Nepal Earthquake 2015
Rapid Environmental Assessment

Government of Nepal
Ministry of Science, Technology and Environment

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Ministry of Science, Technology and Environment
Singha Durbar, Kathmandu
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Credits
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Hon. Vishwendra Paswan
Minister for Science, Technology and Environment

Government of Nepal
Singhadurbar, Kathmandu
Nepal

Ref. No.

Date: 26 Nov. 2015

Message

Nepal suffered heavily from the devastating earthquake in the 25 April 2015. Still we are experiencing its aftershocks. The earthquake and its aftershocks have caused huge loss of life, properties and development infrastructures adding additional presser to household and national economy. Thousands of people are injured, many houses and public buildings are destroyed and families were displaced, government offices were severely disrupted and the daily life and livelihood have become very hard in the affected districts. Similarly, many development gains over the last decades were lost in the affected districts.

Ministry of Science, Technology and Environment had initiated "Rapid Environment Assessment (REA)" to study and assess the impacts of earthquake in the environment and recommend for future interventions. The REA team has developed this report after rigorous consultative process and field study. I am pleased to acknowledge the coverage and recommendations of this report.

After the relief and recovery effort, we are now working for rehabilitation, resettlement and reconstruction. Government of Nepal has decided to expedite reconstruction process through National Reconstruction Authority mobilizing internal resources as well as the resources from development partners and international communities. I believe this report will compliment to the "Post Disaster Need Assessment (PDNA)" and could be very useful for policy provisioning, planning and programming for disaster resilience development in Nepal.

Finally, I would like to thank REA team, government officials, academia, civil society members, experts, professionals and all the people who have involved and contributed in REA process and this report.

Thank you very much.

Vishwendra Paswan 26 NOV 2015
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Government of Nepal

Ministry of Science, Technology & Environment

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Foreword

The disastrous earthquake of 25th April, 2015 and the aftershocks that followed not only led to loss of life and property in more than 31 districts of central Nepal, but also caused several environmental damages such as landslides, soil and water contamination, blockade of roads and waterways, forest and biodiversity loss, and damage to agricultural land and crops, among others.

Upon observing similar damages in other districts, I realized the immediate need for a rapid survey on the environmental impact of the earthquake in the most affected districts of Nepal. Based on consultations with key authorities and potential donors, a Rapid Environmental Assessment (REA) was commissioned with the permission of the then Rt. Hon. Prime Minister and the Minister for Science, Technology and Environment, Sushil Koirala.

The main objective of the REA was to understand and identify the environmental damages caused by the earthquake, to prepare a strategy and action plan to restore and rehabilitate the damaged ecosystem including various sectors, and to make recommendations to the concern authority for its implementation. This study has carefully identified and analyzed the damages caused by the earthquake on the natural environment and human health, and considers the potential impacts during and after the reconstruction phase. It recommends the possible actions to reduce multiple hazards posed by the earthquake and suggests ways and means to build back better as per the concept of Sendai Framework on Disaster Risk Reduction focusing more on making reconstruction safer and greener. The findings of the REA are important considerations for the reconstruction phase in order to ensure that the outcomes of our efforts are sustained.

This study has been endorsed by a multi-stakeholder Steering Committee and submitted to the government of Nepal to consider this as a part of the Post Disaster Need Assessment (PDNA) and implement during the reconstruction phase.

I believe this report will help build a better understanding of the immediate impacts of the earthquake and the possible impacts of the reconstruction phase on our environment, thereby contributing to the overall reconstruction process.

I take this opportunity to thank the then Rt. Hon. Prime Minister and the Minister for Science, Technology and Environment, Sushil Koirala, for his approval to conduct the REA. I highly appreciate the hard work and valuable contribution of Dr. Shankar Sharma and the team of experts in producing the REA report. I would like to acknowledge the expert guidance of Ms. Judy Oglethorpe, Mr. Santosh Mani Nepal and Dr. Shant Raj Jnawali and thank WWF Nepal and the USAID-funded Hariyo Ban Programme for their financial and technical support. I also thank all the members of Steering and Technical Committees and the local people who contributed to this study despite the difficult times.

Krishna Chandra Paudel, Ph.D.
Secretary
2072/06/26

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Acronyms and Abbreviations

AEPC	Alternative Energy Promotion Centre
BFI	Banks and Financial Institutions
BZUC	Buffer Zone User Committee
CA	Conservation Area
CAMC	Conservation Area Management Committee
CARE	Cooperative for Assistance and Relief Everywhere
CBO	Community-Based Organization
CBS	Central Bureau of Statistics
CDRC	Central Disaster Relief Committee
CFUG	Community Forest User Group
CoRD	Centre of Resilient Development
CSO	Civil Society Organization
DDC	District Development Committee
DDRC	District Disaster Relief Committee
DNPWC	Department of National Parks and Wildlife Conservation
DRCN	District Road Core Network
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSCWM	Department of Soil Conservation and Watershed Management
DUDBC	Department of Urban Development and Building Construction
EFLG	Environment Friendly Local Governance
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GBV	Gender Based Violence
GEF	Global Environment Facility
GESI	Gender Equality and Social Inclusion
GLOF	Glacial Lake Outburst Flood
GM	Genetically Modified
GoN	Government of Nepal
GRR	Green Recovery and Reconstruction
GRRT	Green Recovery and Reconstruction Toolkit
HCFC	Hydrohlorofluorocarbon
I	Immediate
IAS	Invasive Alien Species
ICCG	Inter-Cluster Coordination Group
ICIMOD	International Centre for Integrated Mountain Development
ICS	Improved Cook Stove
IEE	Initial Environmental Examination
IFRC	International Federation of the Red Cross and Red Crescent Societies
INGO	International Non-Governmental Organization
IPP	Independent Power Producer
IWM	Integrated Watershed Management
IWRM	Integrated Water Resource Management
LAPA	Local Adaptation Plan of Action
LPG	Liquid Petroleum Gas
LRN	Local Road Network
LSGA	Local Self Governance Act

LT	Long Term
MOAD	Ministry of Agricultural Development
MoCTCA	Ministry of Culture, Tourism and Civil Aviation
MoE	Ministry of Education
MoEN	Ministry of Energy
MoFALD	Ministry of Federal Affairs and Local Development
MoFSC	Ministry of Forests and Soil Conservation
MoHA	Ministry of Home Affairs
MoHP	Ministry of Health and Population
MoI	Ministry of Industry
MoLRM	Ministry of Land Reform and Management
MoPIT	Ministry of Physical Infrastructure and Transport
MoSTE	Ministry of Science, Technology and Environment
MoUD	Ministry of Urban Development
NARC	National Agricultural Research Council
NBSM	National Bureau of Standards and Metrology
NEA	National Electricity Authority
NGO	Non-Governmental Organization
NP	National Park
NPC	National Planning Commission
NRA	National Reconstruction Authority
NRM	Natural Resource Management
NSDRM	National Strategy for Disaster Risk Management
NTFP	Non-Timber Forest Product
ODF	Open Defecation Free
OHS	Occupational Health and Safety
PA	Protected Area
PCB	Polychlorinated Biphenyl
PDNA	Post Disaster Needs Assessment
POP	Persistent Organic Pollutant
REA	Rapid Environmental Assessment
SEA	Strategic Environmental Assessment
SRN	Strategic Road Network
ST	Short Term
TU-CDES	Tribhuvan University, Central Department of Environmental Science
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
USAID	United States Agency for International Development
VDC	Village Development Committee
VRCN	Village Road Core Network
WASH	Water, Sanitation and Hygiene
WR	Wildlife Reserve
WWF	World Wildlife Fund

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EXECUTIVE SUMMARY

The Nepal Earthquake 2015

The Gorkha earthquake of 25 April 2015 and its aftershocks resulted in huge loss of life, injury, and economic damage in Central and Western Regions of Nepal, affecting all sectors. The post disaster needs assessment (PDNA) estimated the value of damage and loss at $7,065 million, a large proportion of it housing (National Planning Commission 2015). While reconstruction will take many years and much investment, there is a great opportunity to ensure that building back is not only 'better and safer' but also greener, ensuring healthy ecosystems for disaster risk reduction and natural resources for resilient livelihoods and economic development.

A rapid environmental assessment (REA) was undertaken from May to July 2015 with the goal of assessing the immediate impacts of the earthquake on biodiversity and the natural environment, identifying potential environmental impacts of recovery and reconstruction, and promoting green recovery and reconstruction for a more resilient Nepal.

This REA, the first of its kind in Nepal, was undertaken with widespread support from the Nepalese government, and in consultation with the PDNA to influence recovery outcomes. Led by the Ministry of Science, Technology and Environment (MoSTE), the interdisciplinary assessment team comprised expert consultants; staff of World Wildlife Fund (WWF) Nepal and the Hariyo Ban Program; and 20 environmental science university graduates.

