. Design, Supervision and Construction Quality are chosen as parameters to measure it. The other purpose was to find out the relation of awareness with individual parameters of implementation to see the affect of awareness on each parameter individually.

Average numbers of buildings constructed per year was taken as a basis for defining sample size for survey in each of the five municipalities. Considering the overall timeline of the research and other resources like human resources and the budget only Kathmandu metropolitan city was chosen for the survey. Mainly the under-construction sites were selected to observe actual as-built condition. Some recently completed buildings were also included. Necessary information was collected from questionnaire survey and both quantitative and qualitative techniques were applied for analysis. Based on analysis, relation between awareness and design, awareness and supervision, awareness and quality was found to be positive. Analysis showed that home owners with higher level of awareness have employed engineer for design, supervision and quality control of their building in comparison to people with low awareness level. From this research it can be concluded that better construction quality can be achieved by increasing awareness. This research showed positive relation between awareness and implementation. But further research on larger scale is recommended for better understanding. Researchers interested to explore further in this issue can research in other locations.

Determination of Domestic Water Consumption Pattern in Urban Kathmandu Valley

Gyawali, Manoj; Sharma, Khem Raj

Normal households use water for drinking, food preparation, bathing and personal hygiene, utensils washing, laundry, watering lawns and gardens. Water consumption is affected by various factors depending on the classification of the cities, economic status of the people living, among others. There is difference in domestic water consumption pattern among people of various economic levels and as a result this research concept was concurred and conceptualized in order to: (a) obtain actual per capita water consumption by activity based on household water usage, and (b) understand water uses pattern by different income classes. For this 41 households connected to Kathmandu Upatekya Khanepani Limited (KUKL) of urban areas of Kathmandu Valley (Nepal) were selected by convenience sampling method. The study included flow rate test and questionnaire survey. In this study physical and economic assets were considered such as type of house, material used in construction, roof type, surface finishing, and garden for the former; and facilities like cars and motor bikes, geyser, solar heater and washing machine for the latter.

Study found that there was wide range of variation of water use according to the economic class distribution. High income class consumption is 196.77 Liters Per Capita per Day (lpcd) which included 3.73 lpcd for drinking and cooking; 32.14 lpcd for toilet; 90.77 lpcd for bathing and washing; 10.71 lpcd for utensils washing; 29.88 lpcd for face, hand and teeth clean; and 29.54 lpcd for lawn watering and vehicle wash. In other hand, middle income class consumption is 129.91 lpcd (drinking and cooking 3.49 lpcd; toilet 29.22 lpcd; bathing and washing 49.33 lpcd; utensils washing 7.37 lpcd; face, hand and teeth clean 23.42 lpcd; lawn watering and vehicle wash 17.08 lpcd). Finally, low income class consumption is rather low at 71.58 lpcd (drinking and cooking 3.08 lpcd; toilet 24.76 lpcd; bathing and washing 22.82 lpcd; utensils washing 4.28 lpcd; face, hand and teeth clean 16.64 lpcd). Taking the average of all 41 households, the daily per capita consumption is 140.32 lpcd (drinking and cooking 3.49 lpcd; toilet 29.39 lpcd; bathing and washing 57.22 lpcd; utensils washing 7.86 lpcd; face, hand and teeth clean 24.25 lpcd; lawn watering and vehicle wash 18.11 lpcd). It was found that 33.8 % of total daily water could have been saved if waste water coming from shower, baths, wash basin and washing machine after treatment were used. Due to insufficient and irregularity of supplied piped water from the KUKL, people were found using alternate sources. The high income households were using multiple sources of supply. The low income households were mostly dependent upon the KUKL supply and neighbourhood dug well in worst case. It was observed that 66.4 % water used by the households consumption was met from the KUKL and remaining from the private vendors including tanker supply, mineral water, among others.

Fire Safety Design and Management of High Rise Apartment Buildings in Kathmandu Valley

Khatiwoda, Rajendra; Bhattarai, Deepak

There is an increasing tendency amongst urban settlers of Kathmandu Valley to reside in high rise apartments mainly due to the availability of urban facilities, well-developed physical infrastructure, and improved security system and escalating land price. However, due to some unique features of such high-rise apartments, a hidden danger of fire-induced disasters persists which would remain uncontrolled if not adopted in the pre-planned programs. It is in this scope that a study has been undertaken with overall objectives of identifying shortcomings of the current fire related regulatory provision; assessing the awareness of apartment users towards fire safety ; and recommending suitable guidelines for apartment developers, designer, occupants and related government bodies. For this, related literature of some developed as well as developing countries mainly concerning regulatory provisions (of fire safety) were reviewed. Based on the existing literatures, questionnaires were developed for primary information. Additionally, apartment designers were interviewed for information such as existing design practices. Moreover, fire code experts and apartment occupants were consulted for information on safe exit practices. Finally, information obtained was cross-verified with the approved design drawings of the apartment buildings.

Based on the respondents' opinion and review of fire cases of some (developed and underdeveloped) countries, there is an urgent need for revision of existing design elements to include additional design components within the regulatory framework related to high-rise apartments. Analysis showed that the design for high-rise apartments that were being constructed in the valley needed to take into considerations the following components: i) involvement of competitive professional designers; ii) construction zoning, set back and distance between blocks as per the height of the buildings; iii) safe and short escape route; iv) smoke containment structures; v) automatic sprinkler system; vi) electrical equipment for fire detection, information and control; vii) fire safety plan, fire drills and education for the occupants; viii) recruitment of fire officer/ technician in each apartment; and ix) fire safety audit and enforcement. Stating not only the shortcomings of the current Nepalese regulatory provisions, this research recommends an integrated system of fire safety components and baseline to achieve the fire safety standard in high-rise apartment buildings. The recommendations include design elements of architectural, sanitary and electrical services with design theme of safe and short evacuation route, reduction of human casualty and property loss as well as different management plans like safety, operation, maintenance and regular fire-safety audit to ensure the enforcement of fire-safety issues, among others.

Sustainability Challenges of Open Defecation Free Zone in Nepal

Sah, Ram Chandra; Mishra, Abadh Kishore

Declaration of Open Defecation Free (ODF) zones has become very important part of sanitation movement in Nepal. An ODF zone at any level is declared if every household of a Village Development Committee (VDC) or a municipality or a whole district has an accessibility to improved toilets, no trace of human excreta exists in the declared area at any time and all the public institutions like schools, offices etc. within the declared area, have toilet facilities. Recent studies, reports and field observations show that at certain places, it is very challenging to sustain ODF zone due to several reasons (construction related or managerial or policy gaps). In this context, a study was undertaken with main objective to assess the situation and find out reasons responsible for the sustainability of ODF situation. For this, some specific objectives were set: (a) to find out the gaps or weaknesses in the related policy documents, and (b) to assess sustainability challenge faced by an ODF zone. For this, Dharan municipality from Sunsari, Kanchanpur VDC from Saptari and Aanbukhaireni from Tanahu districts were selected as case study sites. This study used three types of questionnaires. The first set was related to household data collection, the second to all government schools of the study sites while the third set was related to the policy, decision making and implementation level people.

Result showed that gaps existed at policy level resulting into inability to solve the problems related to sustainability of an ODF zone. Education level, income level, technical assistance and overall sanitary condition of schools were directly related to sustainability, while providing financial supports for household toilets were found to be unfavourable to sustainability of ODF. In other hand, availability of water showed little effect on sustainability of ODF. Moreover, study also found that local governments had important roles to play for sustainability of ODF. It was further revealed that proper planning for sustainability of ODF as well as post ODF activities, challenging nature of middle income level people, awareness creation, and behavioural change rather than financial support, proper mobilization of students for school sanitation management, proper monitoring mechanism were the key factors to be considered for sustainability of an ODF zone.

Study of Effectiveness of Road Maintenance Management System (A Case Study of Division Road Office, Kathmandu, Nepal)

Karki, Sudarsan; Sharma, Keshav Kumar

Departments of Road (DoR), Nepal introduced planned maintenance system for Strategic Road Network (SRN) in 1994. Currently, the entire SRN is being maintained by the DoR under 25 maintenance divisions. The Kathmandu is the largest Division Road Office (DRO) having 317 kilometers (Kames) of SRN. Some shortcomings like inadequate budget, inadequacy in maintenance norms etc. are being experienced in (adopted) planned maintenance system which demanded necessary improvements in this system. In this context, this research was carried out as a case study in 10 roads having total length of 41.02 km within the DRO, Kathmandu. Primary data were collected through questionnaire survey and interviews with different stakeholders such as road experts/engineers, road neighbours, traffic police, drivers, length workers/supervisors, sub-engineers; and secondary data were collected from literatures, past reports and dissertations. Riding quality, Surface Distress Index (SDI) and frequency of maintenance were taken as indicators of the effectiveness of planned maintenance system.

Results showed that maintenance planning process in the form of Annual Roads Maintenance Plan (ARMP) was good enough. The planned maintenance is keeping the roads in better condition than before as the SDI on the road remained was similar or even decreased. However, the road surface condition was found not to be good enough. Although routine maintenance has been carried out regularly in the selected sectors of the road, periodic maintenance had not been carried out for the last ten years. Similarly, recurrent maintenance which was scheduled to be conducted twice in a year (before and after the monsoon) was not carried out at the desired level. The study found some key factors to be considered for improvement, such as lack of proper norms for routine and recurrent maintenance for the high level of traffic, lack of adequate number of site supervisors during the maintenance works, lack of adequate budget, leakage of sewer and water supply pipes, frequent excavation of road pavement by other governmental agencies due to lack of co-ordination among line agencies. The study recommended improvement on maintenance norms, effective implementation of maintenance activities and better co-ordination among the line agencies along with timely execution of recurrent and periodic maintenance to keep the roads in Kathmandu at desired level.

Insurance Program of Rural Water Supply Systems: A Case Study of Projects Conducted by RWAAFDB, Nepal

Upadhyaya, Purna Prasad; Sharma, Hari Prasad

Many Nepalese rural communities suffer from lack of basic water supply services. Despite active community involvement in a water supply project in its every stages (which has been a policy thrust in the Rural Water Supply Systems - RWSS), available records have shown that around 43% of projects need major repair in nationwide context. Moreover, communities are unable to bear risks arisen from natural disaster/calamity (e.g., earthquake, flood and landslide) that may damage or completely wash out the system. In this context, this study has reviewed and analyzed a recently proposed alternative as initiated by the Rural Water Supply and Sanitation Fund Development Board (RWSSFDB) to reduce economic burden on communities from such natural calamities. They have been practicing insurance programs for RWSSs to transfer risk of the project due to natural disasters to designated insurance companies. For this, this study selected several rural water supply systems from Dhading, Nuwakot, Kavrepalanchok, Dolakha, and Makawanpur districts. All the systems were gravity flow type ones. Questionnaire survey was conducted with users and user committee members. Besides, a separate questionnaire survey was carried out with experts form government organizations and insurance companies. Collection of secondary data was carried out by reviewing past studies, fund board's published and unpublished documents and other related documents.

Study found that although insurance program was started immediately after the completion of the project, neither users or the Water Users Committee (WUC) members were found to be aware about it. Study found that there had been regular payments of water tariff and premium. The premium rate was found to be in the range of 7-18% of the water tariff. All the users and WUC members, when informed, were found to be satisfied/happy with the premium structure of the insurance program. The major strength of such program was evident in the financial capability and satisfaction of users. However, weakness in the managerial capability of WUC members was noted. Weighted average of the strength of the insurance program was found to be 73.10% against 26.90% weakness. Based on the findings, the study recommended: (a) insurance program should be appreciated as a part of project cycle and it could be an activity during execution of different phases of the project cycle; (b) during pre-development (of project) phase, it should incorporate need assessment of insurance, advocate the users and WUC members and then seek the acceptance/approval of users; (c) because of weak awareness level of the users as well as of the WUC members, training programs should be organized in which supporting organizations should provide information regarding insurance modality and the claim process should also be included; (d) fixation of the premium should be finalized with coordination between WUCs and insurance companies during (project) development phase. It is believed that with the consideration of the stated potential adaptation measures, a replicable insurance program in rural water supply systems could be developed.

A Case Study on Road Maintenance Management Practice of Balkhu Dakshinkali Road Section, Kathmandu, Nepal

Karna, Kamlesh Kumar; Das, Rajesh Kumar

Vehicular movement on Balkhu Dakshinakali Feeder Road (FR) of Kathmandu valley is increasing due to strategic location of the Dakshinakali temple for religious, tourism and its function as a (sub-) feeder road to Hetauda, Nepal. Present road conditions however show rather poor level of service. As such lack of regular maintenance system was evident in the section. This study is therefore conducted with the aim of identifying ways to improve maintenance management system of the section. For this, the study collected various primary and secondary data. Primary data were collected through site observation, and questionnaire survey with technicians whereas secondary data were collected from published/unpublished documents such as government policy, working papers and associated guidelines as well as journals and periodicals.

Study found that despite efforts on regular maintenance during the years 2004-11 using existing pavement management system, the riding & comfort ability of the road section was poor (as evident from high value (>4) of Internal Roughness Index - IRI). However, visual condition of the section was found to be good to fair (as evident from rather low value (<3) of Surface Distress Index – SDI). Further, there was problem with respect to budgetary provisions being not uniform and not as per surface condition especially at two sub-sections namely; Balkhu-Chovar and Chovar-Dakcchinkali. Even in some instances of enough budgetary allocations, no or under utilization of budget was found. This study noted a number of issues which needed to be addressed in order to achieve sustainable management of the section. For instance, length workers were found to be with low capacity, or, they were unproductive mainly due to over age, poor contract management, inadequate works inspection and supervision, poor quality of handed equipments, and even lack of basic equipments. There seemed a severe lack of an easy and quick reporting and recording system to check general progress of jobs assigned to different gangs or units, equipment, etc. Besides, numerous institutional problems related to maintenance management, attitude of involved person, utilization of fund and capacity constraints were observed, too. Hence, study recommended: (a) improvement through a systematic process of maintaining road assets, (b) combining engineering principles with sound management practices, and (c) providing tools to facilitate organized and flexible maintenance in order to enhance both riding and comfort, and visual condition of the road. Besides, these improvements would allow roads users to benefit from safer, faster, less costly and more comfortable travel in the road section.

Saptakoshi Flood Affected Land Reclamation Project in Sunsari District

Kushwaha, Rajaram Prasad; Yadav, Mahendra Kumar

Saptakoshi River is one of the three largest rivers of Nepal and a major tributary of the Ganga River having catchment area of 60,400 km² up to Nepal India border. On 18th August 2008, left embankment of the Saptakoshi barrage (constructed for multipurpose facility, e.g., irrigation, flood control, etc) was breached causing catastrophic disaster, and course of the river was shifted through breached part of the left embankment near West Kushaha. This event damaged 2340 ha agricultural land by depositing sand/debris in Sunsari. In view of reclamation of these affected agricultural lands, the Government on Nepal (GoN) established Saptakoshi Flood affected Rehabilitation Agriculture and Livestock Services Office (SFRALSO) and implemented the Land Reclamation Program (LRP) on affected area as post disaster rehabilitation work requirement. The impact study of this huge expenditure for relief, rehabilitation program and reconstruction program was felt a necessity. Therefore, this study has been undertaken as a case study type research and carried out based on progress from fiscal years 2008-2012 in which 1734.56 ha of agricultural land has been reclaimed, out of total 2340 ha. The study considered three severely affected VDCs, namely, Haripur, Shreepur and Paschim Kushaha of Sunsari district for detailed analysis. The followed methodologies included collection of data through questionnaires, key informant interview, focus group discussion, and spot observation, along with review of available secondary information/literature.

Site visits confirmed that the fertile agriculture land converted into a virtual unproductive land. These lands were categorized according to the depth of sand deposition and reclaimed implementing different modalities accordingly. Now, the cropping pattern on the reclaimed land has changed and farmers are growing almost every type of crops on their reclaimed land. The average yield recovery percentage from the reclaimed lands at low, medium and high impact areas were found to be 88.73%, 85.41% and 46.47% respectively. This indicates that the reclamation project has been quite effective. Results also showed that the reclamation program has improved, in general, fertility of the area, increased use of fertilizers and improved seed variety which resulted increase in farmers' income level. As secondary effects, education level of farmer's child/children has improved and so was their social status. Besides, study found that the program helped to reduce poverty level of the farmers. As a result, there is high acceptance rate of the program among the farmers and the study recommended the land reclamation program to continue in the remaining affected area in earliest possible.

Delivery of Service Quality by Design Consulting Firms of Road Projects

Acharya, Rohit Sharma; Acharya, Keshav Raj

Service quality delivery is one of the most important performance indicators of a design consulting firm. Quality of design work starts right from field investigation and data collection. Poor design sometime leads to overall failure of a project. It is thus important to know common sources of error in design, and to pinpoint remedial measures for better design which ultimately delivers quality service to client(s). This study has thus minutely analyzed problems generally encountered during design and has explored the most common hidden sources affecting design consulting firms in delivering of quality services. For this, road projects were taken as case studies. This study is based on qualitative data. As such, questionnaire survey followed by focus group discussion with the target groups was conducted.

Study found that consulting firms were weak in delivering quality services to clients. Often, consulting firms did not meet client's requirement and consequently client were not satisfied. Majority of the problems that have been arisen for quality service delivery were result of human resource mismanagement, poor or faulty field investigation, and improper data analysis, unwillingness to incorporate in design, inability to establish quality control mechanism and inability to implement value management. On the other hand, clients were also in fault. They failed to make an inductive environment to get better services from the consulting firms.

Cement Quality and Market Case Study of Pokhara Sub-Metropolitan City, Nepal

Thapa, Ishwor; Bhattarai, Deepak

There are several brands of Ordinary Portland Cement (OPC) and Portland Pozzalona Cement (PPC) available in the local market of Pokhara, but variations in their physical parameters occur due to the variation in their chemical composition. This study aims at investigating physical parameters of OPCs and PPCs comparing it with Indian Standard (IS) specification and relates the demand of these brands with quality, price and consumer choices. For this, different cement suppliers were surveyed to find the demand size of different brands of cement in past six and half years. Consumers were surveyed to enlist factors affecting the demand of cement. As such, consumers from all the 18 wards from the study area were approached with questionnaires.

It was found that 39% of respondents preferred Indian origin cement and the rest 61% preferred Nepalese origin cement. Most of the consumers chose the ACC brand of cement followed by Brij, and Jaypee cement. Moreover, 42% of suppliers placed Indian cement at first in their preference list while 38% of suppliers ranked Nepali cement at first in their preference list and the rest 20% made no comment. The market survey showed that PPC cements were preferred over OPC brands. The coefficient of correlation between price and demand was found to be -0.669 implying that lower priced cement had higher demand. On testing physical parameters of the highest and least demanded cements, it was found that the OPC brands had higher 28 days strength. In other hand, the Indian PPC brands had higher 28 day strength than the Nepal PPC brands. The coefficient of correlation between quality and demand stand at -0.681 indicating lower strength cement had higher market consumption. Moreover, the coefficient of correction between price and quality stand at 0.963 showing higher price cement had higher strength. The regression analysis between demand, price and quality; the multiple regression analysis between demand, price and consumers choice; and the multiple regression analysis between demand, quality and consumers choices were all significant ($p\text{-value} < 0.05$). From the study, it can therefore be concluded that price and consumer's choice plays vital role in the demand of a particular brand of cement. Although Nepali OPC brands have higher strength than the other brands, their market share was very small (providing figure could be useful) due to their higher price. Higher strength cements have lower market consumption and price significantly affects the demand of cement. Although the Indian cement have higher price than the Nepali brands, they are still taking more than 30% of the market share, possibly due to effect of nationality among the supplier's and the consumers. The other factors such as advertisement, third party source (e.g. engineer, contractor and neighbor) and availability of certain brands of cement in local hardware shops also affected the consumption of the cement.

Factors Contributing Road Traffic Accidents and Possible Counter Measures on Kathmandu-Bhaktapur Road

Adhikari, Guru Prasad; Pradhan, Saroj Kumar

Road traffic accidents are outcome of factors associated with traffic system, road users, road environment and vehicles. Despite good road surface, the Kathmandu-Bhaktapur 9.1 kilometer road section has high accident records. Traffic police records showed that 1530 accidents had occurred from July 2009 to 2012 alone. Hence, this study has been undertaken (a) to identify locations with high accident numbers, (b) to investigate possible causes of accidents, and (c) to propose counter measures. For this, accident data were gathered from Metropolitan Police Office (MPO), Kathmandu as well through questionnaire survey and field observation. Frequency analysis was used for the analysis. Bar chart, Pie chart and tables were used to present data and results of the study.

Of the total 1530 accidents reported from July 2009 to December 2012, 1219 were minor injuries, 243 were major injuries, and 68 were fatal. 46% of the accidents have been recorded in two separate sections namely, the Sallaghari-Suryabinayak and the Tinkune-Jadibuti. Record showed that 42% of the accidents were on the level crossing. Pedestrians were the main victim of the accidents. Associated factors for such accidents were high speed of vehicles, carelessness of driver, non-compliance with traffic rules and overconfidence of drivers. Moreover, accident trend during the study period showed that accidents increased immediately after road opening possibly due to users being unfamiliar with the road after its opening. Road users were unfamiliar with the changed/new features of the road section, too. In other hand, vehicles travelling with higher than the designated speed were the main cause of accident. Accidents corresponding to 12:00 – 15:59 hours were the highest and drivers aged to 25 to 34 were involved in most of the accidents. Accident data further showed that victims were male biased. Finally, study recommended counter measures such as enforcement measures, education measures, and engineering measures.

Labor Based Environment Friendly and Participatory (LEP) Approach in Construction of Rural Roads in Nepal

Gurung, Man Bahadur; Lamichhane, Suraj

Roads can open up a multitude of opportunities to enhance local's livelihood. In Nepal, conventional method of road construction started 40 years back for state infrastructures which in turn started only 15 years back for rural roads. Technological development of low-cost, environment-friendly, rural roads based on people's participation has been taking place in Nepal since mid 1980s. The Local Road Improvement Programme (LRIP), supported by German Technical Cooperation (GTZ) and Helvetas in Palpa district, constructed 96 kilometers road in 1986 based on environmentally sound Green Road Concept (GRC). This concept was widely adopted in other districts by various donor funded projects. In due course of time, GRC was implemented in 20 districts of Nepal as of 2011. In other hand, Labor based Environment friendly and Participatory (LEP) approach is continuation, extension and expansion of the Green Road Concept. This approach is labor based technology without completely ignoring the use of machineries but rather advocates the use of selective equipments like rock breaker, mechanical compactor, tractors, trucks etc. It is participatory labor based approach replacing the traditional labor intensive technique. Besides, it also focuses on the social and economic development of local people for sustainability of the societal development by conducting several trainings. In this context, an assessment of such approach was a necessity and a study has been undertaken to: (a) identify problems and issues of the LEP approach and (b) recommend measures for the effective implementation of the LEP approach.

The major findings of the study were: (a) stage wise construction was partially adopted, (b) the use of manually handled equipment like rock breaker in hard cutting was increasing; (c) insurance policy was applied for workers but took time to get insured amount; (d) compensation policy was found partially applicable; (e) organized training such as income generation, saving and credit programs, awareness training were found to be effective but in insufficient numbers; (f) Environment Management Plan (EMP) was found to be partially followed for the protection of environmental; (g) lack of coordination with the User Committee (UC); (h) incentive cost for meeting and management was found to be partially provided but was insufficient. In other hand, the main challenges for the adoption of the LEP approach were shortage of manpower, and cost and time overrun. In some sections, it took huge time and cost especially in complex topography, hard rock cutting, huge mass cutting area and long material haulage sections. Further, it required substantial documentation works, lots of dealing to the UCs, Road Building Groups (RBGs) and to the public. Similarly, it needed many supervisors in the construction site. For the best execution of the project (and the approach), the mixed technology i.e. use of Labor Based Technology (LBT) as well as use of Equipment Based Technology (EBT) is recommended for rural road construction in Nepal.

Impact of Seismic Resistant Reinforced Cement Concrete Residential Building on Cost: A Study of Building Under-Construction in Kritipur Municipality, Nepal

K.C., Himal; Adhikari, Rajendra Prasad

Current practice of building construction in Nepal is highly influenced by owners and local contractors. They, in general, have minimum level of technical knowledge regarding earthquake resistant features. In the other hand, people are still unaware about the damages that an earthquake can bring. Additionally, there is general misconception amongst people that earthquake resistant building construction would cost much higher than normal building construction. As such, people are reluctant to incorporate earthquake resistant features in their building construction. In this context, a study was undertaken with main objective of exploring cost difference between non-engineered residential and engineered earthquake resistant residential building of a model building. Study collected information on current practice of residential building construction at Tyanglaphat and Bhatkyapati area of Kritipur municipality. Altogether, 25 residential buildings of the selected localities were considered. Moreover, questionnaire survey was carried out to collect information on current practice of residential buildings. Structural details as per current non-engineered practice were implemented in the proposed model building. Then, detail cost estimate was carried. The same model building was (re-) designed using structural analysis tool – the SAP 2000, and its structural detail/drawings were prepared as per Nepal National Building Code (NBC). Detail cost estimate of the building was carried out and comparative analysis was then made between engineered and non-engineered model building.

From the study, it was revealed that the cost difference of 12.18 % between the engineered and the non-engineered residential model building mainly contributed from the structural (detailing) cost. It was also found that awareness level on earthquake resistant features to buildings was very low amongst house owners and local contractors. With increased level of awareness supported by research findings of the study, it is hoped that it could significantly reduce the misconception of people regarding the cost of engineered building.

Impact of Stage Construction Strategy of Feeder Roads in Nepal (A case study of Tokha-Chhahare Road)

Nepal, Kedar Prasad; Gautam, Ghana Shyam

Concept of stage construction strategy, as opposed to a crash project, in the realm of road sector in developing countries like Nepal is getting popular mainly due to financial resources limitations. The construction of roads in many stages (phases) from earthen stage to blacktopped stage is often said to be financially economical. It is in this scope that a case study of a feeder road linking Tokha (Lalitpur) to Chhahare (Nuwakot district) has been undertaken to assess and analyze the current stage construction strategy of Department of Roads (DoR), Nepal. The impact of stage construction strategy has been analyzed using both quantitative and qualitative approach. The quantitative approach has been adopted to analyze the cost effectiveness of the strategy whereas qualitative approach has been adopted to carry out the impact in technical, economical, environmental and socio-cultural issues. For the latter, questionnaire survey was conducted with local people and technical personals involved in road construction projects. Besides, direct field observation and key informant interviews have been conducted.

From the study, it was found that the construction cost of the stage construction strategy was slightly lower (14.67 million NRs per km) compared to that of crash project (16.66 million NRs per km). However, the study found both positive and negative impacts in physical, environmental and socio-cultural issues due to the stage construction strategy. The stage construction strategy would have positive impacts in socio-economic dimension of the local people if concerned parties follow the strategy with systematic and scientific approach of project formulation. The study recommends that the road to be constructed by stage construction strategy should be planned earlier by the concerned authority and time of upgrading at minimum traffic volume should be clearly mentioned at the beginning of project formulation phase. Finally, the road infrastructure through stage construction strategy should meet the requirement: logistical availability, financial affordability, technical appropriateness, socio-cultural acceptability and environmental sustainability, among others.

Maintenance System in Heavy Equipment Division, Department of Roads, Kathmandu

Parajuli, Mahesh Kumar; Shrestha, Ashok Kumar

The Department of Roads (DoR), Nepal is the main division responsible for planning, construction and maintenance of all types of roads in Nepal. Construction of roads often requires heavy equipments which demand substantial initial investment. As such, the DoR has a separate Heavy Equipment Division (HED). However, cases of poor maintenance of the equipments have been reported. It is in this scope that a study has been undertaken with the main aim of studying the existing maintenance system in the HED leading to identification of problems on existing maintenance system and looking for solutions towards the improvement within the given resources. For this, the study identified basic problem areas through structured questionnaire to management officials of the HED, mechanics and storekeeping staffs; regular informal discussions with related personnel; site visits and direct observations on different maintenance activities; and analysis of the available (secondary) data and records. The study used descriptive statistical analysis, including mean breakdown time, mean time between failures for effectiveness of maintenance and reliability of equipment, correlation and their significance test analysis for breakdown, utilization and their availability of equipment.

It was observed that repair and maintenance of equipments and vehicles were performed largely on breakdown basis. Because of poor maintenance record keeping system and failure analysis culture, there was severe lack of critical and important information on the status of equipments, which are often essential for proper operation and maintenance, and replacement and/or disposal. From the analysis, increase in breakdown hour had direct impact on machine utilization. Increase in frequency of breakdown decreased machine reliability, availability and utilization. Besides, increasing trend of maintenance cost revealed that existing breakdown maintenance system was ineffective and inefficient. The study found preventive maintenance system to be suitable for the HED against the existing breakdown maintenance system. In addition to preventive maintenance system; planning, scheduling and controlling of maintenance activities and resources, improved workflow system, and recording formats and organizational structure needed to be incorporated into the so-called “*improved maintenance management system*”. Management officials also need to focus on the improvement of existing inventory management, skill development training for all types and categories of employee, and utilization of modern facilities and tools. In order to solve the problems of existing maintenance system and to achieve desired goal of cost effective maintenance system of the HED, this study also recommends the “*Improved maintenance management system*”. Such improved system is expected to reduce the frequency of breakdown, breakdown hour, repair hour and maintenance cost in the long run resulting in increased reliability, utilization, availability and overall performance of machine. It will also lead to optimum utilization of human, physical and financial resources, too.

Capacity Development on Operation and Maintenance of Mangadh Water Supply Project

Bajracharya, Binu; Puri, Deepak

Realizing the need of capacity development of Water Users and Sanitation Committee (WUSC), Japan International Cooperation Agency (JICA) together with Department of Water Supply and Sewerage (DWSS) implemented a capacity development project to improve the technical, financial and organizational capacity of Birat WUSC, which is managing Operation and Maintenance (O&M) of Mangadh Water Supply Project in Biratnagar, Nepal. It, therefore, becomes imperative to assess the effectiveness of the capacity development project. It is in this context that a study has been conducted with an overall objective of assessing the outcomes of capacity development on the O&M of the water supply scheme. It led to several specific objectives: (a) assessing the changes in the technical capacity of the WUSC personnel, (b) assessing changes in the financial and organizational ability of the WUSC, and (c) assessing improvement in safe and sustainable water supply services to the consumers due to capacity development. For this, this study selected several indicators to assess financial, organizational and technical capabilities. The indicators for assessment of financial capability included revenue collection, water tariff, and unit operating cost per cubic meter sold, Operating Cost Coverage Ratio (OCCR) and cash balance. Similarly, organizational capability indicators included staff productivity, personnel costs and human resource development. Finally, technical capability and service improvement were assessed using indicators such as service coverage, water production and consumption, Non Revenue Water (NRW), water quality. Moreover, this study involved a descriptive research methodology to collect data from all 11 WUSC members and 7 staffs of the WUSC utilizing 2 sets of questionnaires and individual interview as the survey instrument. Questionnaires and interview were intended to comprehend their understanding, knowledge and skill on the safe and sustainable O&M of the system and services. Informal interviews were also conducted at random to assess consumers' perceptions on the reliability and quality of the services provided by the WUSC. This included 12 consumers in total with 10 consumers met at the WUSC office, and 2 consumers met during two separate field visits.

The study found that the capacity development activities greatly helped to enhance technical knowledge, skills, and self esteem of the WUSC members and staff; and also helped to enhance financial and organizational capability of the WUSC. Financial capability indicators such as average tariff per cubic meter sold, unit operating cost per cubic meter sold and the OCCR showed that the WUSC has developed sufficient capacity on managing the O&M of water supply facilities and services to the users. It is covering operating and maintenance costs from tariff revenue with an OCCR of 1.15. While the WUSC has extended its service to an additional 11 percent population of the service area, it has also been able to reduce personnel costs from 56 percent in 2009/10 to 46 % in 2012/13, and staff productivity index from 4.63 to 3.95 staff per 1,000 connections with an efficient use of human resources. The WUSC has also been able to reduce the NRW from 19.06 % in 2009/10 to 18.21 % in 2012/13. Capacity development for O&M of water supply systems is recommended to integrate in project implementation activities and to implement regularly as post construction activities in other water supply projects too. It is also recommended to provide technical and financial support to develop and implement WUSCs business plan for improving and expanding the facilities and services.

Impacts of Climate Change on Livelihood and Biodiversity

Kalikote, Bhim Bahadur; Bhujel, Krishna Bahadur

This research entitled “The Impact of Climate Change on Livelihood and Biodiversity” was carried out in the Goukhureswor Community Forest User Group, Dhulikhel-1 Kavrepalanchok district of Nepal to assess impacts of climate change on biodiversity and livelihoods and its adaptation strategies at local level for mitigating vulnerability and threat to their lives. It assesses and analyzed existing understanding level of climate change and its effects on the biodiversity and livelihoods of local communities. Analysis is based on field data obtained from, household survey, focus group discussion, key informant interview and direct observation, secondary data collected through different sources as CFUGs constitution/Operational plan. Statistical tools such as mean, variance and liner- equation were used for the analysis purpose.

The study indicated some signs of climate change experienced by rural communities of the study area. Local communities felt an increase in warm days. The pattern, intensity and amount of rainfall also changed, resulting in the scarcity of water. Moreover, people started to feel scarcity of water for irrigation and drinking. Most of the respondents (about 76%) agreed to decrease agriculture production of main crops may have been partially resulted due to water scarcity as a consequence of climate change. Similarly, the majority of respondents accepted that unwanted species and forest fire increased and shifted flowering and fruiting season by 2-4 weeks period than its normal schedule in last 20 years. The climatic data from Dhulikhel meteorological station also supports the people’s perception and experiences on climate change and its impacts on biodiversity and local’s livelihoods. The traditional and indigenous adaptation techniques like shifting the crop cultivation and harvesting schedule for potato, rice, wheat and maize; using pesticides on crop; storing of agriculture residue and grass for dry season; planting improved grass and reducing livestock number were adapted by locals to improve agriculture and livestock system. Similarly, conservation and protection of trees around water sources, construction of water tank on the water sources, plantation and conservation of tree, construction of loose check dam, early removal of dry leaf litter and extinguishing forest fire were adapted by the locals to improve their livelihoods. Community forestry has initiated land allocation and NTFPs plantation to cope with decreasing NTFPs in the forest focusing on poor community/households. it concludes that the local have realized the climate variation even though their understanding towards climate change is limited. The poor are more vulnerable to climatic hazards although they were adopting few indigenous practices to cope with it. Raising awareness and sharing information on climate change should be increased among locals, at the same time scientific techniques should be incorporated into indigenous knowledge to cope with changing climate as sustainable basis.

Groundwater Irrigation Potential: A Case Study in Kanchanpur District of Nepal

Deo, Manoj K.; Pathak, Mahesh, Shrestha, Indra Narayan

This thesis entitled “Groundwater Irrigation Potential a Case Study in Kanchanpur District of Nepal” for delineation of shallow tube well is based on empirical study of secondary data of Ground Water Resource Development Board. Point data of 457 Shallow Tubewell were converted into raster surfaces namely Static water level below ground, Discharge of tube well, Length of screen, Total depth of well and Topography (Slope), using Inverse distance weighting method in GIS software Arc map 9.3 version. Cell size of 20 m X 20 m was maintained in each map during the raster interpolation. These raster maps were prepared based on the Longitude and Latitude co-ordinates of Tubewell data and the related parameters (namely Static water level below ground, Discharge of tube well, Length of screen, Total depth of well and Topography (Slope)).

The potential map derived superimposing above five surfaces was further classified into four classes namely Very high (Index no. > 48), high (Index no. 44 to < 48), Moderate (Index no. 39 to < 44) and Low (Index no. <39) consisting of 15.77 % (253.9 km²), 24.62 % (396.38 km²), 27.31 % (439.69 km²) and 32.31 % (520.19 km²) respectively. Standard deviation approach was used for the classification. After considering exclusionary areas the Low, Moderate, High and Very high potential areas reduces to 7.8 % (125.58 km²), 13.47 % (216.87 km²), 9.93 % (159.87 km²) and 11.34 % (182.57 km²) respectively. Exclusionary areas considered are cutting cliff, swamp, pond, protected area, forest, road buffered (26 m) and River buffered (20 m). This result should be considered as a part of decision criteria for the delineation of shallow Tubewell for Kanchanpur district but should not be considered as the replacement of existing decision system based on socio-political system. Further study considering seasonal variations of discharge as well as depth of groundwater table below ground from the surface is recommended.