Rapid Environmental Assessment Results

1. Identify immediate environmental impacts, hazards and risks resulting from the earthquake and prioritize them for subsequent recovery and reconstruction

Geological and hydrological impacts

The earthquake induced at least 2,780 landslides and many ground cracks in 31 districts, significantly damaging settlements, infrastructure, agricultural land, forests and water resources; the frequency of landslides was three times greater than that before the earthquake. A large avalanche in Langtang valley destroyed Langtang village and flattened nearby forest. The moraine dams of three glacial lakes were further destabilized and are now reported to be dangerous (Byers, 2015). Water sources changed in some areas, with reduced or no flows in some, and new sources starting to flow in others. Freshwater ecosystems in the Koshi and Gandaki basins were affected by increased amounts of sediment, and a few rivers were temporarily blocked by landslides. Risk of downstream flooding is increased due to deposition of large amounts of sediment.

Forests and biodiversity

An estimated 2.2% of forest cover in the affected areas was lost, mainly pine forest and sub-temperate forest (NPC, 2015). It will take many years for many sites to stabilize and vegetation to re-establish, and there is a risk of invasive species establishing. Seven protected areas were severely affected, and their management and that of community and government forests was disrupted, with risk of increased illegal extraction. Some wild animals are known to have been killed directly by the earthquake; others are likely to be

affected by landslides restricting their ranges, and the earthquake occurring during the main breeding season. Rainbow trout escaped from fish farms into local streams, with risk to native fish species. Loss of non-timber forest products or access to them has significant impacts on local livelihoods, as does the disruption to tourism.

Photo 1: Landslide in Rasuwa

Solid waste and hazardous materials

A huge amount of debris was generated from damaged buildings. Hazardous waste released into the environment included medical waste that was haphazardly disposed of; electrical wastes; chemicals from laboratory spills; industrial chemicals; and petroleum products. Lead and mercury were released including lead in paint, posing long-term health hazards. Some toxic chemicals will end up in ground water or rivers; some are persistent pollutants. Waste generated in emergency camps was not well managed, and plastic generated during the relief phase was either burned, causing air pollution, or dumped and will remain in the environment because it does not decompose. Dead bodies and livestock carcasses contaminated the environment.

2. Develop a strategy for minimizing impacts of recovery and reconstruction, and for building back better, safer and greener in a more resilient and environmentally sensitive way across multiple sectors

A set of 10 principles for recovery and reconstruction was developed by the REA and PDNA teams. Recommendations include:

Ensure land use planning incorporates hazards and disaster risk reduction

Spatial planning that integrates disaster risk reduction (DRR) should be used for resettlement of communities and relocation of agriculture and infrastructure away from very hazardous locations, while ensuring adequate land and resources for new settlements, and maintaining or restoring ecosystem functions and biodiversity.

Promote the use of safe and green building materials and reuse of disaster debris

Reconstruction of buildings and settlements will have significant environmental impacts from brick manufacturing, and extraction of timber, poles, rock, sand and gravel. As much material as possible should be reused or recycled. There is an important opportunity to promote safe and green building materials including sustainably harvested timber and bamboo, as well as energy and water efficiency in building designs.

Develop environmentally responsible solid and hazardous waste management plans

Solid waste management and disposal of hazardous materials were a major challenge before the earthquake. There is a risk that non-usable building debris and hazardous materials will be dumped haphazardly. There is an urgent need to develop and implement sound waste management plans for all settlements and for facilities producing hazardous materials as part of building back better and greener, and to safely dispose of waste accumulated after the earthquake.

Ensure strategic road planning and reconstruction

Roads in rural areas were already causing severe environmental problems before the earthquake, including landslides and sedimentation of rivers. Reconstruction risks further environmental damage, for example in opening of new routes around damaged sections, and in inappropriate disposal of landslide debris. There is an opportunity to redesign networks of rural roads, focusing on strategic access, closing roads that are not feasible to reopen, and ensuring proper planning and sound construction of new roads in the future.

Promote alternative energy and energy efficiency methods

Damage to hydropower projects likely resulted in increased sediment discharge from settling basins and debris in rivers. Their repair will involve further extraction of building materials. Loss and damage of alternative energy such as biogas, improved cook stoves (ICSs) and solar systems, as well as electricity from hydropower, resulted in increased use of firewood from forests, with health risks from indoor air pollution from fires in shelters. The earthquake provides an opportunity to review hydropower for seismological safety as well as reducing downstream and upstream environmental impacts; and to promote extensive use of other forms of alternative energy in reconstruction.

Improve water and sanitation and promote integrated watershed management

Environmental risks during the recovery and reconstruction phases in water, sanitation, and hygiene (WASH) include health risks from water contaminated by fecal matter and hazardous materials; the earthquake destroyed many toilets in the affected districts, challenging the Government's program to improve sanitation. With changes in water source distribution and flow, people's water extraction patterns will change, with possible impacts on wildlife, vegetation and areas that are climate refugia. Recommendations include improved sanitation and hygiene, inventorying water sources, and promoting integrated watershed management (IWM).

Support alternative livelihoods and environmentally responsible agriculture

Existing and potential impacts from agriculture and livelihoods include: greater dependence on forest products until people can restore livelihoods; opening of new farms in forest land; increase of livestock in forests; loss of local crop landraces and breeds, and introduction of unsuitable ones; increase in invasive species and soil erosion in abandoned farms; increased use of chemical fertilizer and pesticides; and impacts of irrigation due to changing water sources and reconstruction of infrastructure. Recommendations include rapid support to restart agriculture including distribution of only tested crop varieties and animal breeds; promotion of labor saving technologies; rapid introduction of cash-for-work programs; support to alternative sources of livelihoods; and restoring nature-based tourism.

Promote reforestation and sustainably sourced timber for reconstruction

Possible impacts from recovery of the forest and conservation sector include: spread of invasive species with tree planting; unaesthetic tourism development; and accelerated erosion from trails. Recommendations for recovery and reconstruction include urgent restoration of law enforcement and rebuilding management capacity of government and community forest groups; provision of sustainably sourced timber and poles for reconstruction; and replanting of trees where feasible in damaged sites that pose a risk for settlements, agriculture and infrastructure.

Promote sound environmental practices through schools and other academic institutions

DRR and green recovery approaches should be mainstreamed in curricula of education institutions to improve natural resource management (NRM) and raise disaster risk awareness for greater resilience; students should be involved in green recovery activities in their schools, colleges, universities and communities.

Promote equity in the recovery and reconstruction process with particular attention to women and vulnerable or marginalized groups

The earthquake had differential impacts on women, poor and marginalized people, in relation to the environment. Issues of concern center around: water, forest produce, energy, non-timber forest product (NTFP) enterprises, ecotourism, land distribution and ownership; forest encroachment; gender-based violence; women's leadership in NRM groups; poaching and smuggling; and exposure to hazardous materials. Recommendations include following fundamental principles of human rights during recovery and reconstruction, with particular focus on ensuring equitable support; reducing gender-based violence in relation to natural resources; restoring and promoting alternative energy and improved water supplies to reduce women and girls' work; and strengthening women's roles in forest management.

Incorporate climate change into recovery and reconstruction

In all sectors, climate change aspects should be incorporated into recovery and reconstruction, allowing for more extreme weather events such as intense precipitation and unreliable monsoons, as well as higher temperatures.

3. Identify policy gaps and assess institutional capacities to mitigate environmental risks and manage environmental recovery

Support policy implementation and enforcement mechanisms

Nepal in general has sound policies, but their implementation is a challenge in many cases. During recovery and reconstruction there is a good opportunity to promote improved implementation of policies, laws and regulations, in order to build back better, safer and greener. This includes enforcing environmental impact assessment (EIA)/ initial environmental examination legislation, and speeding up the process. In some cases, legislation requires updating. There is an excellent opportunity to integrate green recovery aspects into earthquake recovery guidelines of different sectors.

Build capacity for green recovery and reconstruction and support risk awareness raising activities

In order to promote green recovery and reconstruction as part of building a more resilient Nepal, there is an urgent need to build capacity in the various sectors at national, district and local level to incorporate environmental aspects into their recovery and reconstruction work, and to raise awareness about the issues and what can be done. There is a high demand for this. Strong leadership is required to promote green practices, and the new National Reconstruction Authority (NRA) can play an important role.

Audiences

The REA results are intended for the NRA and other Government Ministries and Departments; the humanitarian and development sectors; donors; the forest and environment sectors; the private sector; other civil society groups; the media; and affected communities.

With the huge amount of donor funding, donors have a unique opportunity to promote better, greener practices through the use of their funds in order to increase resilience. The finance sector has a major opportunity to play a role through packages to help environmentally responsible small and medium sized enterprises to restart businesses, and to increase social and environmental corporate responsibility.

CHAPTER 1

Introduction and Approach

1.1 Background

On 25 April 2015, a 7.8 magnitude earthquake struck Nepal with an epicenter in Gorkha district, 81 km northwest of Kathmandu. This was followed by strong aftershocks, including one of 7.3 magnitude with an epicenter 18 km southeast of the town of Kodari in Dolakha district on 12 May, 2015. The earthquake and its aftershocks left over 8,700 people dead and over 22,000 injured (National Planning Commission (NPC, 2015). The earthquake destroyed over half a million houses and damaged over 200,000 more. A large number of people were displaced, some living in displacement camps. Many people required humanitarian assistance; a month after the disaster, humanitarian partners estimated that 2.8 million people would need assistance for at least another four months (United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), 2015).