Status and Conservation Threats of Blackbuck (*Antelope cervicapra*, Linnaeus, 1758) at Krishnasar Conservation Area, Khairapur, Bardia, Nepal

Shah, Manoj Kumar; Bhatta, Shiv Raj

Grasslands and grassland ungulates are considered to be inter-dependant, often to have co-evolved, and the interactions between them substantially influence each other in various ways. This study was conducted to assess the reason of population rise of blackbuck since 2004, to analyze the status of the conservation threats, to evaluate status of crop depredation by blackbuck and to find the status of land ownership issue in Krishnasar Conservation Area (KrCA), Khairapur, Nepal, from September 2012 to February 2013. GIS was used to find the realized habitat of blackbuck, forest area, encroached area, human settlement area and coverage of *Cassia tora* in blackbuck habitat. With the active participation of staff of KrCA, total and severe crop depredating areas were mapped. 20 % of the HHs were selected randomly and interviewed with both structured and semi-structured questionnaires in severe crop depredation area. Key informants were interviewed to cross check and enhance the reliability of the data.

Since 1999 till 2012, there has been an increase of 203 % in blackbuck population during which total births and deaths were 315 and 113 respectively. Natural death was 50 % followed by deaths due to predation 24 %. The population increase was highest (32 %) in 2008. Nine conservation threats to blackbuck were identified among which settlement inside the blackbuck habitat followed by grazing by livestock were most serious. Broadly, the entire area can be categorised as forest, settlement area and actual blackbuck habitat. Settlements with cultivation cover almost half (49%) of the blackbuck habitat and blackbucks were compelled to squeeze in 34 % of the blackbuck habitat. Total area (including settlements) that experiences crop loss was 2703 hectares and that experiences severe crop loss was 763 hectares. In severe crop loss area, black gram experiences the highest crop loss (71.2 %) followed by field pea, cowpea, wheat and chilly more than 60 % and paddy, radish, sesame, garlic and potato experience less than 20 % crop loss respectively. 119 hectares of land was under encroachment which was 23 % of the blackbuck habitat. Registered land in blackbuck habitat was 29.17 hectares. 1027 livestock graze the area every day including 309 cattle, 489 buffaloes and 232 goat/sheep. Realized habitat of blackbuck was 254 hectares of land. The domestic cattle graze in 201 of 254 hectares regularly. The area infested by *Cassia tora* is 50 hectares which was 20% of the area available to blackbuck for grazing. Land acquisition (1997) was very meaningful to blackbuck population. Only 37% of total blackbuck habitat was available to blackbucks. For current population of 285, the habitat is sufficient if other anthropogenic activities remain similar. Settlements along with grazing pressure compel blackbuck to raid crops in summer season. High crop depredation in certain areas was one of the major reasons of KrCA-people conflict. *Cassia tora* is degrading the habitat and feral dogs' threats to blackbucks. Study recommends resolving settlement issues, provision of compensation for crop depredation, regulate grazing by livestock, removing weed *Cassia tora* and sterilizing stray dogs.

Effectiveness of Collaborative Management of Terai Forests: A Case Study in Tilaurokot Collaborative Forests in Kapilbastu District, Nepal.

Subedi, Vijay Raj; Kanel, Keshav Raj

The study was carried out with the general objective of evaluating the effectiveness of collaborative management (CFM) of Terai forests. Specific objectives were to assess implementation status of Collaborative Forest Management scheme, evaluate the sustainability of forest management activities undertaken and understand the perception of users. The study was carried out in Tilaurokot CFM in Kapilbastu district of Western Development Region from October 2012 to July 2013. Scientific forest management programme was initiated in Tilaurokot Collaborative Forest Management in 2011. Necessary data and information was collected through questionnaire survey through randomly selected 150 households, interaction with stakeholders with a checklist, observation of the site and literature review.

The study found that various forest management activities such as compartment and sub-compartment delineation, fire-line construction, regeneration felling, regeneration promotion, thinning, and forest products sale and distribution were carried out according to management plan. However, some principal activities such as regeneration felling, regeneration promotion and thinning did not achieve the full target. Several criteria were used for evaluating sustainability. It was found that the yield regulation was done based on the number of stems, programme was implemented in multi-stakeholder environment, several ecological and biodiversity conservation measures were considered, and large numbers of local people were employed in program implementation. However, collaborative forest management group had no policies regarding labour safety and rights. Forest management was financed by the government in the first year but it was jointly financed by the government and collaborative forest management group in the second year. The study concludes that the implementation status of the plan was satisfactory and the programme was generally sustainable and appropriate. Further, the users believed the programme was running satisfactorily and they perceived it as sustainable and highly suitable/appropriate for Terai forests.

Status, Potentiality and Market Chain Analysis of Commercially Important Non-timber Forest Products of Nuwakot District, Nepal.

Gautam, Gopal Prasad; Sharma, Bhuvan Keshar

Non-Timber Forest Products (NTFPs) are integral part of rural livelihood in Nuwakot district. NTFPs have been supporting livelihood of forest dependent people through its supply for local use or for trade within or beyond the district. The study intends to identify NTFPs in use at local level and commercially important NTFPs along with their market chain. The study employed key informant survey, focus group discussion, and review of literatures to document NTFPs, identify locally important NTFPs and commercially most potential NTFPs, and assesses the market chain of NTFPs identified as commercially most potential in the district. To ease the data collection and improve accuracy, the districts were coarsely divided into four regions based on altitude from mean sea level (msl).

The study documented 116 species of NTFPs which were found in different parts of the district and used for various purposes. Similarly, the study found 32 NTFPs species very important for local use indicated by amount of consumption in the form of construction materials, food, fiber, spices, and medicine. Likewise, currently 47 species of NTFPs were exported from the district. The parts in current trade were rhizome, roots, tuber, stem, bark, flower, seed, fruit, leaves and whole plant as well. The study, using numerous criteria developed for the study, identified Argeli, Satuwa and Majitho as top three commercially most potential NTFPs. The criteria used to determine the potential species were industrial demand, export from the district, and cultivation potential. The study showed that the government is the sole producer of Argeli, Satuwa and Majitho. However, local people were involved in different stages of market chain of those NTFPs. There was no barrier for entry and exit of the people in collection and trade of NTFPs. Despite this, oligopoly was observed in trade of the NTFPs in the district. The processing system in the district was at very incipient stage; fraction of bark of Argeli produced in the district was processed before exporting from the district, whereas all other produce exported in unprocessed form. Effort of Government and other voluntary organizations working for the development of NTFPs was found very feeble in the district. Therefore, the study recommends for planned development of NTFPs coupled by sustainable harvest. The study suggests for partnership amongst agencies working in the NTFP sector for scientific management and commercial development of NTFPs, and effort to process NTFPs at least for some initial stages so as to contribute on economy of the area.

Evaluation of Income Generation Activities in Ultra Poor Families of Collaborative Forestry Users in Sarlahi and Mahottari Districts of Nepal

Yadav, Ganesh Prasad; Sharma, Khem Raj

Impact evaluation in collaborative forestry which is recent compared to other management regimes is essential to understand the distribution of income in the ultra-poor families. Thus, the current study was carried out with general objective to find best performing IGAs and their impacts on living condition of ultra poor families. It also examines the variation of results between counterfactual analysis (with and without project comparison) and conventional (before after comparison) method of impact evaluation. The method used internationally recognized impact evaluation procedure and “randomized experimental design” to find out the impact. Standard statistical tools and test were used to analyze data which came from 247 treatment and 250 control group households from 44 poverty pockets located in 14 VDCs of two collaborative forest groups in Sarlahi and Mahottari Districts.

About 90% of treatment and control group members were illiterate. Only 26% of treatment and 37% of control group had registered land with the mean holding of 0.13 ha and 0.15 ha respectively. Additionally, about 70% households of both groups have burden of loan with Rs. 35,943 in treatment group and Rs. 43,967 in control group. The current per capita income of both groups was lower than the poverty line (Rs.19,261) set out by national living standard survey 2010/11. More than 18 types of income generation activities were implemented by treatment group in the study area. The average IGA support received was found to be Rs.9,338. Based on success potential and benefit potential criteria, best performing IGA includes i) hen rearing, ii) livestock business (buy and sale), iii) Non-agro business (hotel, wood business, butcher and selling snacks), iv) Cow rearing, v) grocery retail shop and vi) pig rearing. The total average income of treatment and control group was Rs. 87,071 and Rs.80,056 respectively which shows income of treatment group was 8.8% more than control group household and is significant at 95% confidence interval (with p-value 0.033). However, average annual expenditure of IGA family was Rs. 105,114 which was higher by Rs.4,592 (5%) compared to control group. The difference was not significant at 95% confidence internal (with p-value 0.149). About 11% of treatment and 10% of control group were engaged in illegal selling of fuel wood with an average income of Rs.26,880 in treatment and Rs.22,149 in control group. It was a bit more than 10 % baseline value in 2010 with average income of Rs. 15, 867. Thus, it was concluded that there is no meaningful relation between income generation activities and forest protection, as currently approached. The conventional method (before after comparison with same project beneficiaries) of impact evaluation gave 4.88 more result on annual mean income and 6.48 times more on mean annual expenditure of treatment group in comparison to the counter factual analysis of impact measurement in place of conventional method to find actual impact to the project.

Routine Maintenance of Trail Bridges through Bridge Warden: A Case Study of Tanahun District

Timilsina, Som Raj; Gelal, Mani Ram

Bridge wardens are appointed for routine maintenance of trail bridges. Despite, there have been reports of improper maintenance of the bridges. It is in this scope that a study was carried out to assess the policy and practices of routine maintenance with specific focus on bridge wardens' performance. For this, this study selected Tanahun District where 42 trail bridges out of a total of 83 were inspected. The study covered different categories of bridges at various locations, constructed through several agencies. Checklists were used to assess the physical status of the bridges. Besides, interviews were conducted with wardens, bridge site neighbors and Village Development Committee (VDC) Secretaries. Also, questionnaire survey was conducted with sub-engineers, engineers, senior divisional engineer of District Technical Office (DTO) and technical coordinators of Trail Bridge Site Users for their feedback.

It was found that most of the bridges lack routine maintenance in a proper way. Minimum tools and other maintenance related materials were not provided to bridge wardens. Resource allocated for routine maintenance per bridge was low and not released regularly. Implementing agencies like VDCs and bridge maintenance committees were also not informed about this system. No training was provided to members of bridge maintenance committee and VDC Secretaries. Criteria for bridge warden selection were not specified. Refresher trainings to bridge wardens were not conducted. Monitoring, documentation and reporting from all concerned agencies were lagging. Routine maintenance fund is limited to remuneration of bridge warden. The amount was same irrespective of type, span, location and efforts put in. The remuneration amount was Rs. 3,000/- per bridge per year for routine maintenance which is raised to Rs. 6,000/- from this fiscal year 2013/014. Mechanism of cash flow from DDC/VDC/Municipality to bridge warden was not clearly established. Bridges are becoming insecure in a short time due to lack of routine maintenance. Existing norms is to be reviewed to provide necessary budget for routine maintenance. Bridge wardens should be made responsible to bridge maintenance committees which in turn should be made accountable for routine maintenance. They should be empowered and provided with necessary resources. Review meeting, refresher trainings to VDC Secretaries, management committees and bridge wardens should be organized on a regular basis. For effectiveness of this approach, routine maintenance should be linked with Minimum Conditions and Performance Measures (MCPM) of VDCs/Municipality.

Competitive Bidding System for the Department of Urban Development and Building Construction Projects in Nepal

Khadka, Bidur; Shrestha, Hari Mohan

Among the various contractor selection methods, lowest bidder selection method is being widely practiced for the public procurement works in Nepal. However, such practices have adverse implications, and it is in this scope that this study was conducted. The effect of existing competitive bidding system on the time and cost performance of public construction projects executed by the Department of Urban Development and Building Construction (DUDBC), and the clients and contractors' perceptions for the improvement of existing bidding system was analyzed. Two case studies of construction projects awarded to the lowest responsive bidder were assessed and their effects on the project implementation were explored. Statistical analysis (linear regression diagrams and F-test – one way ANOVA) of successive thirty one and thirty eight data sets were analyzed from DUDBC, Okhaldhunga District and Tourism Infrastructure Development Project, Kathmandu through questionnaire survey, each of thirty sets of responses were also received from client and contractor respondents working for DUDBC to understand their perceptions on the prevailing issues and suggestions to amend competitive bidding system practiced in DUDBC.

The study confirmed that higher the number of bidders and more the gap between engineer's estimate and bid price, higher was the possibility of the occurrence of time and cost overrun of the construction projects in DUDBC. Even though the competitive low bid method was found to save a considerable amount of money during bidding, it caused the increase in project cost and duration. The results indicated the need for improvement in the existing competitive bidding system in order to increase the performance of DUDBC construction projects. Alternative bidding procedures such as the weighted multi-criteria selection methods of contractor, competitive bidding method awarding contracts to the lowest bidder which was within predefined range of engineers' estimate and competitive average-price based bidding included in the study were highly appreciated by respondents. Moreover, there is need for provisions in Public Procurement Act (PPA), which allows the evaluation committee to reject the bidder's financial offer if it is above the certain threshold percentage below engineers' estimate. Besides, attendance of bidders in pre-bid meeting should be mandatory. Further, rejection of the bidders' financial offer if he/she can't justify the quoted rates, provision should also allow to set the objective qualification criteria based on which the bidders' total score can be summed and awarded to the bidder having highest scores, and exercise the average-bid method as an alternative contractor selection method.

Fire Vulnerable Zone and Analysis of Suitability of Fire Station Location in the Kathmandu Metropolitan City, Nepal

Chhetry, Sachin Kumar; Kayastha, Prabin

Urban fire is a hidden danger for city safety. The Kathmandu Metropolitan City (KMC) is no exception. In KMC, there is an existing fire station, located in the Basantapur, central core of the city, Kathmandu, which is out of quick responding emergency aid. Hereto, this study presents fire susceptibility and vulnerability mapping, and appropriate fire station location area within the metropolis. For this, the study adopted geometric incremental method to estimate the population of 2013 based on latest census data. The detailed land use, road network and river network maps were obtained from the Department of Survey (DoS) for the susceptibility analysis. Based on these, the population density map and the distance from fuel station map were prepared for further analysis. As such, the study integrated Analytical Hierarchy Process (AHP) model and Index Overlay (IO) logic with Geographic Information System (GIS) as a Multi Criteria Decision Analysis (MCDA) tool. In this, various causative factors were considered for the fire vulnerability mapping such as distance from fuel station, population density and land use; and for the fire station location, land use, population density, distance from road and distance from river.

An area of 4.7 km² within the metropolis was found out to be fire vulnerable zone. Out of this fire vulnerable zone, 9.04 % fell under the high vulnerable zone, 32.92% under moderate vulnerable zone and 58.04% in the low vulnerable zone. The study also revealed that there was no fire vulnerability in Ward Nos. 10, 22, 25, 30 and 32 of the metropolis. The minimum fire vulnerability percentage was at Ward No. 31 while the maximum was at Ward No. 28. Similarly, an area of 13.46 % fell under the high suitability zone for fire station location, 35.97 % under moderately suitability zone and 50.57 % in the low suitability zone. As the moderately suitable area consists of built-up area, it was recommended to construct the new fire site stations in those areas. There was no suitability of fire station in Ward Nos. 22, 24, 25 and 30 of the metropolis. The minimum suitability percentage for fire station location was at Ward No. 3 while the maximum suitability percentage was at Ward No. 26. Such maps presented in this study are trustworthy for future land-use planning related to the fire vulnerable zone and fire station location to the Kathmandu Metropolitan City Office (KMCO).

Construction Management for Participatory Urban Road Construction and Maintenance Works in Lalitpur City

Gautam, Rudra Prasad; Shrestha, Hari Mohan

In Lalitpur Sub Metropolitan City (LSMC), the need of road extension is very high in newly developed areas, and need of road maintenance is also extremely high in inner city area. In comparison to budget available in municipal offices for Local Road Network (LRN) maintenance and upgrading, a participatory approach has been adopted since last 12 years, with the handover of the LRN to the local authorities by the Government of Nepal (GoN). Though inherited with advantages, these approaches have also many challenges in achieving timely completion of the projects within allocated cost and predefined quality. This study presented existing participatory urban road construction and maintenance works in the LSMC and recommends a best execution model under the prevailing rules, regulation and guidelines. There are many LRN in the LSMC, among them recently upgraded (five roads) and completed maintenance works (five roads) were selected as samples. The primary data were generated during research study from field survey and measurement, questionnaire survey, interactions and discussions with the respondents. Secondary data were collected from different literatures, LSMC and other publications.

It was found that the road construction and maintenance in LSMC was following the participatory approach. However, specific guidelines, design manual and detail specification were not prepared. The quality concerns were largely lacking. From the study, it could be concluded that the main challenges for the adaptation of participatory approach for urban road construction and maintenance are to have a systematic approach in legal, technical and financial ground and to provide trainings for the untrained user committee members. Besides, involvement of informal contractors for the implementation of road project needs to be checked and lack of consideration of maintenance fund by user committee should be addressed. A model is therefore suggested to follow management procedures for the execution of projects through participatory approach.

Construction Waste of Office Building and its Management with Special Reference to Nepal Telecom

Sharma, Sushmita; Sharma, Madan

Construction industry is one of the booming industries in Nepal, contributing to infrastructure development. Along with functional usable spaces, construction also generates wastes which have direct impact on economic and environmental issues. The research aim was to study how and why construction wastes were being generated and managed using the principles of 3R (Reduce, Reuse and Recycle) in four newly constructed buildings of Nepal Telecom having more than 500 m² in plinth area. Following descriptive and analytical pattern of research, the study used questionnaires to collect data from construction sites, Nepal Telecom technical team as well as municipalities to understand the scenario of construction waste management. The nature of the data was quantitative in terms of numerical assessment of waste production and qualitative in terms of studies of attitudes and/or perceptions. For qualitative assessment, three and five points Likert scale was used. Field observations also served as a tool to gain understanding of practices relevant to this research.