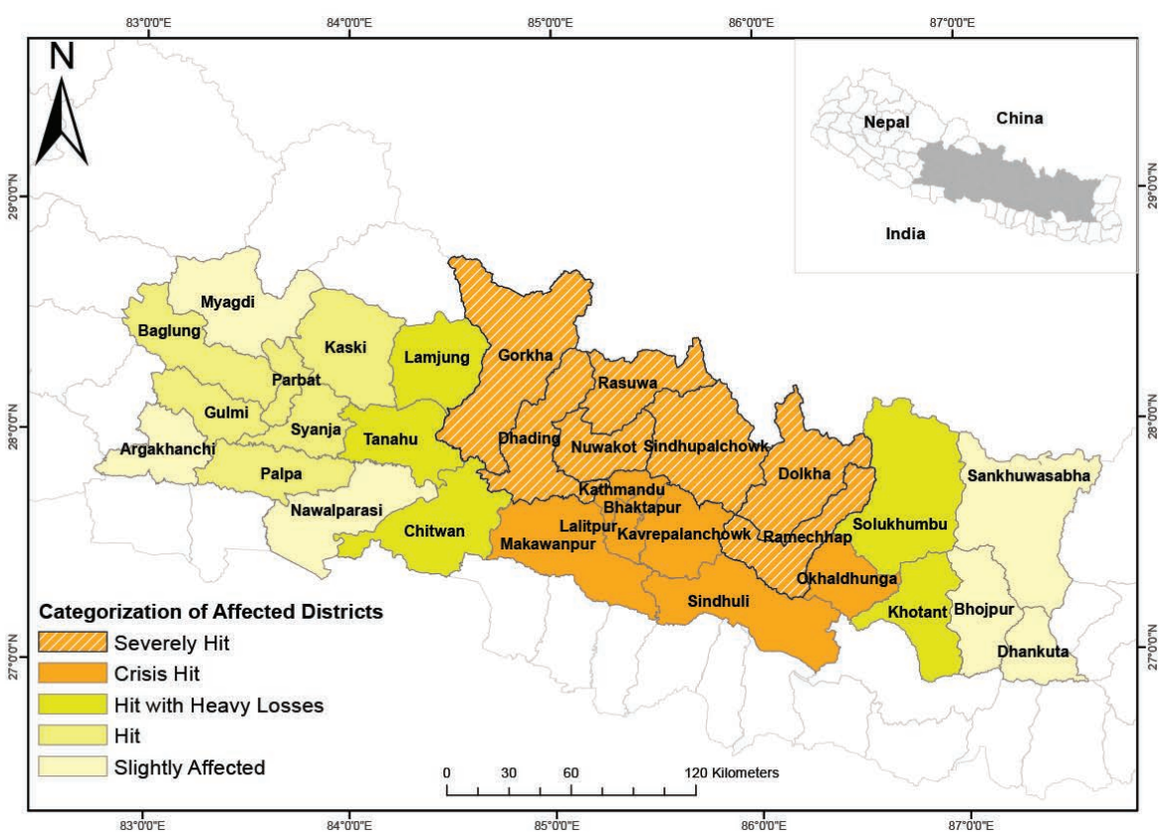

Figure 1: Categories of Earthquake-Affected Districts

Source: GoN/MoHA as of 21 May 2015

The earthquake affected many sectors, including education, health, water, energy, transport, forestry, environment, agriculture, commerce and industry, with severe economic impacts. It damaged or destroyed many monuments and temples of great cultural and religious value. Total economic damage and loss was estimated at US$7,065 million; and rehabilitation and reconstruction costs were estimated at US$6,695 million (NPC 2015). The most severely affected districts are in the mid-hills and mountains of western and central regions, comprising Sindhupalchowk, Dolakha, Nuwakot, Dhading, Rasuwa, Gorkha and Ramechhap; a further 24 districts were also affected (NPC, 2015) (see Map 1).

Following the earthquake, a massive relief effort was launched in the affected districts with special challenges in some areas due to their remoteness and limited access by land and air. There was a rush to secure temporary shelters before the monsoon started in June when landslides, floods and poor weather conditions would make access even more difficult, and pose additional hazards to earthquake-affected communities. As of September 2015, early recovery has started in many places, and will be intensified once the monsoon stops. Massive recovery and reconstruction efforts are needed across many sectors for the next few years.

There is much recognition of the importance of building back better and safer to ensure that Nepal is more resilient to future earthquakes and other disasters, including those related to climate change. Nepal is a highly disaster prone country, with a long history of earthquakes resulting from its location on the subduction zone where the Indian subcontinent tectonic plate is slowly moving underneath the Eurasian plate, creating the Himalayas. In addition, it is highly prone to floods and landslides, especially in light of its highly dissected topography and extreme elevation range. Many of Nepal's people are highly dependent on locally-available natural resources and ecosystem services for their livelihoods and security.

In order for Nepal to become more resilient to future disasters and reconstruct in a way that will not over-exploit Nepal's natural resource base or damage ecosystem services, it is essential to 'build back greener', ensuring environmentally responsible recovery and reconstruction. Functioning ecosystems provide critical protection against natural disasters by stabilizing slopes to protect against future landslides and provide natural space to attenuate floods. This is also an opportunity to tackle pre-earthquake environmental problems and build back better and safer.

The importance of rebuilding in an environmentally responsible manner is recognized by the Government of Nepal (GoN) in its general principles for reconstruction (NPC, 2015). Environmental considerations must be incorporated into the recovery phase for each sector (e.g., shelter and building construction, energy, transport, water, sanitation and hygiene (WASH), food security, education and health). It is critical for those involved in the post-earthquake recovery process to internalize and take ownership of green recovery and reconstruction (GRR) because environmental protection is a shared responsibility.

Indeed, building back better, safer and greener is essential if Nepal is to regain the development progress lost due to the earthquake, and achieve further development gains in the next fifteen years under the new global Sustainable Development Goals (United Nations, 2015).

This rapid environmental assessment (REA) identifies the major environmental issues associated with the earthquake and recommends appropriate actions to be undertaken by the GON, civil society, private sector, and people recovering from the disaster. Results are presented in two volumes: Volume 1 contains the main report and action plan; and Volume 2 contains annexes. In Volume 1, Chapter 1 provides an introduction to the REA. Chapter 2 describes the major direct environmental impacts of the earthquake; and Chapter 3 describes potential indirect impacts from recovery and reconstruction in several sectors, and ways to avoid or mitigate them. Chapter 4 covers policy and governance issues. Chapter 5 outlines the need for training and outreach with many stakeholders to reduce impacts, and provides an implementation plan for future action. Volume 2 contains annexes with further recommendations on solid waste and hazardous material management; detailed policy discussion; and summaries of REA findings in six districts and Kathmandu.

1.2 Goal and Objectives of the Rapid Environmental Assessment

The goal of Nepal's post-earthquake REA is to assess the immediate impacts of the earthquake on biodiversity and the natural environment, identify potential environmental impacts of recovery and

reconstruction, and promote GRR for a more resilient Nepal.

- The specific objectives of the assessment are:
- Identify immediate environmental impacts, hazards and risks resulting from the earthquake and prioritize them for subsequent recovery and reconstruction.
- Identify resilient and environmentally responsible ways to minimize adverse environmental impacts of recovery and reconstruction across multiple sectors.
- Identify policy gaps and assess institutional capacities to mitigate environmental risks and manage environmental recovery.
- Develop a strategy for building back better, safer and greener in a more resilient and environmentally sensitive way across multiple sectors.

1.3 Scope of the REA

The REA evaluates the direct and indirect environmental impacts of the 2015 Nepal earthquake, with a strong focus on the actual and potential environmental impacts of earthquake relief, recovery and reconstruction. It includes a set of recommendations for GRR. During the preparation of the REA, field activities were conducted in the following severely affected districts: Dolakha, Gorkha, Rasuwa, Kavre, Nuwakot and Sindhupalchowk, as well as Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur); however, the recommendations apply to all of Nepal's earthquake-affected districts. The REA also covers national level issues including policy. It includes green and brown environmental issues, including freshwater. However, it does not cover cultural or religious sites including the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Sites, which have been assessed separately. The REA builds on the environment and forestry assessment initiated in the Post Disaster Needs Assessment (PDNA) (NPC, 2015).

The REA provides extensive recommendations to avoid or mitigate potential direct and indirect environmental risks as part of the recovery and reconstruction process. However, it does not replace the need for project-level environmental impact assessments (EIA) or initial environmental examinations (IEE). Rather, it helps to identify likely issues, and should help in defining the scope and coverage of EIAs and IEEs for specific activities, such as road construction.

By its nature the REA provides a view of earthquake-related environmental issues a few months after the disaster; over time, new environmental issues and approaches to green recovery are likely to emerge. As such, the REA is considered a living document that should be revised as new information becomes available.