The study revealed that the construction industry followed orthodox construction methods and major construction wastes were concrete, reinforcement bars, wood and bricks. The use of new technology and prefabricated elements, though desired by Nepal Telecom were not being explored. The haste to complete design and construction works often created loopholes which resulted in more wastes. Lack of proper managerial planning, hesitation to invest in training and learning procedures and lack of monitoring and stringent rules from the government were seen as dominant causes of haphazard management of construction waste. Presence of theoretical understanding of waste management in all concerned parties and lack of pragmatic approach in its implementation were observed. The principal wastes identified could either be reused or recycled. Partial reuse and recycling techniques using scrap dealers were being practiced in all the studied sites. Potential measures for waste reduction were hardly addressed. After analysis of the collected data, a number of recommendations were made to the three major stakeholders, viz., the client, the contractor and the government. The recommendations include proper communication channels to be developed so that each concerned party can address issues of construction waste; use of waste specification in contract so that alertness is developed from initial phase; identifying secondary markets to encourage recycling; promoting use of prefabricated materials; encouraging source segregation of waste; municipality to enforce solid waste management rules and the government to develop policies to address construction waste and its management in an effective manner.

Construction Waste Minimization System for Nepalese Contractors

Baidhya, Sabir; Nakarmi, Mahesh

Construction Management with effective system and with updated processed information by well designed construction waste minimization software is a key for the success of any project. The objective of the study was to understand existing construction waste knowhow and develop a computerized software tool and a system of waste minimization and control in order to lower the percentage of waste generation in the construction site and to work in a database system to get the information regarding the status of the project easily whenever required. Decrease in the percentage of waste is “profit” for the contractors. During field work, questionnaire survey was conducted to investigate the current system of waste minimization. The average waste rates of dominant materials were also studied.

Current practice was manual based and hence lacked an effective and proper system. Software related to construction waste minimization was not quite available. Contracting companies, in general, were not calculating material waste quantity, amount and its percentage. Lack of user friendly software was the major problem for waste minimization and control; and most contracting companies believed, the current problem of waste, was due to the simple traditional manual management practice. The contracting companies in general agree for their little attention and non-realization of contractors towards waste minimization, and shortage of qualified personnel was not a major problem. Large variation in the responses was found. It can be interpreted as lack of accurate knowledge due to the absence of regular feedback through kept records (database) about waste rates from previous projects. Formwork with an average waste 22.69 %, sand with an average 18.23 % and aggregate with an average of 15.77 % shared the highest percentage of waste. All the contractors had shown willingness to get and use user friendly construction waste minimization software for maintaining database of materials, labour, equipments, supplier, waste quantity, amount and their percentage needed for managing construction projects. MS Excel was used in developing the software tool as most companies in Nepal are familiar with it. The software tool was implemented in a construction project to test its suitability to local practice. It has been recommended that contracting companies should use software for maintaining database system for saving time, cost and minimize the waste at source.

Cost Effective Housing for Urban Poor of Kathmandu Valley: A Case Study in Ichangu Housing

Joshi, Ronika; Gelal, Mani Ram

Nepal has been urbanizing rapidly with the current 17% of urban population and 3.38% of annual growth rate in urban areas. The high inflow of migrants seeking better livelihood opportunities, due to centralized development process, made the Kathmandu Valley to be out of its threshold capacity resulting into emergence of increasing numbers of slums and squatters in the urban centers. This trend of urban development shows further sprawling of slums and the spread of urban problems if no remedial measures are taken. The research aim was to analyze the attributes of urban poor and their housing condition and identify proper measures for providing them appropriate housing through cost effective technology. In order to fulfill these objectives, two settlements of urban poor - Thapathali and Sankhamul squatter settlement areas were chosen. Similarly, two housing types-one Non Governmental Organization (NGO) led resettlement project in Kirtipur and one government led housing project - Ichangu housing were taken. The research was conducted through literature review of related issue, followed by case studies and questionnaire survey designed for the two types. The first was aimed to examine the housing conditions of squatter/informal settlements of the study area and needs of low-income group, while the second was to analyze the feedback and suggestion from professionals involved in private and public sector. The need and requirement of the study area together with the approach of cost effective housing were demonstrated in government led Ichangu housing. The approach to cost effective housing was done through comparison of planning of land with its density per hectare through row housing and multi storey flat system.

The study revealed that low rise walk up apartment not exceeding 5 storeys provides the optimum level of land use. The use of Reinforced Cement Concrete (RCC) frame structure with hollow concrete as building infill material and the concrete door window frame with aluminum shutter play a significant role in minimizing the cost. As, the Ichangu Housing is the approach towards the cost effective technology, but still the cost reduction strategies could make it more cost effective to minimize Rs. 235,000 per dwelling cost. However, the study shows that urban poor are unable to access housing, even after using all kinds of cost reducing measures. So, suitable financing mechanism together with the policy support could make the cost effective housing approachable to meet the demand and supply of housing needs. Hence, there is a need of an interface between the formal financial sector and low-income households, where the government should act as the facilitator in managing the access of housing for urban poor.

Customer-Focused Performance Assessment on Apartment Buildings in Kathmandu Valley

Poudel, Suraj; Gelal, Mani Ram

It has now become indispensable to address the growing demand of housing due to rapid urbanization in Kathmandu Valley. With constraints of availability of land and its price rising, apartment projects have been best solution towards fulfilling urban housing needs, which provide vertical community living with all necessary amenities in prime location. The measure of customer satisfaction enables apartment construction companies to differentiate themselves from their competitors and create sustainable advantages in the long run. The study assessed customer focused performance of apartment buildings in Kathmandu Valley. Completed buildings for the study were Rio and Sunrise Tower whereas Grandee and Sunrise apartments were ongoing projects of respective developers. Key Performance Indicators (KPIs) were identified from literature review and contextualized through focused group discussion. Status of KPIs was analyzed by using Relative Importance Index (RII) and Relative Satisfaction Index (RSI). Quality gap in completed apartment projects was observed by comparing existing RII and RSI with maximum values. Along with the reliability of data, significant difference of each KPIs as well as KPIs of two apartments were tested by using t-test, as it is appropriate statistical tool for chosen sample size and applied research methods. Key informants of major stakeholders of apartment building construction were interviewed to suggest role and responsibility of measuring customer satisfaction and implementing feedback at different stages of project cycle along with the activities for enhancing performance level of ongoing apartment projects.

There was remarkable gap between expected and existing quality, hereafter referred as quality gap, in both of the completed apartment. Most of the KPIs in completed apartment buildings were at average level of satisfaction. Some of the KPIs were at less than average level of satisfaction in the Sunrise Tower. After analyzing key informants' suggestions, activities for enhancing performance could be summarized as; improvement in Customer-Focused Performance Assessment (CFPA) and feedback implementation system; improvement in legal framework; professionalism in apartment building construction; use of modern technology and materials in construction; and developing faith in apartment building construction industry. Further suggestions included collaborative effort of measuring customer satisfaction in different stages of apartment building project cycle and utilization of findings of completed projects in ongoing projects by responsible stakeholders, ensure continuously enhancing of customer satisfaction of apartment and provide safe as well as quality living standard housing facilities with sustainable housing construction industry.

Knowledge and Practice of Safety among Labours in High Rise Building Construction Works in Kathmandu Valley

Kansakar, Nisha; Shrestha, Hari Mohan

Construction works are often termed as dangerous, especially in high rise buildings. With a view to ensure safety for construction of high rise buildings, high standard of knowledge and practice are must, which is generally lacking in developing countries like Nepal. It is in the scope that the study was conducted and it presents the status of knowledge and practice of safety, and suggests possible safety measures to be adopted in high rise buildings construction. As such, ten sample projects sites were selected from the total construction industry of Nepal. Semi structured questionnaire was conducted to collect the relevant information.

It was found that, most of the labours had the safety items. However the use of the safety items was immensely lacking. Even with the basic ideas of the safety items, carelessness was the major reason for not following the safety acts, fire regulation acts and associated safety rules and regulations. Other major reasons behind the accidents in the construction sites were found to be irregular repair and maintenance of the tools and equipment. Knowingly or unknowingly, the use of helmets (hard hats) in the construction sites was found to have reduced the accidental cases. From the study, it can be concluded that knowledge and practice increase with education, experience and skill. Hence, training should be provided to increase the knowledge and skill, of the labours. It is recommended to have strict rule and regulation and policy, establishment of separate safety department, and provision of supervisors and regular monitoring. The labour force should be familiar with the cause and effect of accidents and its remedy. For further safety for the minor injuries and inner injuries, safety belts, gloves, shoes, masks, glasses, aprons etc should be strictly used. Other safety measures like air plugs for prevention of noise, speaker for clear communication and announcement systems are to be introduced in the construction sites.

Maintenance Practices and Funding Mechanism of Rural Roads: A Case Study of Sunsari District

Mishra, Krishna Kumar; Gelal, Mani Ram

There are about 50,000 km rural roads (DoLIDAR-2012) in Nepal out of which 1,200 km is in Sunsari District. With the restoration of democracy in 1990, the trend of rural road construction has increased tremendously, however, the provisions for proper maintenance are lacking. Therefore, the serviceability of these roads has always been questioned. The main objective of this study was to analyze the effectiveness of existing maintenance practices and funding mechanism of roads in Sunsari District. The study examined the current maintenance practices, identifies problems and checked whether sectoral policies are being implemented or not. This descriptive research was focused on following parameters: (a) general information about maintenance need of rural roads (b) maintenance planning and funds (c) maintenance policies and practices (d) institutional and managerial capacity of local bodies for road maintenance, and (e) suggestions for effective road maintenance practices. Issues were identified through the literature review and preliminary consultation with the stakeholders. The questionnaire for primary data was distributed and interviewed to a wide range of stakeholders, i.e., District Development Committee (DDC) and District Technical Office (DTO) management, secretary of Village Development Committees (VDC) and transportation professionals. By administering the questionnaire, opinions of the stakeholders about the major issues on maintenance practices and funding were obtained.

Most of personnel agreed that the local body mainly DDC to be responsible agency for maintenance and funding of rural roads. Most significant causes of road failure were found as: heavy axel load, lack of quality of material used, poor workmanship and lack of supervision. The study found out that there exist a big gap between “resource requirement”, “funding available”, its “planning” and “implementation” of maintenance works. The study recommends the establishment of a separate rural road maintenance unit in the district under DDC/DTO. Also there is need of institutionalization of maintenance mechanism to strengthen and capacitate key stakeholders so that these entities can function and operate in the long run. There is an arrangement for special fund for maintenance in DDC according to Local Agencies Financial Administration Regulation (LAFAR, 2007). Therefore, following the provision, DDC needs to arrange necessary resources to construct physical infrastructure and perform maintenance works. The amount collected in special fund for maintenance should be termed “District Rural Road Maintenance Fund (DRRMF)”. Financial resources can be generated for this from sources like Government of Nepal (GoN), Roads Board Nepal (RBN) and donor organizations supporting road projects and part of complementary fund should come from local agencies.

Opportunities and Challenges of Land Pooling for Urban Development in Nepal

Wagle, Suresh Kumar; Gelal, Mani Ram

The gap between supply and demand of planned urban land is leading to haphazard urbanization and unhealthy urban living environment. The study aimed to assess the opportunities and challenges of land pooling for planned urban development in terms of land demand, physical challenges, and socio-economic issues. Random sampling method was used for sampling the landowners and judgmental sampling was used to select other stakeholders. Literatures were reviewed and secondary data were used for the population projection and to calculate the land demand and supply. To understand the general land pooling practice, three lands pooling projects were studied and analyzed.

Land Pooling (LP) was found as a participatory flexible process of land development in terms of spatial, physical, demographic and socio-economic condition of project site and landowners. Considerable boost in land value and planned and serviced land was found. Clarity on purpose of its development and project boundary; technical, financial and economic feasibility of the project; consensus among the landowners; negotiation skill of project team; availability of initial financing source; need and desire of landowners; composition of Land Management and User's Committee and their decision making process were critical factors. Easy acquisition of land for public purpose, formulation of ample policies and legal instruments, establishment of various institutions, increasing demand of developed urban land, and availability of vacant land in most of the urban centers, easy to enforce land-use zoning, participation of landowners, economic upliftment of landowners and proximity area, proportionate contribution, best way of resolution of its dispute were some other opportunities. Low government investment in urban sector, unclear policy and conflicting legal provisions like land ceiling, weak institutional capacity of local bodies, establishing inter agency coordination, initial financing, primitive land record, land fragmentation, disputes among landowners, maintenance of infrastructure, difficulty to get consensus from land owners, managing surplus fund, existing infrastructure, formulation and imposition of bylaws, unregistered plots and social inclusion were the main challenges. Intervention from concerned agency at Policy, Administrative and Project Level is expected in terms of land use plan, concession on land ceiling and floor area ratio, mode of contribution, availability of revolving fund, strengthening local bodies, enhancing inter-sectoral coordination, social inclusion and cost sharing by the government in LP projects.

Performance and Sustainability Challenges of Small Town Water Supply and Sanitation Project in Lekhnath Municipality, Nepal

Ghimire, Dinesh Kumar; Bhattarai, Bidya Nath

Adequate and safe drinking water is essential for life and is right of every citizen, provision of which is becoming challenging in most of the developing countries including Nepal. The construction of utilities is given more attention whereas the post construction activities are overlooked in most of the cases which leads to the inefficient service delivery from the water utilities. In this scope, this study presents an assessment of the post implementation performance and challenges of Lekhnath Small Town Water Supply and Sanitation Project (LSTWSSP) for its sustainable service delivery. For this, the study collected primary data through field observations, formal and informal interviews with project officials, technicians, local household beneficiaries, Water User and Sanitation Committee (WUSC) members and local leaders; and secondary data through project related documents, audit reports, websites, publications and journal articles. The study identified different performance indicators of water utilities such as Non Revenue Water (NRW), working ratio, staff per 1000 connections, etc.; and the sustainability factors of water utilities such as financial, technical, social and environmental.

It was found that the performance of the LSTWSSP was satisfactory with respect to best practice values in terms of indicators working ratio, staff per 1000 connections, and it was below best practice with respect to NRW and services coverage to population. Lack of technical expert team and instrument were main problems for improving the indicators like NRW and its service expansion. Besides, it was found that the LSTWSSP was strong in civil society participation, however the grass root level involvement was still lacking. Major causes of water problems identified were bursting of pipes in winter season, frequent disturbance of water system and uncontrolled urbanization. About 96% of respondents argued that one of the causes of such problem in water supply was due to construction errors in pipeline layout, designing High Density Polyethylene (HDP) pipe in place of Galvanized Pipes (GI) pipes and low depth of pipe line trenches. They pointed out that natural calamities were also a major cause of such problems. External supports, in terms of technical and financial assistance without any major operational intervention was emphasized by about 88% of the respondents. Unequal distribution of water supply among the sub-systems areas and intermittent supply were some other problems. It was therefore concluded that among the different factors of sustainability, technical backwardness and lack of external support were the major ones in the system.

Performance Assessment of Irrigation Management Transfer in Sitaganj Branch of Sunsari Morang Irrigation Project

Jha, Bhagwan; Sharma, Khem Raj

Since late 1980s, Department of Irrigation (DoI), Nepal has been in the process of transferring the management of public irrigation systems over to Water User Associations (WUAs) through participatory joint management and turnover programmes with the inherent idea of increasing agricultural productivity by ensuring equitable distribution of irrigation water to the users and reducing government's obligation to the operation and maintenance (O&M) of the system. As such, this study was undertaken with an objective to assess the performance of the Irrigation Management Transfer (IMT) of Sitaganj secondary system (SS9) of Sunsari Morang Irrigation system (SMIS) under Irrigation and Water Resources Management Project (IWRMP) of DoI. For this, the study carried out several field activities between August and September, 2013 such as physical walkthrough in the system, participatory rapid appraisal, household sample survey and interview with key informants both of DoI as well as various tiers of WUAs; with focus on examining the current physical, agricultural, socio-economic and institutional status of the SS9 system.

From the study, it was found that almost all the steps needed to be followed under IMT were completed in haste. It was based on almost top-down approach, and agreement between DoI and the WUA was completed without sufficient grass root exercise. The water distribution system however, has been found to be better established and improved than before; as such the cropping intensity got increased from 176% to 205% after the IMT. It was also revealed that Irrigation Service Fee (ISF) in the form of cash was collected on the basis of landholding size in the command area with the rate of Rs.300/ha/year which was found to be far less than adequate to cover O&M cost of the system at present. Furthermore, conflict occurrence has decreased after turnover due to the development of some ownership feeling among the water users. The yields of paddy, wheat, maize, sugarcane, oilseeds, and potatoes increased at different levels after turnover. However, the farmers at tail reach do not get irrigation water as regular and sufficient as the farmers at head reach, and therefore the farmers at tail reach were often reluctant to pay ISF. As a result, the collection of ISF has not been regular and effective and it is quite difficult to increase ISF tariff. To address this issue, it is suggested to deliver adequate irrigation water timely to the tail reach areas particularly by augmenting water from Thalaha and Tengra Kholas to SS9 canal system. The other important task to be considered is to install effective mechanism of silt removal to increase performance of canal system for ensuring sufficient irrigation water from head to tail reach of the system.

Road Traffic Accident in Banepa-Sindhuli-Bardibas Road and its Countermeasures

Gyawali, Pashupati; Gautam, Ghana Shyam

Among 208 National Highways, Banepa-Sindhuli-Bardibas is one which connects Mid-Hill region directly with the Terai region of Nepal. The 160 km highway starts at Dhulikhel and ends at Bardibas. Based on available statistics, the Nepalthok – Dhulikhel section of this highway was found to have higher frequencies of accidents. The road infrastructure and ancillaries are the means to segregate the traffic there by enhancing perceived safety. In order to provide such facilities, a research was felt necessary. Thus, the research was intended to identify locations as well as causes of accidents. The study finally concluded with the accident cost and possible countermeasures for safe and smooth traffic in future. The research was basically focused to identify causes of accidents related to: road side peoples, drivers, vehicles and road geometrical parameters. Accident data were collected from District Police Office of Kavre, Sindhuli and Bardibas. Questionnaire survey was conducted to further look in to the causes of road accidents based on human perception. Field observations were carried out to evaluate the road geometry with set standards, at the locations occurring high accidents. Human capital approach was used to estimate the cost of losses caused by road accident.

Based on accident data, 83 accidents occurred during four year duration (2008-2012). Among 83 accidents, 105 were fatalities, 102 major injuries and 123 minor injuries. Based on road side people's behavior, non – compliance of traffic law, children playing over the road are found as the major causes of accidents. Likewise high speed and drivers under liquor influence were other major causes. Lack of regular maintenance was observed as the cause related to the vehicles. Again the sharp curves with insufficient sight distance and set-back distance were observed as road geometrical causes of the accidents. Based on the findings, awareness campaigns and restriction to road crossings are the recommended measures for road side peoples. The drivers were not limiting the speed even in speed restricted areas, so enforcement of law and mandatory road safety courses are recommend to the drivers. In order to increase the sight distance and set-back distance, widening and back cutting are recommended for improving road geometry.