1.4 Target Audiences

Addressing environmental concerns during the earthquake relief, recovery, and reconstruction process is a shared responsibility that requires action across different disciplines and sectors. The information and recommendations contained in the REA are targeted at the following constituencies:

- Ministries and Departments of the Government of Nepal (GoN), including the new National Reconstruction Authority (NRA)
- Humanitarian sector – United Nations (UN), international non-governmental organizations (INGOs), non-governmental organizations (NGOs), and clusters
- Donors
- Forest/conservation/environmental sector
- Private sector
- Other civil society organizations (CSOs) and community based organizations (CBOs) including women's groups
- Affected communities

1.5 REA Methodology

The REA methodology is based on existing guidance for post-disaster assessments, especially the *Environmental Needs Assessment in Post-Disaster Situations* (United Nations Environment Programme (UNEP) 2008) with additional elements from the human-centered *Guidelines for Rapid Environmental Impact Assessment in Disasters* by the University College London and Cooperative for Assistance and Relief Everywhere (CARE) International (Kelly, 2005). The REA team also used the Green Recovery and Reconstruction Toolkit (GRRT) developed by World Wildlife Fund (WWF) and the American Red Cross (WWF and American Red Cross 2010) to assess likely recovery and reconstruction impacts in different sectors. The team also drew on experience of REAs in other countries, including Haiti, Pakistan, Philippines, and Chile. The REA information gathering process occurred from May to August 2015.

The methodology included a literature review of available sources; direct field observation; focus

group discussions and key informant interviews; consultations with district level GoN institutions, local NGOs, CSOs and earthquake-affected families; and central level stakeholder interviews and consultations.

Consultations: The REA team was guided by a steering committee chaired by the Ministry of Science, Technology, and the Environment (MoSTE). An initial stakeholder consultation was held to present the REA concept and approach, and gain feedback and insights from stakeholders. The meeting was attended by senior GoN staff including the National Planning Commission (NPC), MoSTE, Ministry of Forests and Soil Conservation (MoFSC), as well as donor organizations and civil society. The REA process, including a discussion of sectoral impacts, was presented to the United Nations Inter-Cluster Coordination Group (ICCG), as well as the Shelter, Food Security, and Education Clusters. A full list of consultations is contained in Annex 1.

Field visits: The REA team comprising thematic experts and 20 environmental science university graduates visited six badly affected districts (Dolakha, Gorkha, Kavre, Nuwakot, Rasuwa, and Sindhupalchowk) and the Kathmandu valley to assess the situation on the ground, interact with relevant district level organizations and affected households, gather data, and verify available information. The expert team developed a set of questionnaires and checklists to guide discussions with relief and recovery organizations, including government agencies, and earthquake-affected communities, drawing on UNEP (2008) and Kelly (2005). The visits were conducted at two levels: preliminary visits followed by a week-long detailed survey. Interview teams were led by one or more technical experts and included the graduates as research assistants; the latter had received orientation and training before the field work. Focus group discussions and key informant interviews were conducted with affected communities in the target districts. Meetings were held with various departments of the government of Nepal; PDNA team members; ICCG; Food Security Cluster members; Shelter Cluster leadership; UNEP; CARE and WWF; staff from U.S. Agency for International Development's (USAID's) Disaster Assistance Response Team and its Bureau for Democracy, Conflict and Humanitarian Assistance. The teams also visited some damaged sites of specific importance for case studies, which were focused on the thematic areas of the REA: agriculture and livelihoods, forests and biodiversity, landslides, water resources, energy, solid waste, tourism, and gender equality and social inclusion (GESI). During the field studies, nearly 200 people were interviewed and/or consulted, over 80 organizations visited and 54 on-the-spot case studies conducted.

All REA data were compiled by the interdisciplinary team and analyzed to identify common themes and critical issues extracted from (1) interviews and secondary sources, (2) government and relief and recovery agencies, (3) communities, and (4) field observation. The results of the assessment are discussed in Parts 2 and 3 below.

CHAPTER 2

Direct Environmental Impacts of the Earthquake

The earthquake that occurred on 25 April 2015, and the significant aftershocks that followed, resulted in a range of environmental impacts, including major landslides, sediment loading, debris accumulation, forest and biodiversity losses, changes in water supply and quality, hazardous materials contamination, and other impacts as further detailed below. The following section presents the immediate, direct environmental impacts of the earthquake as well as indirect impacts (e.g., water contamination as a result of infrastructure destruction).

2.1 Geological and Hydrological Impacts

Prior to the earthquake, Nepal's fragile geological conditions, high seismic activity, rugged mountain topography and extreme climatic conditions made the country's physical environment highly vulnerable to geo-hazards like landslides and accelerated soil erosion. Furthermore, human pressure on land and water resources contributed to the inherent vulnerability of Nepal. Nepal has a history of intense and prolonged rainfall events combined with earthquakes that frequently trigger landslides in the hills and mountains. As a result, natural hazards such as landslides, flash floods, glacial lake outburst floods (GLOFs), landslide dam outburst floods, and riverbank cutting often leads to loss of life and property, land degradation, reduced production and increased poverty.

In a landscape that was already geologically active, the devastating Nepal earthquake induced thousands of landslides and cracks in 31 districts, significantly damaging settlements, infrastructure, agricultural land, forests, and water resources. The earthquake, followed by hundreds of aftershocks, ripped off eastwards from the epicenter, causing a fault rupture up to 150 km long running east of Gorkha district. An area approximately 120 km by 50 km around the Kathmandu Valley was lifted up by at least 1 meter and moved south (Spencer, 2015).

A total of 2,782 landslides covering 38.2 km^2 area were recorded in 14 affected districts, generating an estimated 19,118,538 m^3 of sediment, which will have drastically increased sediment loads in downstream water courses (Table 1).[1] The majority of the landslides (about 75 percent) occurred in the Indrawati, Sunkoshi, Tamakoshi, Dudhkoshi and Likhu sub-basins of the Koshi river basin, generating at least 11,225,382 m^3 of debris. Large rock fragments and boulders are the major part of the debris and will be transported for short distances downhill and downstream. However, smaller debris particles of sand, silt and clay will travel much further downstream to the Terai region and will result in rising river beds, sedimentation and flooding in flatter low-lying areas posing increased risks to settlements, agriculture and forest lands. The number of earthquake induced landslides was estimated to be 3 times greater than the number of pre-earthquake landslides, although caution should be used with this figure as it has not been adjusted for differences in methodologies.[2]

[1] The estimates of debris volume are based on observations by REA team members that the average depth of earthquake-induced shallow landslides is around 0.5 m in sampled districts; this figure has been assumed as an average for all landslides and used to estimate total volume of landslide debris.

[2] The pre- and post-earthquake landslide occurrence was estimated by comparing the post-earthquake satellite imagery from International Center for Integrated Mountain Development (ICIMOD) (2015) with pre-earthquake landslide imagery by Tribhuvan University, Central Department of Environmental Science (TU-CDES 2015) in the most affected districts. Pre-earthquake review used imagery from various dates in 2013, to December 2014. Some variation may be attributed to the fact that the post-earthquake survey recorded smaller scale landslides than the TU survey; the use of different satellite images in the two surveys; and differences in methodologies by TU-CDES and ICIMOD.

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Photo 2: Communities at risk due to landslides in Rasuwa

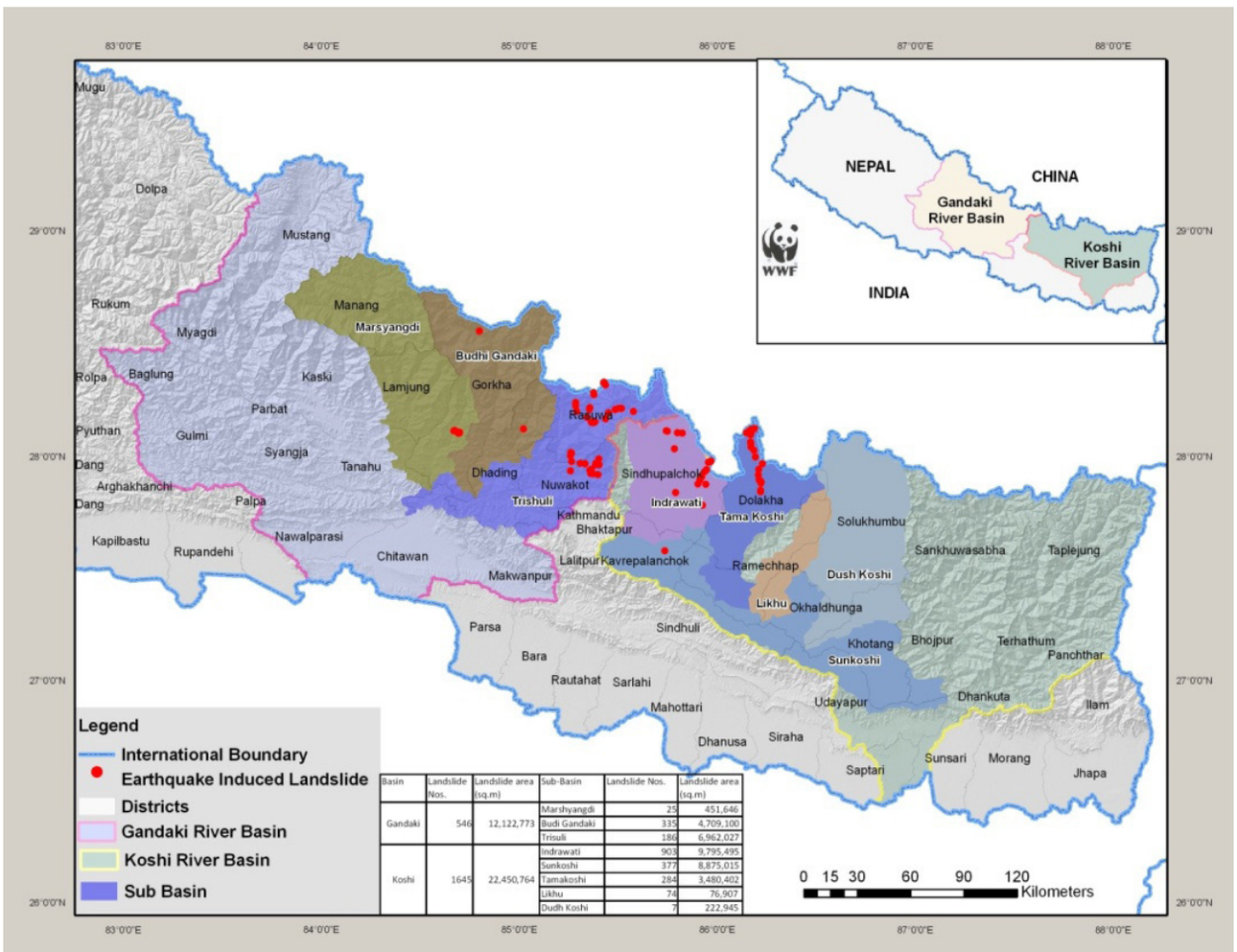
Table 1: Pre-and post-earthquake situation of landslides in the affected districts of Nepal

S. No.	District	Pre Earthquake Landslides*			Earthquake Induced Landslides**		
		Total Number of Landslides	Total Area m^2	Total Volume of Debris m^3	Total Number of Landslides	Total Area m^2	Total Volume of Debris m^3
1	Gorkha	62	1,796,607	898,303.5	107	1,993,838	996,919
2	Dhading	76	2,577,996	1,288,998	275	3,162,267	1,581,134
3	Rasuwa	70	3,243,149	1,621,575	127	5,828,329	2,914,165
4	Nuwakot	38	118,887	59,443.5	66	1,242,119	621,059.5
5	Sindhupalchowk	87	3,623,521	1,811,761	1278	18,667,721	9,333,861
6	Dolkha	29	259,475	129,737.5	153	3,080,708	1,540,354
7	Ramechap	101	1,714,325	857,162.5	253	764,032	382,016
8	Kathmandu	NA	NA	NA	44	328,797	164,398.5
9	Bhaktapur	NA	NA	NA	NA	NA	NA
10	Lalitpur	NA	NA	NA	65	85,025	42,512.5
11	Makwanpur	87	1,046,123	5,230,61.5	156	204,060	102,030
12	Kavre	52	2,968,952	1,484,476	176	1,129,346	564,673
13	Sindhuli	171	2,448,103	1,224,052	59	1,361,619	680,809.5
14	Okhaldhunga	80	3,158,977	1,579,489	23	389,215	194,607.5
	Total	**853**	**22,956,115**	**11,478,058**	**2782**	**38,237,076**	**19,118,538**

** Source: TU-CDES (2015)*
*** Source: ICIMOD (2015) (Makwanpur data obtained from DSCWM[3])*
NA: Data not available

Most of the landslides on mountain tops and mid slopes are rock fall and translational[4] landslides. Some of the landslides near valleys, and along rivers or tributaries are deep seated rotational[5] landslides. Many landslides occurred around villages, causing injury and loss of human life, loss of livestock and property, and damage to infrastructure. Many landslides occurred above and below roads, trails, and irrigation channels, damaging these infrastructures especially where there were poor toe protection measures. Much infrastructure is vulnerable to further damage by potential landslides during the rainy season. Dams caused by landslides occurred in the Kali Gandaki river at Ramche in Myagdi; district and Tom Khola, a tributary of the Budhi Gandaki river in upper Gorkha district; but the dams were breached safely without causing damage to downstream communities, farmlands or infrastructures.

[3] Department of Soil Conservation and Watershed Management 2015, unpublished initial data on earthquake induced landslides.
[4] Landslides in which the mass moves out, or down and outward along a relatively planar surface
[5] Landslide in which the surface of rupture is curved concavely upward (spoon shaped) and the slide movement is more or less rotational about an axis that is parallel to the contour of the slope.



Basin	Landslide Nos.	Landslide area (sq.m)	Sub-Basin	Landslide Nos.	Landslide area (sq.m)
Gandaki	546	12,122,773	Marshyangdi	25	451,646
			Budi Gandaki	335	4,709,100
			Trisuli	186	6,962,027
Koshi	1645	22,450,764	Indrawati	903	9,795,495
			Sunkoshi	377	8,875,015
			Tamakoshi	284	3,480,402
			Likhu	74	76,907
			Dudh Koshi	7	222,945

Figure 2: Earthquake induced landslide distribution map in Koshi and Gandaki River Basins Nepal

** Source: WWF Nepal, based on landslide data from ICIMOD (2015)*

Of the 31 affected districts, Gorkha, Dhading, Rasuwa, Nuwakot, Sindhupalchowk, Dolakha, Ramechhap, Kathmandu, Bhaktapur, Lalitpur, Makwanpur, Kavre, Sindhuli and Okhaldhunga suffered most seriously from landslides and cracks. Major landslide impacts by districts are summarized in Table 2, though a complete evaluation of landslide impacts has yet to be carried out.

Table 2: Examples of landslide damage by sector

Sector	Location
Landslide damage to settlements	Laprak and Sindradanda Barpak of Gorkha; Haku of Rasuwa; Deupur-2, Khattechaur of Kavre and Syaule-8 Kerabari of Sindhupalchowk
Landslide damage to agricultural lands	Gerku-4, Gairikharka of Nuwakot and Bhimeswor-8 Dihi, Dolakha
Landslide damage to forest lands	Gerkhu-4, Jalpa Community Forest, Nuwakot, Golmeshwor Community Forest, Magapauwa-9, Dolakha, parts of Langtang National Park and Gaurishankar Conservation Area
Landslide damage to roads and bridges	Nuwakot (Nuwakot-Dhunche road) and Sindhupalchowk (Barhabise-Tatopani road); Larcha bridge in Bhotekoshi River
Landslide damage to trails	Almost all trails in high mountain areas including Arughat-Sama trail in Gorkha
Landslide damage to irrigation systems	Bhimeshwor-8 Dihi, Dolakha
Landslide damage to drinking water supply	Melamchi Drinking Water Supply project in Sindhupalchowk
Landslide damage to hydropower	Mailung Hydropower Plant Rasuwa and Charnawati Micro Hydropower Plant in Dolakha

Source: REA Field Survey

Photo 3: Roads damaged by landslides - Rasuwa & Nuwakot

Landslides and forests: Food and Agriculture Organization of the United Nations (FAO) Rome estimated a forest loss of 2.2 percent in 6 earthquake affected districts (Gorkha, Dhading, Nuwakot, Rasuwa, Sindhupalchowk and Dolakha), based on an analysis of pre and post-earthquake satellite imagery from the Google Crisis Response (Google, 2015). Assuming that the scale of earthquake impact is similar in all of the most affected districts (except Kathmandu, Bhaktapur and Lalitpur which have very limited forest), forest loss of 2.2 percent gives an estimate of total forest loss of around 23,375 ha (NPC, 2015).

Photo 4: Drinking water source affected by earthquake

Avalanches and glacial lake outburst floods: Avalanches and GLOFs are other potential environmental hazards linked to the earthquake. An avalanche of ice and rocks that hit Langtang village in Rasuwa district completely buried the village, killing about 200 local inhabitants and tourists, and leaving about 500 people homeless. The moraine dams of the three largest and potentially dangerous glacier lakes: Imja, Tsho Rolpa and Thulagi have been affected by the earthquake, and now pose a much greater risk (Byers et al. 2015). A recent outburst following the earthquake was also reported in one of the supra glacial lakes located above Imja lake causing temporary increase in water flow in the river. These indicate serious risks of GLOF in the future which may be further exacerbated by the impacts of climate change. Close monitoring of these lakes including further study on the effect of the earthquake on the stability of the moraine dam is required.