Role of Private Financing and Management of Road Infrastructures for Economic Development - A Case Study of Kathmandu – Kulekhani Tunnel Highway Project

Dhakal, Chuda Raj; Devkota, Dinesh Chandra

For safe, reliable and cost effective transportation service to enhance standard of living, private sector is a major partner to fulfill the fund gap. The study presents the issues and identifies the solution for road transportation project development through private financing along with its economic benefit and policy issues. Primary data were collected through two sets of questionnaire administered to people of Zone of Influence (ZoI) and experts (stakeholders) in related field and four focus group discussions with experienced professionals, bureaucrats, clients/consultants, contractors, investor and lawyers. Secondary data were collected through policy review, analyses of laws, rules and lesson learned from neighbors as well as western countries. In order to examine the importance of private financing, four aspects (mean, standard deviation, population mean and z-test) were applied.

It was found that due to lack of a permanent institution, policies are not specific to allocate the functions, authorities, responsibilities and resources to create investment environment in the country. This is highly important to collect toll charge, handle judicial cases, address the issues of killer project and wasteful competition, transparency, toll charge collections, role of oversighting agencies, monitoring and evaluation system, FDI and Tax management. The project is feasible and affordable based on Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), funds using in local materials, employment opportunities, saving operating cost and travel time cost and sensitivity analysis. So, to fulfill the fund gap by solving the social issue with national pride, private financing is highly significant. Act, guidelines, policies, provisions should be amended to specify the allocations of functions, authorities, responsibilities, resources through permanent institution under the Prime Minister with representation from Ministry of Finance, leader of opposition party in parliament, National Planning Commission (NPC) and line ministry. A state share investment infrastructure company should be established under infrastructure development bank to enhance good governance for financing close up with monitoring and optimizing the resources with national consensus by ensuring the successful implementation of Kathmandu – Kulekhani Tunnel Highway.

Role of Superplasticizers in Concreting Works

Shrestha, Mukesh; Sharma, Madan

Concrete is probably the most used material in construction works. Increasing the strength of concrete, and hence minimizing the concreting works (and volume of its ingredients) is therefore a need. It is in this scope that this study presents a detailed analysis on the variation in strength of the concrete, reduction of water without affecting workability, reduction in the quantity of available local materials such as fine aggregate (sand) and coarse aggregate and the reduction of cost without affecting the desired strength of the concrete by using super-plasticizer. For this, a nominal size of the aggregate within 20 mm was used. The super-plasticizer named COREPLAST SP2 and a popular brand of cement in Nepal, namely the Udaypur, Gainda Chhap were used. The fine aggregate used was outsourced from Sangle Khola, Gongabu, Kathmandu, and coarse aggregate from Mahadev Besi, Dhading. Varying water cement ratios of 0.5, 0.48 and 0.46 were used in the study. Besides, the variation in characteristic strength at 7 days, 28 days and workability of only M20 grade of concrete with and without the above super-plasticizer was studied for preliminary test results while for further tests, characteristic strength at 28 days of three different grades of concrete namely M20, M25 and M30 by increasing the dosage of the super-plasticizer was studied. The workability without changing the water cement ratio of the three grades of concrete with and without super-plasticizer was studied too. Similarly, the change in workability by reducing the water cement ratio with and without super-plasticizer was also studied. The change in size of members such as foundation, beam and column with one grade of concrete without using super-plasticizer and the higher grade of concrete achieved by using super-plasticizer without changing the cement, fine aggregate, coarse aggregate and water cement ratio were also studied.

It was found that the strength of the concrete changed with the change in the quantities of the super-plasticizer. The characteristic strength of the design mix of M20 grade concrete without super-plasticizer could easily impart characteristic strength of M30 grade by only using selected amount of super-plasticizer without changing the ratio of cement, fine aggregate, coarse aggregate and water / cement ratio. Furthermore, it was also observed that the workability increased on same water cement ratio by using super-plasticizer. The same desired workability could also be achieved by adding selected dosage of super-plasticizer even by reducing the water cement ratio. Additionally, the study showed that the characteristic strength of M20 grade of concrete increased to the characteristic strength of M30 grade by simply adding 0.5% super-plasticizer. This resulted in the reduction in quantity of concrete by 19.83% in column; 7.69% in beam and 11.36% in foundation which is 8.50% in overall context of structural concrete thus decreasing the quantities of local materials such as cement, sand and aggregate by the same percentage. The results obtained from the study reveals an appreciable amount of cost saving by using super-plasticizer provided the structure is designed for higher grades of concrete, generally M30 and above. The overall cost reduction was found to be about 4% in the structural concreting works on the addition of super-plasticizer.

Safety of Workers in Road Construction Project in Nepal

Paudyal, Sunil; Gelal, Mani Ram

Safety of workers is of paramount importance in any construction project and road construction project is no exception. It is in this scope that this study presents an analysis of the safety of workers in road construction projects in Nepal. For this, three running projects; Dhulikhel – Sindhuli – Bardibas Road, Maldhunga – Beni Road having different size and capacity and being implemented through International Competitive Bidding (ICB) and Kathmandu – Nijghadh Supper Express Road similar to the ICB contract, were selected. Primary data was collected through questionnaire survey and walkover field survey whereas source of secondary data from literature review and contract documents of the respective projects. Percentage based data was generated in most of the cases and presented; and Likert Scale was also used in some cases.

The study revealed that the condition of safety in the road construction projects was not satisfactory. Accidents occurred in all the projects and death was on top of the impact list. Lack of safety trainings and lack of motivation were the major reasons of the accident from the management perspective whereas lack of safety culture was reported from the workers' perspective. There was no effective government organization to follow up and contribute in improving safety in road construction projects. The stakeholders of the road construction projects did not have knowledge about current rules and regulations regarding the safety even though they all believed that implementation of safety regulations could help in reducing accidents. Workers did not get job related trainings. There was no practice of safety recording and accident investigation. Deployment of safety officer was rare and regular safety meeting and audit were found almost nil. The major causes of accidents were: falling object and fall from the height. Other causes were insufficient and unskilled operation of equipments, hit by highway vehicles, trench collapse, negligence of site supervisors, lack of safety trainings etc. The study also found that there was a provision of safety in the contract documents and they have workers' insurance in their construction site. The study further revealed that the cost of safety was less than 1% of contract amount and the study therefore suggested to include the same in bill of quantity as separate item. Including safety provisions in specifications and bill of quantity and also for the establishment of strict monitoring system to follow safety regulations could reduce the risk. Formation of separate government agency to provide regular information regarding rules and regulations of safety, follow up and evaluation of the safety performance, training to the workers, improving safety culture and budgeting for safety measures are some other recommendations.

Seismic Details Implementation in Apartment Buildings of Kathmandu Valley

Bajaracharya, Prabin; Shrestha, Hari Mohan

Kathmandu Valley has a long history of destructive earthquakes. Lots of apartment buildings are being constructed in the valley to meet the ever growing demand of the population. It is in this scope that this study overviews the knowledge of the various stakeholders involved in the construction of apartment buildings in Kathmandu Valley on seismic details. The research also aims to review the ongoing procedure for the construction of apartment buildings highlighting the importance of the seismic details. The major objective of the research is to identify the existing knowledge of the different stakeholders regarding the use of the seismic detailing during the design of the apartment buildings. In addition, the research aims to identify the construction practices and the application of the seismic details in apartment buildings. For this, descriptive research analysis was carried out with the field visit, discussion with the experts, and questionnaire survey with different stakeholders such as client, contractor, consultant and the technicians from Department of Urban Development and Building Construction (DUDBC).

It was found that most of the issues and agenda were covered by the designers, construction team as well as the DUDBC technicians to make a seismic resistant apartment building. In essence, most of the details such as strong columns, weak columns, percentage of flexural reinforcement, lapping position and detailing and other issue were well evaluated and implemented on site. Minor lapses were made as higher percentage of reinforcement was placed on site ultimately making congestion on the joints. Availability of the required length of the reinforcement also was found to govern the lapping position of the reinforcement bars on the beams, columns and other important structural elements. Moreover, the construction field of the apartment building had been streamlined in better direction at present. All the stakeholders involved in this field had ample amount of knowledge regarding the present national scenario regarding the earthquake and the risk it brings within the construction field. All the designers, consultant, builders, contractors, employee of DUDBC as well as the users were well aware of the significance of the seismic details in the construction. The technical knowledge and information were readily available however need to be strictly followed. It was observed that the DUDBC was leading from the front to supervise all the apartment buildings that are being constructed and are making considerable efforts in controlling the quality. Most of the major stakeholders in Kathmandu Valley, all those involved were making a greater effort to make all the construction of apartment buildings earthquake resistant. It can therefore be concluded that if the present procedures and norms were strictly followed the apartment buildings that were being designed and constructed would have been seismic resistant. In addition, if all the stakeholders involved took more liabilities and responsibilities in the project implementation, then the apartment buildings will prove to be safer to live in against the risk of earthquake.

Study of Selected Community Managed Stone Spouts and Dug-wells in Lalitpur Sub-Metropolitan City

Jaiswal, Shankar Prasad; Mishra, Nawal Kishor

Lalitpur Sub-Metropolitan city is rich in natural sources of water, stone spouts and dug wells. As there is limited supply of drinking water in Lalitpur, these traditional stone spouts and dug wells play important role for the management of the sub-metropolitan city drinking water supply. Hence, this research is formulated in order to find out the causes for non-functioning of dug wells and stone spouts and postulate the way forward to revive their utilization. The study selected four stone spouts and four dug wells, half of those are non-functioning. The methodology included the field observation, questionnaire survey for water users, focus group discussions with local people and key informant interview with government officials. The results obtained from the laboratory test conducted for samples from each location were used to explain the quality of water in terms of physical, chemical and micro-biological parameters.

Based on field observation the recharge capacity of soil and the discharge of water in stone spouts and dug wells were found as non-uniform. So the design, drawing and construction methods of recharge technologies should not be same for all the locations. A gap was observed during designing and construction stage of the installed recharge technologies, which is due to the lack of policies and design guidelines. So there is need to accord a standard for the design and construction of recharge technologies. Also, the existing water recharge technologies, including recharge pits and rain water harvesting, installed in Lalitpur city were inefficient to fulfill the requirements. The installation of number of recharge pits and rain water harvesting is recommended for construction based on proper design guidelines. The users agree that there is gradual decline in the yield of water in dug wells and stone spouts. The results show that the active bodies for the preservation of stone spouts and dug wells were: *Guthi*, local clubs, NGOs and Municipality. The existing activities for maintenance and preservation were found unsatisfactory. Based on observation and local people perception, these areas can be saved for a long term by declaring stone spout and dug well area as heritage area, and formulating heritage friendly policies. As the quality of water is directly related with the health of people, a regular mechanism for water quality test is recommended along with the notification system to the users.

Time Overrun and Its Impact on Cost of Construction of Small Hydropower Projects in Nepal

Thapa, Suman; Mishra, Anjaya Kumar; Pandit, Hari

Despite having huge hydropower generation, Nepal is suffering from load shedding which can be reduced by harnessing this potential with the construction of hydropower plants. Many hydropower plants have been proposed and construction work has started. However, the timely completion of these hydropower plants as a result of varied casual factors is the main issue which not only delays the project but also profitability of hydropower projects. In this context, the study aimed to find out factors, magnitude, cost and the way time overrun has been increasing the cost of project along with its economic evaluation. For this, four projects were selected for study; namely, Hewa Khola Hydropower Project (HKHPP) of Sankhuwasabha District, Middle Chaku Khola Small Hydropower Project (MCKSHPP), Bhairab Kunda Hydroelectric Project (BKHEP) of Sindhupalchowk District and Bijayapur Khola-1 Hydropower Project (BKHPP) of Kaski District based on area-sampling-technique. Two set of developed questionnaire - first set for client and second set for client, consultant and contractor followed by informal interview and two focus groups discussion in MCKSHPP was done. The qualitative data of questionnaires was converted to quantitative data with five point ranking Likert scale to calculate Relative Importance Index (RII) for causes of delay to find major factor and its cost. The increment of the cost by time alone had been calculated by detail costing and analysis along with its economic evaluation and without time overrun.

It was found that all sample projects were facing time overrun. The major factors for this were found to be social issue and land acquisition with resulting 90% and 97 % of its estimated cost increment respectively in MCKSHPP. Furthermore, 18.27% cost increment of total estimated cost was found on which 30 % was only due to time increment. Along with time overrun direct cost was negatively related and the indirect cost was positively related, direct cost was more significant than indirect cost of the hydropower project resulting in the total cost negatively related with time increment. Profitability was decreased due to time factor though it was positive till other factors were not impacting. The research concluded that social issues were the main cause of time overrun which was not properly addressed at time of planning. Time overrun had become norm than exception on projects. Time was partial factor of cost overrun causing to reduce its profitability. Besides time other factor which was causing the cost overrun is to be identified and control for cost overrun. It is recommended that the developer should focus in reducing the direct cost, too. At the time of planning social demand should be addressed by social impact assessment through the provision of significant amount of expenditure.

Trail Bridge Maintenance Management System in Nepal: A Case Study of Tanahun and Gorkha Districts

Singh, Resham Jung; Dallakoti, Khem Nath

This research was based on the study of existing Trail Bridge Maintenance Management System in Nepal. The main objective of the study was to study the current situation and practices of Trail Bridge Maintenance Management System and to find out shortcoming/difficulties and suggest appropriate maintenance system. Tanahun District is selected for research as it represents the average district bridge number of the country and mix topography. Gorkha District is also selected for case study of Trail Bridge due to presence of old and valuable Trail Bridge in the district and to study the condition and situation of maintenance practice along with Pritihvi Highway over Trishuli River. Questionnaire survey, interview, case study are carried out to get information and suggestions with Bridge Wardens, Bridge Maintenance Committee members, Sub-Engineers, Engineers and Senior Divisional Engineers of DDCs/DTOs, DoLIDAR Trail Bridge Support Unit/HELVETAS Nepal and the beneficiaries. This study tried to study the present situation of maintenance and the prevailing factors because of which Trail Bridges are in poor condition and it also incorporate situation of maintenance management system at operational level to the policy level. This study tried to find out the associated problems and difficulties and analyze the existing policies, strategies regarding maintenance.

Major causes identified behind bridge vulnerability are lack of effective routine maintenance, lack of ownership of users and lack of timely support for maintenance from DDCs and concerned agencies. There was no effective maintenance planning mainly due to lack of updated District Bridge Records. Complete picture of the present practice of maintenance is reflected in this study. The outcome of this research assists VDCs, DDCs, I/NGOs, DoLIDAR, Donor Agencies and other stakeholders to understand the root problems and possible solutions for trail bridge maintenance. Furthermore, all major stakeholders need to give special focus on proper planning and give top most priority for bridge maintenance; follow the prevailing policies and strategies and establish reporting, monitoring system as proposed in this thesis. Besides, it is recommended to establish an effective Trail Bridge Maintenance Management System.

Community Management of Rural Water Supply and Sanitation System in Ugrachandinala VDC, Kavrepalanchok District of Nepal

Gautam, Ananta Prasad; Sharma, Khem Raj; Shrestha, Anushiya

Access to safe drinking water and sanitation services is fundamental need to improving human health and health of a nation. Provision of safe water supply and improved sanitation to the rural areas has been a major challenge to the national governments in the world and more particularly in the developing areas like Nepal. It has been increasingly accepted that operation and maintenance (O&M) are keys to improve the performance, efficiency and sustainability of the rural water supply and sanitation services in developing countries. In addition to technical issues, these include social, community, gender, financial, institutional, political, managerial and environmental aspects and should be managed at the community level with appropriate support from the state and the non-state agencies working to improve water supply and sanitation situation. Nonetheless experience of rural water supply and sanitation services in Nepal reiterates lack of access to management and technical skills and materials resulting poor management by water users committee of operation, resource mobilization as a major issue pertaining to community managed rural water supply and sanitation schemes. In this context this study was undertaken to understand the operation and management practices of a functional scheme, evaluate its socio-economic contribution and analyze the operation and maintenance issues pertaining to community managed rural water supply and sanitation scheme in Kavrepalanchok District of Nepal.

The study used a descriptive research design. Qualitative information were garnered through focused group discussions, key-informant interviews, field observations and informal meeting with water users and key functionaries of the rural water supply system under this study. The collected information were substantiated through consultation with the representative from NEWAH (implementing organization for the system) and review of literatures related to operation and management aspects of rural water supply and sanitation within national and global contexts. The study found community participation; involvement of women and socially disadvantaged groups in all phases of the project has made Kodarthulichaur one of the best functioning rural water supply and sanitation schemes of Nepal. This community managed system has been functioning independently for over a decade. This has brought significant improvement in the rural community through improved water access and availability and reduction in diseases. The time saved through improved water access and improved health has increased economic involvement of local people especially women in economic activities. A notable social contribution has been inclusion of socially marginalized ethnic groups in general community activities including operation and maintenance of the system. Despite its achievements and appreciations in effective management and substantial socio-economic contribution, the scheme has its weakness related to technical, financial, social and institutional management. Lack of contingency planning for major repairs which seemed to be required in the near future and inadequate financial and technical capacity were major issues related to operation and management of the water supply and sanitation system. Effective and timely addressing of its operation and maintenance management issue is necessary for sustainable functioning of the system and in maintaining the goodwill established by the scheme.

Impact of Climate Change on Agriculture and its Adaptation Practices: A Case Study in Dhungekharka VDC, Kavrepalanchowk District

Manandhar, Ajay Vikram; Poudel, Prem Prasad

This study attempts to find out the impact of climate change on agriculture in Dhungekharka VDC, Kavrepalanchowk, Nepal. The objectives of the study were to know the level of people's awareness and knowledge on climate change, particularly, to assess the impacts of climate followed by the communities to sustain and enhance their livelihoods. Interview was conducted with thirty local people comprising of 3-4 households from each ward representing poor, medium and reach category with the age range of 15-60. Seven Key informant interview and four Focus Group Discussions were conducted in order to validate household data and explore more information. Secondary data were collected from literature review. Monthly temperature and rainfall data (received in Dhulikhel station during 1878 to 2011/12) from department of Hydrology and Meteorology were assessed to analyze the annual variability and their influence on agriculture pattern. The data collected during the field works were analyzed by using both quantitative and qualitative methods. Quantitative data were analyzed using descriptive statistics such as percentage, mean, variance, linear equation and use of graphics whereas, changes in water resources, drying of marshland, change in rainfall pattern, change in temperature trend, change in different flora and fauna and increase in disease and insects in agriculture crops were collected in qualitative form.