Changes in water sources: Changes in water sources were reported in several districts. Some springs dried up, or flow reduced or increased. In other places new springs appeared where there had been none before. Water level in wells changed in some places, indicating changes in water table levels. Water quality was affected in some places. Changes in water sources will have significant impacts for local rural water supplies, and may result in conflicts between communities, or between communities and wildlife.

Changing water sources: winners and losers

A number of springs were reported to have dried up in Arjeldhara and Okarpauwa in Nuwakot and Sarkiswara-7 in Dolakha district. A significant decrease in water flow was reported from springs in Rahuldhara and Bidur Municipality in Nuwakot. Local communities in Marbu-7, Dolakha reported the sudden appearance of new water sources. Change in water quality, with colored water and high turbidity, was reported in Bhimeshwor-8 Dihi, Dolakha for a short period.

In Katteldanda, a locality near Gorkha headquarters, there was an increase in water in nearby water-holes (*kuwa*) after the first tremor (April 25). However, the aftershock of May 12 almost dried them up, bringing hardship to 85 households.

(Source: REA field survey)

2.2 Forest and Biodiversity Impacts

Forests and biodiversity provide key resources and ecosystem services for local communities and play an important role in the economic development of the country. Nepal has a total of 118 forest ecosystems ranging from tropical below 1000 m to alpine vegetation between 4,000 and 5,000 m above sea level. The country is exceptionally rich in biodiversity with globally significant wildlife species including tiger, rhino and elephants in the lower Terai; and Himalayan musk deer, red panda and snow leopard in the high mountains; many endemic plants and a large number of non-timber forest product (NTFP) species including medicinal and aromatic plants. Nepal is also rich in agrobiodiversity with many landraces of crops and breeds of livestock within its high elevational range.

The majority of people are dependent on Nepal's natural resources and ecosystem services for livelihoods and security including forests, agricultural areas, grasslands and wetlands. Forest diversity, species composition, regeneration and ecological connectivity are affected by anthropogenic factors like deforestation, forest degradation, illegal hunting and poaching, as well as climate induced and natural disasters.

Damage to forest areas: The earthquake damaged the forest resources of 31 districts. As mentioned above, FAO Rome estimated 2.2 percent forest loss for 14 of the most earthquake-affected districts, amounting to approximately 23,375 ha of forest at a value of NRs. 63.9 billion (NPC, 2015).

Two main types of forest were damaged: pine forest (30 percent), and sub-temperate forest (70 percent) as assessed by the PDNA team. In Langtang valley, a patch of forest dominated by *Larix himalaica* was swept away by the avalanche. *L. himalaica* has a restricted distribution in Nepal and is confined to the Langtang valley and to Manaslu Conservation Area (CA) in Central Region.

Strong earthquakes are a major driving force for vegetation dynamics in this tectonically active region (Cheng et al. 2009). Generally, mountain ridges and acidic surface soils are difficult to restore (Lin et al. 2004); and temperate forest restoration is estimated to require at least 50 years following landslides as in the mountains of Puerto Rico (Guariguata, 1990). Hence reforestation of landslide and avalanche sites is likely to take many years, particularly at higher altitudes. Early colonizing tree species include alder (*Alnus nepalensis*), chir pine (*Pinus roxburghii*) and blue pine (*Pinus wallichiana*). Alder plays an important role in stabilizing landslides, whereas pines can be problematic as they are prone to forest fire, re-exposing landslide sites to erosion or further landslides.

Landslide affected areas are at risk of colonization by invasive alien species (IAS), including species such as *Ageratina adenophora*, *Chromolaena odorata* and *Lantana camara*. If these species become established they may out-compete native species, and prevent natural forest regeneration.

Impacts on protected areas: Seven protected areas (PAs) were affected by the earthquake: Sagarmatha National Park (NP), Makalu-Barun NP, Langtang NP, Shivapuri-Nagarjun NP, Gaurishankar CA, Manaslu CA, and Annapurna CA covering an area of 15,988 km^2 (about 47 percent of the total protected area coverage in Nepal). The most severely affected were Langtang NP, Sagarmatha NP, Manaslu NP, Gaurishankar CA, and two Ramsar sites: Gosainkunda and associated lakes; and Gokyo and associated lakes. Affected forest area in the seven PAs is 408.5 ha (0.1 percent) of forest out of total 432,488 ha including 81,650 ha under community forest management.

Impacts on wildlife: The PAs provide refuge to several wildlife species of global significance such as red panda, musk deer, and Himalayan tahr. Important mammal habitats such as blue pine forest, temperate oak forest, subalpine fir and birch forest are reported to be damaged in Langtang National Park.

Wildlife killed in the earthquake

Over 50 Himalayan tahrs, one snow leopard, five wild boars, as well as barking deer and musk deer were reported to have died in the earthquake in Langtang National Park. Actual losses may be much higher. Tahr are an important prey species for snow leopard; the population was estimated at 319 animals in the Langtang valley in 2014.

(Source: Mr. Krishna Acharya, MoFSC, and Mr. Gautam Paudyal, WWF Nepal, personal communications)

A major impact of earthquake triggered landslides was the loss of and damage to wildlife habitat; landslides have also restricted wildlife movement in some places. Changes in water sources as a result of the earthquake will have affected wildlife; drying of sources is likely to particularly affect species that have small home ranges, and some animals may have moved into new areas as a result. On the other hand, new sources started flowing after the earthquake, which will have benefited other animals and may have increased suitability of some areas for wildlife.

Breeding of endangered wildlife species may have been impacted, as April-June is the period when the young of several species are born, including snow leopard, red panda, Himalayan musk deer and Himalayan tahr. Some females could have aborted due to the earthquake, and survival rates of young could have been affected.

It is likely that the earthquake had adverse impacts on bird breeding, mainly on species nesting in cliffs, as the earthquake occurred during the breeding season (early spring to summer) (Namgail and Yoram, 2009). The breeding season of the Himalayan monal (locally called *Danphe*), the national bird of Nepal, begins in April. A detailed study is needed to understand the impacts of the earthquake at species and ecosystem level in earthquake hit areas.

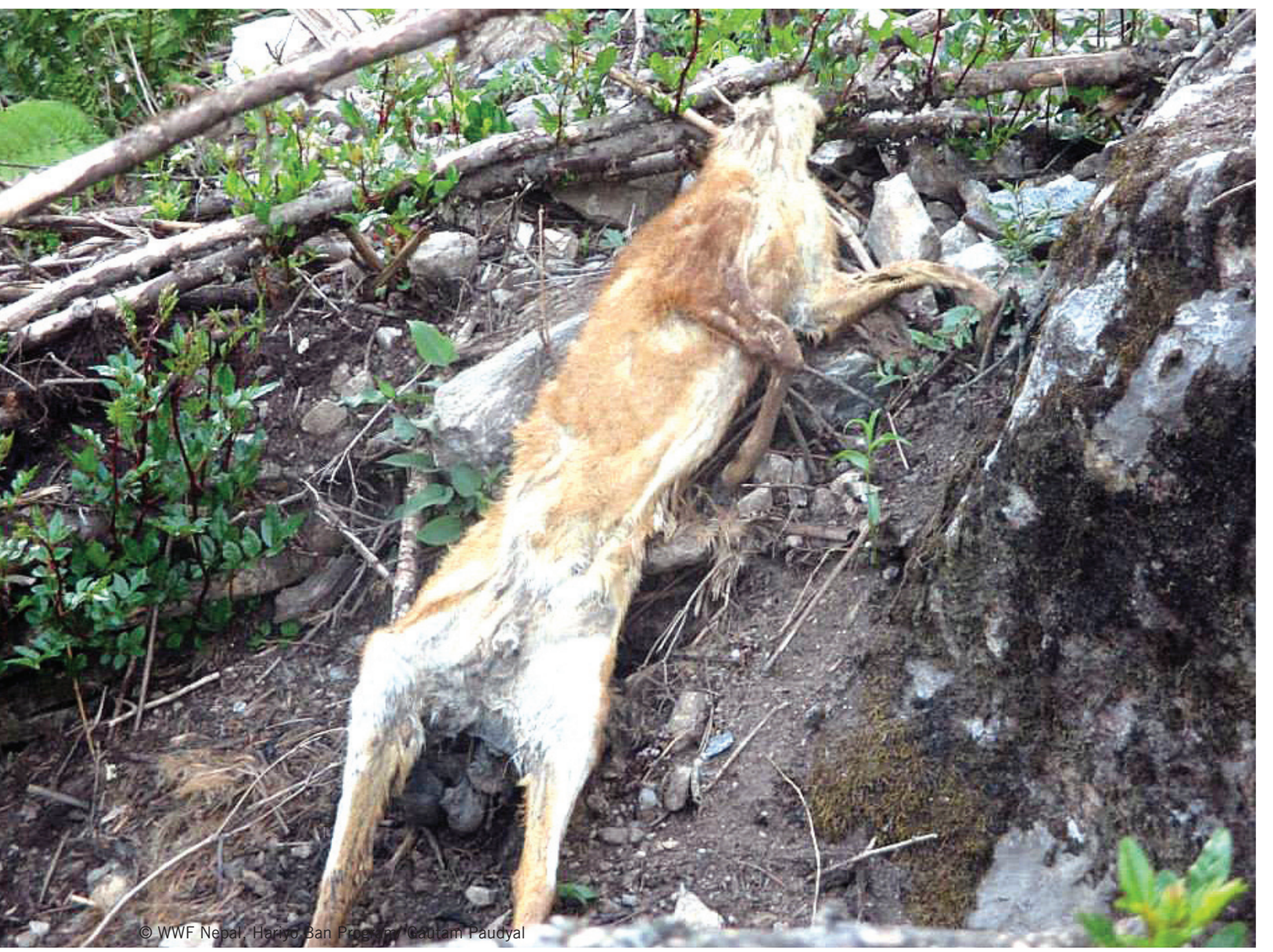


Photo 5: Wild animal killed in Langtang by the earthquake

Wildlife will have been more vulnerable to poaching after the earthquake because of the impacts on law enforcement operations in both local communities and government (see below), for commercial trade and for local subsistence hunting at a time of food insecurity. Illegal trade of live wild animals, animal parts and plants could also have increased once access was reopened, particularly through the northern border of the country due to disrupted law enforcement there. However, poaching declined in at least one place. Devata Community Forest (1995 ha) in Sindhupalchowk is near to Kathmandu, and hunting was done for recreation rather than subsistence. The CFUG reported a drastic decline in illegal hunting in the community forest because hunters were too busy recovering from the earthquake to go hunting, and the wild boar population increased in the five months after the earthquake (Hiranath Ghorasini, Chairperson of Devata Community Forest, pers. comm.).

Human-wildlife conflict arises mainly because of the loss, degradation and fragmentation of habitats; and close proximity of wildlife and human activity. Rural communities with limited livelihood opportunities are often hardest hit by conflicts with wildlife, which can include injury or death of people, crop damage, livestock predation, and other property damage. After the earthquake many people camped outside with their surviving livestock because their buildings were destroyed or unsafe, bringing people into closer contact with wildlife. In some cases people moved away from landslide and flood prone areas into forests, putting them at greater risk. In addition, there may be increased risk of disease transfer between people, livestock, and wildlife, including rabies. The latter could be exacerbated if domestic dogs, abandoned after the earthquake, form packs and go feral; they would also increase wildlife predation.

Impacts on freshwater systems: Escape of farmed rainbow trout (*Oncorhynchus mykiss*) was reported in Nuwakot and Rasuwa districts. If the escapees survive in the Trishuli River, rainbow trout are likely to damage local fish populations including several endemic fish species such as *Pseudeutropius murius batarensis, Pseudechenensis serracula* and *Erethistoides cavatura* (MoFSC, 2014).

Impacts on ecosystem goods and services: Local communities are dependent on ecosystem services and natural resources for diversified livelihood activities to meet basic needs as well as for social security. Loss of natural resources and ecosystem services such as water supplies due to landslides, therefore, may threaten the livelihoods, food security, health and safety of poor people. The availability and sustainability of biological resources in Nepal, including non-timber forest products (NTFPs), and agrobiodiversity are of direct relevance to address poverty, hunger, and food security for rural households who derive a large proportion of their food and income from natural resources (Chaudhary, 2014).

Loss of medicinal plants and non-timber forest products

Dolakha is an important mountain district for the cancer healing Himalayan yew (*Taxus wallichina*). Golmeshwar Community Forest User Group in Magapuwa, Dolakha lost at least 200 Himalayan yew trees in landslides triggered by the earthquake.

In Rayobari in Mahadevsthan and Khattechaur in Deupur, Kavre district, rock falls and debris deposits triggered by the earthquake destroyed cardamom cultivation. Cardamom is one of Nepal's most successful green export enterprises in Nepal.

(Source: REA field study)

Loss of ecosystem services due to landslides have been estimated at approximately NPR 34,715.3 million, and loss of revenue from inability to collect NTFPs including high value *Ophiocordyceps sinensis* 'Yartsagunbu' and other NTFPs has been estimated at NPR 12.31 million (NPC 2015).

Impacts on tourism: Nature tourism contributes substantial revenue to the national economy. For example, during the 2013-14 fiscal year, around 551,680 tourists to Nepal visited protected areas (PAs), approximately 70 percent of a total of 797,616. The March-May tourist season was cut short by the earthquake, when many tourists left early or cancelled their trips. Approximately 13.5 percent of trekking trails (151 km out of a total 1,116 km) in seven severely affected PAs were damaged; the most affected were Langtang NP, in which about 35 percent were damaged); and Makalu Barun NP, in which about 20 percent were damaged (DNPWC,

2015). Many lodges and home-stay buildings were damaged or destroyed. Reconstruction of tourism infrastructure and recovery of tourism capacity is urgently needed in order to contribute to the national economy, and to long-term PA sustainability (NPC, 2015).

Pilgrim trekking route to Gosaikunda

The popular trekking route to the sacred site of Gosaikunda helped to generate revenue for conservation projects in Langtang National Park. After the earthquake at least 18 fissures and 13 landslides and rock falls were observed on the foot trail from Dhunche to Gosainkunda, and the trail area is very vulnerable to mass wasting. This is a major deterrent for pilgrims and other visitors.

(Source: REA field study)

Impacts on watersheds and river basins: Watersheds in the Koshi and Gandaki river basins were adversely affected by the earthquake. A number of landslides and cracks were reported in the catchment areas of tributaries that supply water to these rivers. More landslides are expected in the monsoon; increasing the risk of flooding for downstream communities, forests and wildlife; as well as habitats of flagship wildlife species such as tiger and rhino in Chitwan NP; and wild water buffalo in Koshi Tappu Wildlife Reserve (WR). The river basins of Nepal link people living upstream and downstream in Nepal, as well as communities downstream in India. Local communities are heavily interdependent for ecosystem services, biological resources, cultural relationships, employment and trade. Landslides, blocked rivers, floods, and damaged roads and trails have serious impacts on some of these linkages.

Impacts on management and governance: The earthquake greatly reduced the management capacity of local government and communities including PA management, community forest user groups (CFUGs), buffer zone user committees (BZUCs) and conservation area management committees (CAMCs) in the earthquake affected areas, impacting protection and monitoring of PAs, wildlife, forests and natural resources. Tragically, some community forest user group members were lost. Almost all office facilities in earthquake-hit districts collapsed, and roads and patrolling trails were damaged. This requires immediate recovery for the local institutions to function well, including temporary shelters for offices and guard posts. Delays in the recovery of resource management institutions and consequent weak law enforcement is likely to result in illegal cutting of trees, poaching and hunting of wild animals, and other problems. Nepal already had the bitter experience of rhino poaching in the power vacuum during and after the insurgency in the last decade (MoFSC, 2014). The post-earthquake reconstruction phase will see high demand for forest products, especially timber, posing pressure on natural forests. Hence, it is urgent to restore effective management and governance as soon as possible.

Climate change: Climate change may exacerbate the effects of the earthquake on biodiversity in various ways. For example, increased intensity of rainstorms during the monsoon is likely to increase the risk of landslides on slopes already weakened by the earthquake, and cause soil erosion in existing landslide sites. Flash floods from intense rainfall events will transport earthquake-generated sediment downstream to flatter valleys, where sediment deposition may change river courses, affecting water supplies for people, irrigation and wildlife and damaging infrastructure. Irregular precipitation patterns may combine with hydrogeological changes to exacerbate changes to spring sources. Irregular snow patterns, combined with restricted access because of landslides, may affect how wildlife and livestock use high grasslands. Changes to wildlife prey species are likely in turn to affect predators such as snow leopard. Declining food security due to climate impacts on agriculture can increase local people's dependence on forests during times of stress, especially those with lowest capacity to withstand shocks.

Climate change and the earthquake

While climate change did not cause the earthquake it may exacerbate its effects in various ways: more intense rainfall increases the risk of landslides and flash floods will cause sedimentation in rivers. It may also exacerbate the earthquake's impacts on people and wildlife.

2.3 Environmental Impacts of Solid Waste and Hazardous Materials

Prior to the earthquake, municipalities responsible for waste management were already challenged to provide an effective and efficient waste management system. Only five out of 191 municipalities had sanitary landfill sites, while the rest of the municipalities regularly dumped waste on land and river banks. There was no system in place for collection of hazardous substances generated in residential households and commercial buildings. The majority of hospitals and clinics did not have facilities to treat highly infectious and toxic bio-medical wastes. There was no environmental permitting system for industries and other institutions dealing with chemicals, radioactive materials, and other hazardous and toxic wastes.

The earthquake generated significant solid waste and release of hazardous materials. According to the Solid Waste Management Technical Support Center around 3.9 million tons of debris has been generated as a result of the earthquake, adding a huge challenge to municipalities already struggling with managing municipal solid wastes (Sah, 2015). For example, the quantity of disaster debris in Kathmandu has been estimated to be more than 60 times that handled by the Kathmandu Municipal Government in a normal year, and other municipalities are also overwhelmed. In the municipality of Chautara, an NGO reported to the REA team that the municipality was having difficulty finding a suitable site to dispose of debris and was considering placing it in a ravine and/or using it as fill for a future park and memorial, which should be further examined to avoid unanticipated environmental and social impacts.