Study indicated that local people have been facing adverse effect of climate change from past decade. The adverse effect was especially seen in agricultural production and water resources. Change in flowering season, decrease in yields of the crops, change in crop calendar, change in water resources, drying of marshland, change in rainfall pattern, change in temperature trend, change in different flora and fauna, increase in diseases and insects in agricultural crops was expressed. Farmers have practiced crop rotation, vegetable farming and cultivated new disease resistant varieties and adapted intercultural operations in order to tackle the climate change effects. For example, in maize seedling, most of them used spading rather than plough for minimization of drought problem. They have been starting low cost sprinkle irrigation in place of canal irrigation because of less rainfall and less flow of water in river. In conclusion, this study noted that climate change has effects on local livelihood of Dhungekharka, Kavrepalanchowk, Nepal. Agriculture and water resources are the most affected areas, which are also recognized by national adaptation programs of action especially with the changing rainfall and temperature trend. So, awareness generation and capacity building program should be focused for local people to minimize this problem. Agriculture research agencies and government of Nepal should make appropriate policy and implement properly to minimize the risk of disaster including climate variability in future for this region, who were committed for making climate change resilient community.

Bagmati River Channel Planform Change and its Social Implications in Kathmandu Valley

Shrestha, Process; Sada, Rajesh

Bagmati River Channel has undergone a lot of changes in the past and has been the victim of growing urbanization. Bagmati River has suffered a tremendous pressure from human intervention including its conversion. The study entitles Bagmati River Channel Plan form Change and its social implication in Kathmandu valley intended to look into the pattern of channel change and land use change along the river corridor during the three time periods. It aims to analyze the impacts it brought with the river channel change through local people perception. The study was primarily based on review and analysis of secondary sources. Aerial photographs of 1964, 1998 and goggle satellite image of 2010 were used to analyze the trend of river channel shifting and land use change pattern of Bagmati River using ArcGIS 9.3 software. The total river stretch has been divided into five segments based on presence of physical barrier and confluence with other river. Similarly, 12 land use classes have been identified for land use change analysis. Two sections with most channel deviation in the past were selected and close ended structure questionnaire survey was held at Nayapati to Gokarna gorge and Tinkune to Sankhamul sections.

Study identified that the Bagmati River channel has shifted from its previous course confined in the flood plain of the previous channel in the downstream of the river stretch. The maximum shifting of river channel was observed in Guheswori to Sankhamul gorge section with average migration of 122.510 m during 1964 to 2010 followed by 115.564 m in Nayapati to Gokarna gorge section during the same period. The analysis of the sinuosity index of all three time periods showed that the overall Bagmati river possesses the meandering channel characteristics with average sinuosity value of 1.726 while segment wise analysis indicated that it has a characteristics of a sinuous channel except in the Nayapati to Gokarna gorge section where it depicts a meandering channel characteristics with maximum sinuosity value of 2.022 in 1964. The land use change analysis of 520 hectare along the river corridor indicated that the water body has decreased to 36.27 hectare in 2010 compared to 141.92 hectare in 1964 but built up area has increased to 118.392 hectare from 17.75 hectare indicating Bagmati corridor land conversion for other purposes. Most of the people in the Narayani Gokarna area have lost their agriculture land resulting in the loss of income source. Local people perceived that the river has started shifting its course in the early 1980s and the survey showed that the river width has increased to double fold from the past in Nayapati - Gokarna section whereas it has decreased by more than two times in Tinkune - Sankhamul area. The study concluded that the Bagmati River is a dynamic river which best depicts on natural flow condition. Hence the encroachment along the river corridor should be controlled; people participation in river restoration should be enhanced, proper preventive measures to prevent future impact by the river course change need to be taken to reduce the risk of loss of lives and property.

Comparative Assessment of Governance in Buffer Zone Community Forest and Community Forest of Barandabhar Corridor, Chitwan

Nepal, Padam Raj; Bhujel, Krishna Bahadur

This research was carried out to assess and analyze existing institutional capacity of the buffer zone community forest user groups (BZCFUGs) and community Forest User Groups (CFUGs) of Barandabhar corridor in Chitwan district and compare their existing status of governance. Forest governance is characterized as a process encompasses “*Rule of Law*”, Transparency, participation, accountability, responsiveness, efficient and effective, inclusive and equity and consensus oriented decisions. Analysis is based on field data obtained from direct field observation, house hold survey, focus group discussion, and key informant interview. Secondary data were collected from various sources which include FUGs constitution/operational plan. Statistical tools such as means, variance, standard deviation and t-test were used for the analysis purpose.

The study shows that in both model of forest management (BZCFUG and CFUG) complexities of effective governance exist at various levels. Although it appeared that the CFUG have slightly higher level of good governance practices than BZCFUG, it is statistically insignificant. At FUG level, this difference results due to differences level of awareness, adaptation of transparent and accountable mechanism, protection oriented management, CF related rules and regulations and influential role of politician on resources. The influence of political parties was found to be high affecting their governance system (virtually no autonomy), which may result into failure of the system in the long run. Making FUG more transparent, accountable, efficient, responsive to all users including marginalized group were the major challenges. Gradual increase in participation in marginalized group in committee and general assembly, and maintenance of record keeping with minutes, were some opportunities of FUG to ensure good governance. The study suggests that governing process need to improve through transparent mechanisms in terms of access to information, decision making, law enforcement, benefits sharing and ensuring the meaningful participation.

Assessment of Governance Practices in Buffer Zone Management Program of Sagarmatha National Park, Nepal

Dhakal, Bed K.; Bhatta, Shiv Raj

The research entitled Assessment of Governance Practices in Buffer Zone Management Program of Sagarmatha National Park(SNP), Solukhumbu,Nepal was conducted to assess governance practices of the Park . One Buffer Zone User Committee (BZUC), the Khumbila, was selected randomly among three BZUCs in SNP for the detail study. Semi structured questionnaire surveys, interview with key informants, focused group discussions and direct observation were carried out for the collection of data. This study was based on 3 years program of the Buffer Zone Management Program (BZMP) during which NRs. 75.9 Million (US \$ 1,085,346) was spent on buffer zone management activities. Integrated conservation and development activities such as those related to conservation, community development, skill enhancement, and conservation education were implemented under this program. Microhydros and community buildings were additional activities implemented under this program. The buffer zone management program was found as one of the innovative participatory and decentralized programs in natural resource management.

The analysis of governance in buffer zone development program was carried out based on the three parameters of governance- participation, transparency and accountability. Each of the parameters was further divided into four indicators for detail assessment. Spider web tool was used for analysis. People participation during formation of user group (UG), user committee (UC) and Buffer Zone Management Committee (BZMC) was fully satisfactory. On the other hand, participation of stakeholders in programming and budget preparation, and major decision making process was satisfactory, but was poor during program implementation. Most of the programs were implemented by limited member of UC. Participation of women in UGs and UCs was found satisfactory but there was no woman representation in BZMC. Local communities were well informed about the BZ program and the budget. There was a mechanism of coordination with stakeholders for conduction of integrated conservation and development activities. Result showed poor transparency during implementation of projects although the projects were proposed by the local communities through consultation. Accountability of UG, UC and BZMC was satisfactory, although their accountability could be enhanced through proper implementation of audit report and public hearing.

Participation of Women in Irrigation Management: A Case Study in Khageri Irrigation System of Chitwan

Poudel, Himalaya; Mishra, Vijay Shankar

The Khageri irrigation system is located in the western Chitwan of Narayani zone in the central development region. The construction of Khageri Irrigation System (KIS) was initiated in 1975 and completed in 1985. Of the total 22.5 Km main canal length, the idle length of around nine km lies in the forest area before the start of the command area. It provides water to the cultivated land of Gitanagar, Sukranagar, Shivanagar, parbatipur, Saradanagar, Ganganagar, Mangalpur, and Jagatpur VDCs in western part of Chitwan district. The aim of the study was to assess the participation of women farmers in Khageri Irrigation system and to identify the factors which hamper the participation of women in irrigation management. Field observation, questionnaire survey of 50 from 606 members and 13 focus group discussions were performed to gather the information from the field as primary data followed by secondary data.

The study results showed that despite the mandatory 33% representation in water user association of women demanded by the irrigation policy, the gap still exists in its implementation as it still did not ensure qualitative and meaningful participation of women. Most of the WUA had below 30% representation of women and they were not involved in decision making of different activities. The minimal involvements of women of the WUA were due to lack of awareness, lack of education/low literacy rate and exposure, low socio-economic status, weak information dissemination and communication. In addition, women are burdened with traditional role, they tend to be excluded from male dominated committee and there seems no special effort made on reaching out and addressing the female audiences. Combinely, it hindered in voicing women opinion and seeking information. Most of women in Khageri Irrigation system suggested that if they had good opportunity to participate they will solve all problems in irrigation management. Some of the strategy to be taken for enancing the women's participation in irrigation management is making good policy such as gender equality and social inclusion policy 20 67 BS, women educational activities, training programme, provison of incenteives schemes, gender sensitive awareness, income generation activities, women empowerment program and follow up. Hence, to promote gender sensitive development, it is crucial to identify the roles, problems and opportunities to ensure that the concerns of women and men are equitably addressed. The development initiatives to encourage and facilitate involvement of women in irrigation management should reflect and guided by their actual interest, needs and preent workload condition.

Impact Evaluation of River Training Works: A Case Study Bagmati River, Rautahat

Mandal, Ram Naresh; Mishra, Vijay Shankar

Flooding and inundation have been the major water induced disaster in Nepal. Considering the seriousness of the problem in lower Bagmati basin, government of Nepal has implemented River training works in Sarlahi and Rautahat districts. Both banks of Bagmati river are embanked with continuous levee and associated anti-erosion structures from Nepal-India border to E-W highway. It has been felt necessary to assess the performance of these river training works in light with their design standards, socio-economic and environmental aspects. The main objective of the study was to assess the effective of the counter measure works carried out in Bagmati river training program in purview of technical and financial aspects, along with its impact on social and environmental domains in the area. Altogether 10 VDCs (Brahmapuri, Katarban, Basatpur, Badhadawa, Matsari, Gangapipara, Bhalohiya, Pipararajbada, Gamharia and Dhrampur) of Rautahat district were covered in the study. These VDCs spread up to 23.5 Km upstream of Nepal-India border. Reconnaissance survey, detailed field investigation, interaction and interviews along with questionnaire survey with flood affected people were done to get the related data for the study. Identification and evaluation of disasters by the river in the past were done to get the real picture of the area. The data on measures applied and changed in socio-economic status were obtained and analyzed.

There is significant impact of river training works in the area. Casualties, destruction or damages of houses and loss of cattle have been minimized after the application of river training measures which was chronic problem before. The livelihoods of the people have changed and they do not need to store food materials and medicine for rainy season as they are feeling safe. However, the operation and maintenance of the physical structure were not satisfactory and encroachment of people on these measures by constructing temporary huts and rearing domestic animals due to lack of awareness was a serious problem. These encroachments on the river training measures could be disastrous to the human settlement. The problem of siltation resulting into the river bed rising may create problems in future. Embankments do provide short term and localized benefits to agricultural land, lives and property that face chronic flooding. Shift of focus therefore is needed from flood control to flood management. Soft measures such as disaster preparedness, land zoning, insurance, training, awareness are needed and further study has been felt necessary to address these issues.

Economic Valuation of Carbon Stock in Thuli Community Forests, Kavre, Nepal

Regmi, Rajan; Sharma, Bhuvan Keshar

Community Forests (CF) of Nepal provide valuable goods and services at local, regional, national and global level. The value of direct use benefits, traded in the formal market, is realized by the local people. However, forest ecosystem services which are not marketed in the formal market such as carbon sequestration service need to be valued from non-marketable methods. The realization of the value of carbon sequestration service is important not only for the local people but also to the policy makers so that the people who provide these services can be rewarded by those who use these services. This research was formulated with the objective of quantifying total carbon sequestration in CF and assessing economic value of carbon sequestered from CF. The study was carried out in Thuli CF of Kavre district in 2012. The total carbon sequestration in CF was estimated through forest inventory data. Eight concentric circular plot of four different radii, i.e. 5m, 10m, 15m and 20 m, were selected for forest inventory. Overall, 1.58% sampling intensity was maintained. Its economic value was assessed by using Replacement Cost Method (RCM), Market Price Method (MPM) and Marginal Damage Cost (MCD) methods. From the forest inventory data, oven dry vegetation biomass was calculated and converted to biomass carbon by assuming carbon content value as 43%.

Number of stands in Thuli CF in 5-10 cm, 10-20 cm, 20-30 cm and more than 30 cm diameter class were found to be 1230, 450, 180 and 45 respectively. These stands growing in the forest consists of average volume of 164.2 m³/ha, which was little lower than that of 178 m³/ha of average national growing stock volume of Nepal. Total carbon stock in Thuli CF was 98.81 ton per hectare. The estimated economic value for unit ton of carbon sequestered by different methods in this study falls in the order of MDC>MPM>RCM. The economic value of carbon sequestered in the study area found to be US\$ 2638.23 (98.81*26.7\$/ton) / per ha. Using these values, the economic value of stored carbon in Thuli CF in Nepalese rupees was 263,823.00/ha. As forest has high economic value in terms of non marketed benefits, payment mechanism should be developed to capture these benefits for the betterment of the local people and their forests. Further research should be carried out in biomass modelling, carbon monitoring and valuation of forest services using different valuation method.

Contribution of Resin Tapping on Livelihood of People: A Case Study in Dolakha District, Nepal

Laya P.Subedi,

Resin tapping has become one of the main contributors in raising the living standard or in basic terms in their livelihood. Separate cases of the same have been reported now and then in case of a hilly district Dolakha. As such, this study was conducted with focus on assessing employment opportunities created by resin tapping; quantifying the contribution of resin tapping on total income of Community Forest User Group (CFUG) and household level, assessing current fund allocation scheme in different activities, and analyzing the perception of people towards resin tapping operation. For this, purposive random sampling was applied. Out of a total of 14 CF practicing the resin tapping, 3 of them were chosen. Moreover, 10% respondents were selected from the three CFUGs. The widely used PRA tools such as semi-structured interviews, focus group discussion, and open interview with key informants, and field observation were used for data collection. Different variables were defined and used regarding the analysis of people's attitude on resin tapping program. The mean score (weighted mean) obtained on Likert scale was compared and used to determine the attitude of the respondents of different categories of people. The chi-square test was applied for analyzing differences in perception of the category of people on defined variables at 5% of significance level.

Study found that resin tapping contributed significantly to physical and economic assets of rural people. A total number of 50 people were employed in it with 4000 men days of work with yearly in which earning ranged from NRs 60 to 144 thousand per year. Income from resin tapping related in CFs ranged from NRs 101 to 146 thousand per year which was invested mainly in infrastructure development, forest development, poverty reduction support and administrative purpose. From the research, it was concluded that the response of people towards the contribution of resin tapping on creating employment opportunity to be positive. Similarly, people highly appreciated the contribution of resin tapping in increasing the income of CFUG and same was the case for household level income. Moreover, there was no significant difference towards the response of different status of people on creating employment, increasing the income of CFUG and household level income. Local especially women should be encouraged to engage in the resin tapping related activities by providing training. Furthermore, CF need spend more fund towards forest development and maintain the health of the forest.

Assessing the Carbon Stock in Community Forests of Plain, Bhabar, and Churia Region of Mahottari District, Nepal

Sah, Sanjay Prasad; Mandal, Ram Asheshwar

High rate of deforestation and forest degradation has significant contribution in releasing CO₂ into the atmosphere. In Nepal, people's participation in managing forests, especially the Community Forests (CFs), has been playing a vital role to halt deforestation and forest degradation which lead to lesser CO₂ emission by sequestering it as forest carbon stock. In this context, it is essential to estimate the carbon stock (both above and below ground) and to explore the variation in the carbon stock due to forest management practices. As such, this study presents an assessment of the carbon stock in community forests of plain, Bhabar and Churia region of Mahottari District, Nepal. For this, field excursion was carried out in 2013 in three CFs, namely Indrakali, Gal Tar and Ratu Mahila of the district representing the three ecological regions respectively. Data such as biophysical factors, soil and forest management practices were collected for each CFs. Besides, 56 sample plots were laid to measure trees, poles, saplings, seedlings, litter, herb and grasses. The samples of seedling, litter and herb were then dried. Further, soil samples were collected from 0-10 centimeters (cm), 10-20 cm and 20-30 cm depth beneath the surface, which were analyzed using the popularly used Walkey and Black method to determine the soil organic carbon. A ratio of 0.125 was used to estimate below ground biomass from the above ground biomass while ratio of 0.47 was taken to convert the biomass stocks to carbon stock. Finally, all stocks were summed up to estimate the total carbon stock.

It was found that the Ratu Mahila CF had the highest above ground and below ground carbon stocks at 104 t/ha and 77 t/ha respectively. The soil organic carbon was found to be highest in 0-10 cm and the lowest in 20-30 cm in all three CFs. The estimated total carbon stocks was found to be highest (181 t/ha) in Ratu Mahila CF and lowest in Gal tar CF (117 t/ha). The carbon stock of Indrakali CF showed medium stock. It was found that strict forest management of the Ratu Mahila was the main reason for the highest carbon stock. It could thus be concluded that the CFs have potential in sequestering carbon and as such play vital role for Reducing Emission from Deforestation and Forest (REDD+) Degradation. Furthermore, to harness future benefits from the REDD+ program, assessment of biomass and recording of carbon sequestration in CFs should be carried out while preparing or renewing operation plans. Community Forest User Groups (CFUG) should also adopt appropriate forest management practices such as prolonged rotations and increased rate of thinning which would further enhance carbon sink ability of the forest systems.

Assessment Snow Leopard-Prey Situations in a Human Altered Ecosystem of Kangchenjunga Conservation Area

Thapa, Kamal; Pradhan, Narendra Man Babu

In northern Nepal, snow leopard, livestock and wild ungulate have coexisted for several centuries. Snow leopards, however, are threatened due to several reasons including herders' killing in retribution of losing their livestock and decline in prey population. One important cause may be weak implementation of conservation strategies because of lack of reliable information in both scientific and socio-economic sector. Thus, this study was carried out to assess snow leopard-prey situations in a human altered ecosystem of Kangchenjunga Conservation Area (KCA), Nepal. To quantify snow leopard number, 88 putative snow leopard scat samples were collected during spring season of 2014 from the designated 25 grids of the KCA. Snow leopard numbers were quantified employing fecal DNA technique and estimated population using a program called SPACECAP. Total count method was utilized to calculate the available standing biomass. Micro-histological analysis was used to examine the feeding behaviour of snow leopards. To identify the root causes of human-snow leopard conflicts and assess the effectiveness of ongoing snow leopard conservation measures, 34 (20%) households were interviewed and descriptive statistics were utilized in the SPSS tool to summarize the data.

The study estimated 19 snow leopards with mean 24 (range 19 to 29) in 609 km² area and density of 6 /100 km². Total available prey biomass of blue sheep was 47,736 kg and Yak was 3,07,500 kg. Three wild and four domestic species were identified in the snow leopard's diet. Out of available standing prey biomass, 7% biomass was consumed annually by the snow leopards with wild prey 49%, domestic 45% and rest 6% unidentified. The estimated biomass gives a snow leopard-blue sheep ratio of 1:59 on weight basis which indicates that in the KCA available wild prey are deficient to support the estimated snow leopards population. The proportion of young blue sheep was estimated at 17%, but predation rate was almost double. Predators such as common leopard, wolf and snow leopard share the same habitat and might compete for prey. Thus, long-term study on snow leopard biology has been recommended for further continuation/expansion. Ongoing Community Managed Livestock Insurance Scheme (CMLIS) is encouraging for the long-term survival of snow leopards but, it is time to focus on enhanced livestock guarding system including construction of improved corral with supporting the local people for snow leopard conservation.

Biogas use and its Implication at Household and Community Forestry Management in Patlekhhet VDC in Kavrepalanchowk District, Nepal

Bhandari, Nirmala; Pant, Dhruba

Commercial energy such as petroleum and coal are accessible only to limited population of rural community of Nepal due to country's geo-topographical features combined with inadequate infrastructure and their high cost. As such, there is a need of alternatives of the commercial energy sources and biogas has emerged as a viable option. There have been cases of lesser pressure on community forests after the installation of biogas in households. It is in this context the work was carried out. The study presents an assessment of fuel wood consumption from community forest before and after the installation of biogas plant and its livelihood implication at household level. For this, ward numbers 5 to 8 of Patlekhhet Village Development Committee (VDC), Kavrepalanchowk District, Nepal were selected. Questionnaire survey, key informant interview and focus group discussion were the main research tools used to gather information on the socio-economic parameters, number of livestock, income source, energy consumption, type and amount of fuel wood as well as kerosene consumption among biogas users and non users, amount of money saved, benefits obtained from biogas users, and bio-slurry management and utilization status.

It was found that although biogas was used mostly for cooking purpose, it provided multiple benefits at the household level such as improved sanitation, reduced smoke borne diseases and use of bio-slurry as fertilizer. Study calculated the rate of deforestation in terms of reduction of fuel wood as 1947 kg/HH/year which corresponded to saving of 0.051 ha of forest/year, and financial saving as NRs 10,000/year as a result of one unit of biogas installation at household level. Furthermore, each biogas plant contributed in lessening Green House Gas (GHG) emission at 2077 kg CO₂/HH/year. In national context, Nepal could be benefited US\$ 14/year/biogas installation as carbon abatement revenue if claimed under Clean Development Mechanism (CDM). Women have saved on average 3.3 hours/day through reduced time in the collection of fuel wood, cooking, washing dish, etc. On flip side, 22% of households had been facing less gas production in winter season which had forced them to use fuel wood for cooking purposes. Similarly, 50% reported the increase in mosquito flies, rodent and foul odor than before. As a whole, the installation of biogas as an alternative energy source could be regarded as a successful undertaking in the Patlekhhet VDC.

Farmer's Perception on Occurrence of Drought and Its Impact on Major Crop Production in Khaniyapani Village DEvelopment Committee-9 Ramechhap, Nepal

Shrestha, Shyam Krishna; Adhikari, Devendra Prasad

Developing countries like Nepal are facing drought situation frequently and its severity is increasing every year impacting mainly on agriculture land, water supply, among others. While the frequency and severity of drought on agriculture has been reported on regular basis, its assessments on major agriculture crops regarding productivity on farmer's level in Nepalese context is rather limited. It is in the scope that this study was conducted in Khaniyapani Village Development Committee (VDC) Ward No.9 of Ramechhap District, a rain shadow region of Mahabharat mountain range, Nepal. This study presents farmer's perception on drought, its impact on the productivity of selected crops namely paddy, maize, wheat, finger millet and lentil; and documents adaptation strategies practiced by the farmers. For this, this study considered 30% of the total 101 households, and collected data from both primary (questionnaire survey, key informant survey, focus group discussion) and secondary sources.

Trend analysis of observed data showed distinct changes in temperature and rainfall patterns which was also perceived by the farmers. The local people were suffering from both winter and summer drought with the former being more severe to them. The production of the major food crops such as paddy, wheat, maize, finger millet and lentil were found to be in declining trend since the past 10 years. Conversely, new hybrid varieties of paddy, wheat, and maize were found to have been introduced in recent years which increased the yield in normal rainfall periods whereas these crops, in general, failed in drought periods. The change in the climatic pattern especially insufficient rainfall was the major contributor of decreased yields which has further aggravated food insecurity in the area. Within last decade, outbreak of insect, pests and diseases were also reported. As an adaptation strategy, majority of farmers shifted the cultivation time of almost every agriculture crops. Besides, drinking water problem was becoming more severe and people now spent more than 3 hours to fetch drinking water. Numbers of livestock per household were also found to be in declining trend which resulted in reduction of the farm yard manure. As a consequence, out migration of people to city centers was more prevalent. Slowly and steadily, local people were adapting towards adverse effects of drought through construction of irrigation channel and/or plantation of drought resistant varieties of crops or limited use of water.

Forest Policy and its Implication on Community and Private Forestry Development: A Case Study in Rautahat District, Nepal

Dahal, Govinda Prasad; Tripathi, Devesh Mani

Private forest development, as an alternative to community and national forests, could be an effective means in supplying forest products including industrial raw materials for wood based industries but its extent has not expanded as expected due to lack of appropriate policy and program interventions. In this context, this study assesses forestry sector policy and its implications on both community and private forests. For this, Rautahat District was selected and study was conducted during 2011-13. Questionnaire survey, rapid forest assessment, key informant interview and focus group discussions were performed to gather primary information. Altogether 101 households of Hatemalo community forest were selected for the questionnaire survey. Descriptive statistics were utilized for quantitative data and the widely used ANOVA test was also performed.

While the principal forestry sector policy articulates several provisions related to community and private forestry but the support for private forestry promotion was found to be disproportionately very low as compared to that for community forestry. Unlike the huge support in community forestry development, limited subsidies on planting materials are the only incentives provided by the government so far for promoting private forestry. The District Forest office was found to be only government institution that offered services to private forest development. Farmers were found to use multiple criteria for selecting tree species and the decision to determine the size of private stand on their own depending on the land holding size, market influence and intensity of control on their own land. Only permanent settlers in the area were found to establish private forest and the other forest users such as migrants and forest encroachers followed opportunistic behavior to meet their forest product needs from community and national forests. Local people viewed that their traditional knowledge and skills were not sufficient to practice private forestry effectively. Thus, study recommended that taking a prompt action was a must in order to promote the private forest program effectively, to complement the other types of management scheme, and to ensure the supply of different forest product in sustainable manner. Such actions would facilitate the access on forest products to the people living in the area with no forest and would help to halt market distortion of forest products.

Household Level Contribution and their Dependency in Community Forest: A Case Study of Gulmi District of Western Nepal

Poudel, Parashuram; Gyawali, Dipak

In Nepal, the extent of Community Forests (CFs) has been expanding which has certainly contributed in household level especially to the poor and marginalized people. However, there are limited studies on community forest's contribution to the household level. This study was therefore conducted in Gulmi District in a period of March - August 2014 to explore the cost of users' contribution in CF management and the degree of dependency in CF resources of different socio-economic groups. For this, 5 CF user groups were selected randomly from a total of 414 in the district, and key informant survey, focus group discussions; household questionnaire (with 120 respondents) and direct field observation were carried out for primary data collection. Households were categorized as rich, medium and poor based on the participatory wealth being ranking. Their income and expenses were estimated in terms of local unit rate of price and opportunity cost of wages. The total household income of users was studied as: (a) by farm, (b) off farm, and (c) non-farm sources of income. The widely used ANOVA and Chi-square tests, and the Lorenz curve were employed to examine the strengths and direction of relationship between the different socio-economic and biophysical factors.

It was found that the contribution to poor households was very high from the CFs than medium and rich users who in turn were receiving the least from the CFs. Access to forest products generated from the CFs has contributed significantly to the subsistence lifestyle of the poor households, however, it was not enough to uplift their livelihoods significantly. Overall, all the households were satisfied from the benefits that they have been receiving from the CFs. Similarly, the present practice of CF resource mobilization was found to be less favorable to uplift the livelihoods of the poor households. A major part of the CF fund was invested in local infrastructure development such as construction of road, school, irrigation canal rather than direct livelihood improvement activities of the poor households. With this hindsight, the study recommended CF user groups to give priority on equitable benefit sharing, to organize the activities on skill development training, income generation activities that directly benefit poor households.

Opportunity Cost of REDD+ in Thangsa Deurali Community Forest, Dolakha District (Mid-hill), Nepal

Paneru, Supa; Joshi, Niraj Prakash

Community Forestry (CF) systems have economic potential from the Reducing Emission from Deforestation and Forest Degradation (REDD+) perspective. However, CFs are being changed to agricultural land due to intense urbanization and ever increasing food demand. Hence, it is essential to analyze the opportunity cost of such conversion. This study was therefore undertaken in Thangsa Deurali Community Forest (TDCF) with area of 217.1 hectares of Dolakha District (mid hill region of Nepal) which has been implementing the REDD+ since 2009. This study presents an analysis of: (a) economic potential of the REDD+ in the CF system in the mid-hills, (b) economic value of community forests in the context of REDD+, (c) the opportunity cost of REDD+ when the forest is changed into agricultural land for high-value and mid-value crops, and (d) co-benefits of REDD+ initiatives in the CF. For this, relevant primary and secondary data such as forest management system, agricultural production system, economic status of households, occupation, food sufficiency, land holding size, population, caste/ethnic group, perception of forest density and diversity increment or decrement, alternatives of forest products, practice of CF, REDD+ with its practices and co-benefits of forest were collected from TDCF user group members, its committee members, District Forest Office, and District Agricultural Office.

From the study, it was found that the total timber harvested from the CF was 2,726 cubic feet, total fuel wood consumption was 13832 bhari, total fodder collection was 6365 bhari and total leaf litter collection was 28,425 bhari annually. Moreover, the CF generated total income of Rs.250,000 per annum. The study projected an annual income of Rs 1873,880 per annum for the year of 2012 if the selling of forest products, registration, etc, were evaluated in monetary term. The study also estimated, considering carbon sequestering capacity of the forest and the reward rate received from the pilot REDD+ program in the locality, additional revenue generation of Rs 533,412. Furthermore, from the perspective of land conservation (150.8 ha agriculture land from the CF), the study estimated a total income of high value crop (e.g., potato) to be Rs 8,351,600 and mid value crop (e.g., maize with millet) to be 7,684,692 per annum. The study also found that the opportunity cost of conversion was higher than the revenue from REDD+. However, considering the co-benefits such as biodiversity, water availability and the role of forest in each unit of farming system, community managed system with REDD+ would still be more viable option for the sustainable management of the CF. It was found that only 14% of the total population in the community were food secured while the rest of the community has to buy from the market which rather favours the conversion (from CF to agricultural land).

Role of Micro-Irrigation Technology for Livelihood Enhancement of Marginalized People

Koju, Rishi Bhakta; Mishra, Vijay Shankar

Micro-Irrigation System (MIS) has usually a command area smaller than 25 ha under non-conventional irrigation technology, and such systems have been launched in several scattered lands of up-hills. Such systems are expected to enhance the livelihood of up-hills people especially the marginalized ones. In this scope, this study presents the role of MISs in livelihood enhancement of marginalized people. The study was conducted in three MISs namely Jyamdi, Tanke and Gaudyal of Kavre District during February - April 2012. Respondents were selected randomly from head, middle and tail reaches of each system (Jyamdi, total respondents: 14, Tanke: 14 and Gaudyal: 30). Checklist and open interview were used to collect primary data, and equal weightage has been assigned to each questionnaire for the performance evaluation (a score expressed in percentage, and 100% being ideally functioning system) of the selected MISs.

In Jyamdi, it was found, as expected, that the productivity of major crops and vegetables increased after the introduction the MIS. For instance, maize increased to 2.82Metric Tonnes/Hectares (MT/ha), wheat to 2.7 MT/ha and cauliflower to 8.58 MT/ha. Similarly, in Tanke maize productivity increased to 3.39 MT/ha and potato to 7.89 MT/ha. Likewise, in Gaudyal, the maize productivity increased to 3.69 MT/ha, potato productivity increased to 9.73 Mt/ha albeit fueled by conversion of wheat farming to potato. With regards to system performance based on the respondents' perception indicated that Tanke, Jyamdi and Gaudyal stand at only 48 %, 44%, and 41 % respectively indicating below average condition. During field visits, it was noted that in Jyamdi, distribution network and storage pond need to be repaired for effective and efficient operation of the system. It was noted that in all the irrigation systems, election of the water users association was essential to bring change in management and to increase women involvement. Besides, trainings need to be conducted for capacity development of users on various issues including MIS management. It was also noted that the operators' remuneration should be increased and the job need to be made permanent to increase their accountability.

An Assessment of Pricing Structure of Freight Transport Tariff in Nepal: A case Study of Birgunj – Narayangarh - Kathmandu Road

Kushwaha, Binod Prasad; Pande, Kamal Raj

A price at which goods are carried by a vehicle or vessel, especially by a commercial carrier or cargo is known as freight transport tariff. Freight transport tariff fixed by Department of Transport Management (DoTM) has not considered external cost components such as empty runs, size of freight, loading and unloading facility, physical restriction on road, syndicate etc. in the estimation of freight tariff. These freight transport tariff are also higher than that of average South Asian countries' rates. In this scope, a study was carried out with the main objective being to determine the rationale of freight transportation tariff structure. For this, the Birgunj – Narayangarh – Kathmandu road section spanning 274 km was selected as the road section has the maximum number of truck traffic in the country. Cost based approach has been followed to determine freight transport tariff for commercial trucks. Major inputs regarding vehicle fleet characteristics and some key unit prices were collected through primary survey. Similarly, maintenance labour costs, crew costs and tire price were also collected through field survey. All other input data were collected from concerned agencies. The widely used Highway Development and Management Model 4: HDM4) has been used to analyze vehicle operating cost as it provides a powerful system for the analysis of road management and investment alternatives.

The estimated weighted average freight transport tariff was found to be NRs. 8.93 per ton per km and this tariff would be NRs. 24,468 for 10 ton pay load in truck from Birgunj to Kathmandu. Larger multi-axle and technologically advanced trucks were found economical while put in operation. In recent past year, trucks plying rate (in terms of annual distance plied) was in decreasing trend which eventually contributes in further increasing the freight charge. Furthermore, empty trips are further adding cost and increasing the freight load for return trip would surely reduce the freight transportation cost significantly. It was found that one ton load for the return trip would reduce the freight transport tariff by 8 and 5 percentages for medium and heavy trucks respectively. Furthermore, poor road surface condition was found to be contributing in increasing the freight transportation cost. To achieve the lowest possible freight transport rates, the International Roughness Index (IRI) value was needed to maintain to a minimum possible limit Reduction in the transportation cost would reduce the cost of goods which in turn would ease in competing in domestic as well as global market. It is expected that this would accelerate economic growth and industrial development of Nepal.

Accident Analysis and Its Remedial Measures in Dhulikhel-Nepalthok Section of B.P. Highway

K.C., Mohan Dhoj; Shahi, Thusitha Chandani

Each year about 1800 people die in road crashes in Nepal. For this the road transport system such as road conditions, road users including drivers and vehicle conditions are to blame the most. While site specific analysis of any crashes is more appropriate for the preventive road safety measures, a practical approach to analyze the causes of such road crashes is however lacking. In this scope, this research was intended to analyze accident patterns and to recommend appropriate countermeasures along the newly constructed Dhulikhel- Nepalthok road section of the B.P. Highway. This study was based on the secondary as well as primary data collection, analysis, and recommendations based on the findings were made. To be more specific, road accident data were collected from the traffic police office at Banepa, Dumja and Mangaltar. Similarly, road accident data of 52 months (from August 2008 to December 2012) were compiled and analyzed for their severity, causes and types. Moreover, the accident locations were visited to study the site-specific parameter related to crashes. At the same time, group discussion and in-depth interview were organized with traffic polices and road users. Based on these, road safety assessment was done at selected 7 locations of the road corridor by using checklists.

This study found high speed driving being the major cause of most of the fatal accidents. To be precise, it was responsible for more than 70% of fatal cases. In those cases, 60% of the fatalities were bus passengers, 30% were car passengers and 10% were motorcyclists. Furthermore, study identified the stretches of road sections having the most fatalities were the sections of relative straight reach where high speed driving could be done Head on collision, hitting pedestrians and roadside objects were the most frequent type of accident. Based on field visit and relevant analysis, study identified four black spots namely; Satpatrekhola, Katunjabesi, Mangaltar and Dumja. These spots were characterized by the presence of sharp horizontal curves. The study recommend proper installation of traffic signs, construction of delineation measures, road crash barriers, rumble strips as the short and medium term countermeasures. Furthermore, widening of horizontal curves and correction of alignments were suggested as the long term road safety programs.

An Assessment of Bus Rapid Transit System in Kathmandu

Shrestha, Nava Raj; Chhetri, Ajay Khatri

Kathmandu valley comprising of Kathmandu, Lalitpur and Bhaktapur districts host about 2.5 million of inhabitants which is further increasing, and evidently it necessitated higher number of vehicles to serve the growing population. Hence, a need of advanced and modern transportation infrastructure has been felt. However, development of efficient public transport system in cities like Kathmandu is challenging to all including the planners. In this scope, a research was formulated in order to study the opinion of road users regarding the performance of existing public transportation and to identify their willingness in shifting to new mass transit system. As such, this study assessed the availability of road infrastructure for Bus Rapid Transit (BRT) system. The study area was purposively confined along the ring-road of Kathmandu valley. As a part of data collection, 400 road users were supplied with a set of questionnaire. Besides, 14 purposively selected locations were used in filling the checklists so that a robust assessment on the availability of the proper infrastructure could be made.

Study found that all 100% respondents thought the current public transportation system in Kathmandu needing substantial improvement. Furthermore, about 90% of respondents opined that the service quality of present public transportation was very poor and about 87% respondents pointed out the frequency of public vehicles was very low. Moreover, about 62% respondents pointed out the fare was expensive and 74% respondents said that the availability of vacant seat was very rare. Again, more than 90% of the respondents strongly favoured the BRT system, as mass transit whereas less than 10% respondents did not have any idea to favour the BRT system. Hence, it is concluded that the overall public transportation service of the Kathmandu valley was unable to satisfy users and there were rooms for improvements. Besides, the road users in Kathmandu valley were interested towards using the BRT system. As per infrastructure survey, most of locations had sufficient road width and some of the locations needed widening. Finally, most of bridges had to be constructed before implementing the BRT system. As a remedial measure, outer ring road in Kathmandu has been considered appropriate for the implementation of the BRT system.

Performance Assessment of Crash Barriers Used in Road Safety: A Case Study of Malekhu-Kurintar Section of the Prithvi Highway

Bati Saru; Shahi, Thusitha Chandani

Hill roads in Nepal are comprised of critical geometry and limited roadway clearances. It therefore causes high number of runoff roadway type of accidents with single vehicle. These accidents often carry huge number of fatalities and severe injuries. Installation of crash barriers is the most effective way of preventing such accidents along hill roads. However, the existing practice of construction of crash barriers has not shown satisfactory results. Therefore, this research aimed to assess the performance assessment technique for crash barriers. As such, Malekhu-Kurintar section of the Prithvi highway selected which is one of the busiest highways in terms of traffic volume. Detailed field observations of the existing crash barriers were conducted including measurement of dimensions as well as the physical conditions. Traffic flow and respective spot speed were recorded during the field study. The vehicle movement and angle of the impact to the crash barriers was modelled. On the basis of field records, kinetic energy absorbed by the crash barriers and their deflections were investigated by the application of computer based analysis tool: the ABAQUS V6.10. Study considered different types of crash barriers: W-beam barrier, plum concrete barrier, gabion barrier and random rubble stone masonry barrier.

Analysis of the modelled scenario showed that 45.95% of the impact energy was absorbed by plum concrete barrier which stand at 62.40% in case of W-beam barrier. Moreover, deflections of crash barriers were recorded as 0.229m and 0.341 m, respectively for plum concrete barriers and W-beam barrier. The study found the performance of W-beam barrier to be better than plum concrete barrier both in terms of impact energy absorption and deflection. Based on the results, study recommended for the installation of W-beam barriers along the critical road sections of the Prithvi highway in order to reduce the high rate of fatalities in road accidents.

Study of Public Transportation in Kathmandu Valley: A Travellers' Perspective

K.C., Prajwol; Chhetri, Ajay Khatri

Kathmandu valley comprising of Kathmandu, Lalitpur and Bhaktapur districts host about 2.5 million of inhabitants which is further increasing, and evidently it necessitated higher number of vehicles to serve the growing population. Hence, a need of advanced and modern transportation infrastructure has been felt. However, development of efficient public transport system in cities like Kathmandu is challenging to all including the planners. In this scope, this study was formulated in order to study satisfaction level of travellers in public transport system of the valley. Focus was made on studying traveller's satisfaction in relation to the service quality attributes, identification of high ranked attributes and the prioritization of the attributes for the future improvements. Altogether 400 respondents were supplied with questionnaires.

More than 75% respondents of public vehicle users and 74% of the non-public vehicle users opined that the public vehicle staff were unwilling to help and were impolite. Most of the respondents (70% of public vehicle users and 62% of non-users) questioned the neatness and cleanliness of the Public vehicles. Similar patterns were observed for other attributes such as congestion (or no vacant seat), problems associated to safety and security, avoidable delay during travel, low frequency, lack of information dissemination, low reliability, comfort and punctuality. In overall, respondents had negative feeling towards the public transportation system. With the hindsight, decision makers and service providers need to focus on improving the service quality of the public transportation.

Causes and Implication of Delay in Local Road Bridge Construction

Kuikel, Sudina; Tiwari, Sushil Chandra

Delays in the project have significant implications from an economic as well as social point of view. Delay in construction works, especially in the public service projects like bridge construction constitutes a frightening issue for the economy of a country since it retards the pace of development efforts due to cost overrun and other consequences. Bridge construction projects located in the local road network suffer from many problems and complex issues among which delay is one of the major issues. The objective of this study is to identify the causes and effects of delay in local road bridge construction projects; and to elicit perceptions of their relative importance. For this, study included 16 local road bridges in various stages implemented by the DoLIDAR, Nepal. A comprehensive literature review was conducted to generate a set of factors related to project delay (causes and effects). A total of 105 questionnaires were distributed with the response rate of 74.28% to the three key project participants: owners, consultants and contractors. The importance of the individual causes and the groups were calculated and ranked by their relative importance index (RII) value.

Results indicated that all the three groups had different views regarding the causes of delay but there were some similarities in case of effects. Major causes of delays in local road bridge identified were related to site condition, management, financial and political interferences. Besides, cost and time overruns were found to be the most significant effects. Study found that delay in construction project, could be minimized through the combined efforts of all the stakeholders with improved and changed method of construction using innovative technology like precast bridges, proper site investigation, positive attitude, considering all as equally responsible partners, good communication, review meeting and effective supervision. Moreover, government should run only those projects for which it would arrange the funds timely and assure continuity of budgets. Furthermore, the local government is advised to have proper planning and priority based investments to overcome the problems related to site conditions and financial management. In addition, it is recommended to develop human resources in the bridge construction industry, strengthen monitoring and evaluation, delegation of responsibility with proper authority to the project teams, no transfer of project personnel till the completion of the project, ensured political commitment for the project, regular review of the progress, improved management and provide awareness on the importance of the project in different levels of the management group.

Financial Modality of Kathmandu-Kulekhani-Hetauda-Tunnel Highway

Pandey, Nripendra; Pande, Kamal Raj

The Kathmandu-Kulekhani-Hetauda-Tunnel (KKHT) highway (59.5 kilometers) has been planned to connect the capital city with southern part of the country as an alternative to the existing Kathmandu-Muglin-Narayanghat-Hetauda (220.55 kilometers) highway. However, the project implementation is lagging behind the proposed schedule due to inadequate financial management and injection. The study thus focuses various options regarding financial management of the KKHT highway project. For this, quantitative approach as adopted to calculate Vehicle Operating Cost (VOC) of both routes (the KKTH vis a vis existing) to compare savings. Furthermore, a model developed by the Department of Road (DoR) on the basis of Highway Design and Maintenance Standards Model (HDM-III) was adopted to analyze the road network VOC and road user cost. As such, major inputs regarding vehicle fleet characteristics and unit prices were collected through primary survey as well as secondary sources (e.g., DoR and Nepal *Purbadhar Bikas* Company Limited (NPBCL), etc).

From the analysis, it was found that the conventional mechanism (e.g., public funding from government budget) could be overcome by developing the Public-Private-Partnership (PPP) mechanism in funding such a massive infrastructure project. Moreover, on testing the viability of the KKTH at 20%, 30%, 40% and 60% subsidy and 6%, 8%, 10% and 12% interest rates, the average VOC and trip cost of the KKHT was found to be 8.04% and 61.07% less, respectively as compared to that of the existing Kathmandu-Muglin-Narayanghat-Hetauda route. Results also revealed that 60% subsidy was the most suitable option for financing the KKHT highway under the Public Private Partnership (PPP) mechanism. It is therefore suggested that success of the project largely depended on the amount of subsidy it would receive from the government.

Rural Road Maintenance in Parbat District

Thapa, Shrawan Kumar; Shrestha, Chandra Bahadur

In Parbat District, 92% roads are earthen, mostly constructed using dozer with little consideration of prevailing road standards. Local conditions also showed marked deteriorations in short period which hampered smooth vehicular movement. Improper maintenance efforts of the concerned authorities can be widely felt in these roads. In this context, this study aims at understanding the role of road elements leading to poor road condition, and aims to assess managerial, financial aspects as well as technical resources for rural road maintenance system. For this, three District Roads (DRs) (a) Kusma-Durlung-Halhale, (b) Patichaur-Deupur-Bhuka and (c) Damuwakhola-Naglibang-Banau and one Village Road (VR) namely Nayapul-Majhigaun-Pang, were selected. Primary data on road conditions were collected from field observation. In depth interview with key informants and questionnaire survey with Local Development Officer (LDO), District Technical Office (DTO) chief, road users and their committee members were conducted. Additionally, secondary data were collected by reviewing project specific reports, books, journals and research papers.

It was found that absence or improper surface drainage was the most dominant factor for the road deterioration. Excavation of the earthen roads using machinery without considering geometric standards, inadequate effort towards proper maintenance, and tractor movement during monsoon season were major causes for such deterioration. Labour based technology (contrary to equipment based) was found appropriate for road maintenance which also aligns with the government policies. District Development Committee's (DDC's) capacity to generate internal resources was found to be very limited which resulted into insufficient funds for regular maintenance. Furthermore, lack of knowledge, skill and proper maintenance planning were found to be major causes for poor road maintenance. Organizing the need based trainings to the DDC and DTO technicians, and to the road users were noted to be essential to enhance their capability. Establishment of toll collection system, contribution from road users and budget allocation from Village Development Committee (VDC) on a regular basis could be viable means of resource generation for road maintenance. From the results, the research recommends construction of side drains to be made compulsory for earthen roads. Similarly, the DDC needs to promote labour based technology in construction and maintenance of district roads.

Performance of Public Transport in Kalimati – Balkhu - Ekantkuna - Satdobato Sections of Kathmandu

Gupta, Santosh Kumar; Shrestha Chandra Bahadur

The existing public transport system in Kathmandu Valley has failed to provide proper services in terms of accessibility, timeliness, safety and comfort to the passengers and road users. In this context, this study was conducted in order to identify performance of the existing public transport system which included the examination of public transport service, road surface condition, location of bus stops and road safety situation. For this, two road sections: (a) Kalimati-Balkhu, Balkhu-Ekantkuna and (b) Ekantkuna-Satdobato were taken purposively. The study adopted questionnaire survey with a total of 225 passengers and 75 drivers. Further, Key Informant Interview (KII) was carried out to identify deficiency of current policies on failing to manage public transport system in the valley. Additionally, several field surveys were carried out during the period of April-May 2013.

It was observed that private operators were in absolute majority in providing the public transport service in the valley, and buses, minibuses and micro-buses were the major vehicles. It was found that public transport vehicles were overloaded by 28%-68% during the peak hours (morning and evening). More than 50% passengers were utterly uncomfortable with the service providing means due to overload, haphazard stoppage and lack of proper scheduling. Field survey however showed relatively good surface conditions with all pavements being bituminous. Most of the passengers were unhappy with non- sufficiency of bus stops and their proper management. While about 92% drivers accepted of having knowledge of driving rules and regulation, they (drivers) and their behavior were in fault in causing most (88%) of the road accidents in the considered sections. The key informants agreed on driver's negligence and distraction (to the concentration of driver by advertisement boards, waiting passengers), and illness to be contributing factors for such high percentage of involvement in accidents. Further, it was revealed that Department of Transport Management (DoTM) needed to ensure and enforce the provision of proper scheduling based on the transportation demand with special attention during peak hours. It is recommended that in the long term, the DoTM in coordination with municipalities, Department of Roads (DoR) and transport operators should introduce dedicated lanes for bus transit system in major routes.

Micro-simulation Study on Effect of Traffic Composition in Capacity of Multilane Divided Road (Lokanthali-Gatthaghar) Section

Angel, Shrestha; Adhikari, Prabesh

Rapid urbanization of Kathmandu Valley in past decades inevitably led to rapid increase in traffic volume, and the trend is likely to sustain or even increase in future. The existing transportation facilities which might have been operating in good condition now; might not suffice in future. Hence, it is important to analyze how the transportation system would behave in such situation which in turn can help to formulate alternative traffic management schemes. In this scope, this study presents the effect of traffic composition in capacity of a multilane divided road section. Since the traffic is heterogeneous in nature and as future effect was to be seen, micro simulation study was done at Lokanthali, Kaushaltar and Gatthaghar intersections of Bhaktapur District. For this purpose, VISSIM 6.0, micro-simulation software was used. Video graphic survey was conducted at the aforesaid intersections. Besides, video recording was done to analyze traffic volume, vehicle composition, routing decision and velocity. Field measurement was also conducted to obtain cross sectional parameter of the road and to obtain signal timing at signalized intersection. First, a base model was built up, calibrated and validated by tuning different parameters in the model (VISSIM 6.0). The calibrated and validated base model was then used as a tool for several experiments representing different scenarios to analyze future traffic effects. Effects of signalization of currently non-signalized intersections (at Lokanthali and Kaushaltar intersections) were also tested for allowing orderly turning movements. For this, two future time stamps (2016 and 2019) were considered. To analyze the effect of changed traffic composition, motorcycle share was reduced by 20% (Case I) and 30% (Case II), and mini bus was added to accommodate the occupancy of the reduced motorcycle traffic.

It was found that there was less variation in travel time in Lokanthali-Gatthaghar section as it had less traffic volume at morning peak hours where as in the reverse direction; there was large variation which was evident due to more traffic volume in such peak hours. Travel time was found to be reduced when motorcycle was replaced by minibus in both directions of the Gatthaghar-Lokanthali link. Furthermore, delay was also reduced at considered intersections due to imposed vehicle composition change. Regarding capacity, it was found to be increased, as expected, when future traffic composition was considered but it was found to be reduced when vehicle composition was changed. This implied that substitution of small vehicles (e.g. motorcycle) with large ones (e.g. minibus) allowed space for other vehicles to be added into the network.

Pavement Management System of Feeder Roads: A Case Study of Chabahil – Sankhu Road Section of Kathmandu District

Rai, Prajwal; Adhikari, Prabesh

Pavement performance evaluation and prediction are of great importance to facilitate pavement management system. Chabahil - Sankhu road section, a feeder road of Kathmandu Valley transportation system with a total length of 12.50 kilometers, has to accommodate ever increasing traffic volume in future which necessitates a proper pavement management system of the section. It is in this scope that the study aims to prepare pavement management system by developing a pavement deterioration model using the widely used Highway Development and Management (HDM-IV), adapted for Nepal by Department of Roads (DoR). For this, pavement condition data were collected by visual inspection and observation of the pavement surface distress. Similarly, traffic volume and drainage condition survey were conducted to assimilate their effect on the pavement deterioration. Furthermore, road networks, vehicle fleets and work standards were collected and used in HDM-IV model built up. It was decided that the scheduled maintenance strategy would be applied at every five years, whereas condition maintenance strategy would be applied when roughness reaches to 4.50 m/km with 40mm asphalt concrete treatment. Finally, economic analysis was conducted with a 12% discount rate for the period of 10 years. The economic analysis was done in order to select suitable cost effective maintenance strategy amongst scheduled and condition responsive. Using all the information, the hierarchy of the pavement surface distress of the road sections was developed.

It was found in case of scheduled maintenance strategy; the year of application of the maintenance to be different for each road sections because of its last resurfacing. In condition responsive maintenance strategy, results did not indicate any specific year for the maintenance because of limiting roughness value. Result indicated that there would be a net saving in costs of about 11.13% over the analysis period of 10 years. Therefore, the adaptation of condition responsive maintenance strategy was suitable for the considered road section. The research recommends that similar type of pavement deterioration model could be developed to select the maintenance strategy for other roads in the Kathmandu Valley. Adopting the condition responsive strategy rather than scheduled maintenance strategy could be considered to save time and costs.

Prospects of Developing North-South Road Links as a Transit Route between India and China through Nepal

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Nepal is a landlocked country located between the world's two most populous countries: India and the People's Republic of China. The country uses India's eastern port of Kolkata as its gateway to the sea. Due to its geographical location, Nepal's territory has been used for trading between India and China. In the modern era, due to increasing trade volume among Nepal, India and China, there is great potential to revive the historical trade and Nepal can benefit from trade and transit connectivity. Thus, the study was concerned on the volume of bilateral and trilateral trade between India and China through Nepal that forms the basis for development of North-South road links through Nepal. In premise of government plan to extend North-South road link, the study was concentrated on existing Birgunj-Kathmandu-Tatopani route. The study follows the analytical and descriptive approach in which the view of concerned key personal, target groups and individuals has been incorporated. Trend analysis was done to show the status of trade volume and traffic volume. In order to draw the concrete conclusion the data of trade volume and revenue was collected from Tatopani and Birgunj customs, whereas the traffic data was collected from Roads Board Nepal (RBN) and conducting traffic survey. An interview with experts, policy maker, bureaucrats; interaction with transit driver and road users was also integrated to collect revelation on benefits and challenges that North-South link will generate as transit route.

The study showed that there was non-existence of direct and formal trade between India and China through Nepal. The direct bilateral trade between India and China took place through sea route and very few from land route of Indian Territory. In addition, trade between Nepal and China from Tatopani custom was near to the ground as compared to India and Nepal trade. Majority of bilateral trade between China and Nepal took place by sea route and enter Nepal by means of Indian inland. None of traffic was found carrying cargo directly from Birgunj to Tatopani, which shows the absence of overland trade between India and China through Nepal. It is true that along with bringing in lot of benefits like rise in revenue and economic opportunities, the outward looking development strategy of the transit route may also import a few vices such as erosion in employment, environment degradation, emergence of economic inequality at the initial stage, spread of HIV, women trafficking etc. Thus, the study concluded, overland transit route is not the necessity of India and China for bilateral trade, as sea route is most economical and feasible for them. Hence, for Nepal, with negligible return just only increasing access with China through road has no economic sense, unless it is facilitated to be used as transit route between India and China. This means that if Nepal wants to gain from the emerging opportunity, it has to make it less costly for these two countries to trade by using Nepal as a transit route. This requires, among others, improving the existing Nepali road (Birgunj-Kathmandu-Tatopani) making it usable for containerized cargo, setting up other necessary physical infrastructure and making the regulations conducive for conducting such trade.