The earthquake debris includes toxic chemicals and heavy metals from household electronic equipment, lighting systems, and cottage industries (e.g., metal crafting); some toxic substances are carcinogenic. Contaminated debris requires safe and environmentally sound disposal. However, the Nepal government lacks proper guidelines and framework to manage this problem, and the Solid Waste Management Act of 2011 does not address the management of disaster waste. Because there are no facilities for proper disposal of hazardous wastes, toxic pollutants will continue to release to air, soil, ground water and surface water with long-term exposure for people, livestock and wild animals.

Hazards from dumping post-earthquake wastes

The only dumping site of Bhimeswor Municipality, Biruwa, in Dolakha district is in a populated area on the way to Jiri. All sorts of solid wastes collected in the quake aftermath were dumped in the site, which the local people found environmentally "very harmful." They reported that the resulting leachate polluted the nearby Charnawoti river.

Wastes from Gorkha Bazar were collected and dumped rampantly in the nearby Guthi forest. After the earthquake local people became very concerned about the health hazard of the wastes and volunteered to segregate them, at least into degradable and non-degradable wastes so that they could be more effectively disposed of.

(Source: REA field study)

Building debris: see section 3.4.

Dead fish: Rainbow trout (Oncorhynchus mykiss) is a high valued exotic cold water fish renowned for its taste and tenderness. Nuwakot district, bordering the capital city Kathmandu, has been a major hub of fish farming, hosting eight out of 16 rainbow trout hatchery farms and contributing 48 percent of the total fingerling production in Nepal. The earthquake hit trout farming badly: first by interruption of running water to the Fisheries Research Station in Trishuli, killing tens of thousands of fingerlings within few hours; and second by spilling water or causing ponds to leak in many privately owned farms.

Social impacts of trout farm damage

Ghyangfedi, a remote village in Nuwakot, was gradually overcoming the challenge of human trafficking by introducing profitable trout-farming, providing 40 families with livelihood alternatives. Damage to fish farms by the earthquake pushed local farmers back into the vicious cycle of debt and poverty. One farmer, Mr Raju Tamang, lost some 100,000 fingerings and 3 tons of rainbow trout worth about NPR 2.5 million.

(*Source: REA field study*)

Medical waste: see section 3.4.

Electrical wastes: Electrical and electronic equipment such as personal computers, printers, televisions, mobile phones, refrigerators and air-conditioning units were destroyed in the earthquake, generating a significant amount of electronic waste (E-waste) which is categorized as hazardous due to the presence of toxic materials such as mercury, lead and brominated flame retardants. Damaged refrigerators may have released some hydrochlorofluorocarbon (HCFC) into the atmosphere; while HCFC has no adverse impact at ground level it is damaging for the ozone layer. However, Nepal is currently implementing a HCFC phase out plan which will go until 2030, and the amount that could have been released is considered to be small.

Compact fluorescent tube lights containing mercury, and other household hazardous wastes, are mixed in with building debris, posing risk to workers involved in debris management. There is a high likelihood that toxic substances and heavy metals have been released into the environment and may have contaminated ground water; in the Kathmandu valley ground water is one of the main sources of drinking water.

Lead: Enamel-based and solvent-based paints contain lead that is released in the air through dust particles during debris handling. This poses a risk of lead poisoning for workers and communities, with potentially serious health consequences. While MoSTE recently introduced standards for maximum lead levels in paints (90 ppm), much of the paint in buildings was older than this, and may have had higher concentrations. Another source of lead pollution was from spills from used lead-acid batteries, contaminating the soil with lead.

Laboratories: The earthquake caused major damage in several laboratories. Organic and inorganic chemicals and glassware stores of the National Bureau of Standards and Metrology (NBSM) were badly affected. Immediately after the earthquake fumes with unpleasant odors came from the stores; they reached the surrounding area and people complained. About 50 bottles of chemicals were broken along with 74 kg of powder containers and created a chemical reaction that produced the fumes. Odors continued for weeks, and highly toxic chemicals were released to air and soil. One hundred and forty-eight organic solvent containers were burned and cannot be identified now. All broken hazardous containers and solvent containers have now been isolated and stored. In the National Agricultural Research Council (NARC), around 60 bottles of chemicals (ethanol, carbon tetrachloride, glycerin, acetone, sodium hypochloride, sucrose, yeast, ether, etc.) were destroyed and thus some persistent organic pollutants entered the environment.

In the Department of Food Technology and Quality Control, some chemicals spilled on the floor of the chemical store and a bad smell was observed. Spilled acids were neutralized with lime during the clean-up. Some chemicals went into the drains, and chemicals were also mixed with other waste. The Department stated that it had no other option.

Tri-Chandra Campus suffered the worst of the academic institutions in the valley. The chemistry laboratory was severely damaged, and students were not allowed to enter the Science building. Chemicals spilled on the floor and at the time of the assessment, no work had been initiated to address the problem. Almost all laboratories in academic institutes had chemical spills and glassware damage.

Radioactive materials: Some institutions such as hospitals, nursing homes, clinics, and radiology and imaging facilities have equipment with radioactive material, and also store radioactive materials for use in medical examinations. Bir Hospital and Bhaktapur Cancer Hospital were contacted to inquire whether there had been any damage to medical equipment or leakage of radioactive materials. Fortunately no such incidences occurred, and no other institutions had reported this to the relevant authority at the time of the assessment.

Industrial chemicals: Chemical-based industries (including those that use chemicals as raw-materials) currently in operation in Nepal include paper and pulp, soap, paints, plasticizers, distilleries, sugar, pharmaceuticals, turpentine, cement, foam, iron and steel, tobacco, tooth paste, textile dyeing, carpet dyeing and washing, and metal crafts. All of these industries use chemicals that are categorized as toxic and hazardous, and there is a high possibility of damage to their storage and laboratory facilities in earthquake-affected areas. During field visits by the REA team, industries reported damage to finished products and had made insurance claims for the spillover of some chemicals. There were also reports of dumping soil contaminated with toxic chemicals in forest areas at night.

Spilled paint materials

There are several paint companies in Kathmandu valley, some of which produce over 100,000 liters per month using raw materials that include pigments, additives, emulsions, and resin. Some of these are toxic and hazardous if they enter the environment. Spills of raw paint materials were reported to have occurred as a result of the earthquake, with resulting environmental contamination.

(*Source: REA field study*)

Toxic substances used in metal working: Kathmandu is known for handicrafts, and has a large number of metalcraft cottage industries. According to the Handicraft Association of Nepal (1200 members), metal crafting industries use mercury, cyanide based chemicals, alkali based chemicals, lead (solid form), nitric acid, sulphuric acid, and cupric oxide (powder form). A large size cottage industry uses around 20 kg of mercury while a small enterprise use about 6 kg of mercury per year. Many cottage industry sites were damaged or destroyed, with possible release of toxic chemicals and heavy metals into the environment. They are required to have pollution control certificates as per the Environmental Regulation but none do. Hence industries were hesitant to report on their losses. These sites require special attention for debris management.

Mercury in lighting equipment: Stores with lighting products that contain mercury, such as compact fluorescent lamp bulbs, are also a possible source of mercury contamination. At the time of this assessment, no incidences had been reported to the relevant authorities.

Petroleum products: According the Nepal Oil Corporation, no damage was observed in its fuel storage facilities or in any of the 2,500 fuel distribution pumps in the country. In vehicle repair and maintenance facilities used lubricants, and kerosene and petroleum used for cleaning parts, are often stored in open drums. Some of these wastes spilled during the earthquake, contaminating soil and potentially affecting water bodies.

Impacts on air quality: Immediately after the earthquake, some improvement in the overall air quality of Kathmandu valley was observed due to closure of brick kilns, industries and hotels, and reduced traffic. However, some toxic pollutants will have been released into the air when laboratories and chemical based industries were damaged, with possible exposure of people working there and living in the surrounding areas.

Suspended particles entered the atmosphere from debris of collapsed buildings, and from diesel exhausts of heavy vehicles involved in debris management, especially before the monsoon. In the Kathmandu Valley the levels of suspended particulates in the atmosphere were already very high compared with the levels prescribed in the National Ambient Air Quality Standards. Both short-term and long-term exposure to suspended particulates of a certain size is associated with respiratory and cardiovascular illness and mortality, as well as other health effects.

Impacts on water quality: Toxic chemicals that entered drains and soaked into soil will end up in ground water or rivers, contaminating drinking water sources of millions of people. Some persistent pollutants will likely have long term impacts on human health. Although the brick kilns are not in operation, the broken chimneys, ducts and fuel storage areas will release pollutants to ground water and contaminate it. This includes mercury in dust in the chimneys.

Occupational health and safety: People working in contaminated areas of laboratories, industries, hospitals and dealing with waste management are at risk of exposure to toxic and hazardous chemicals with possibly severe health consequences.

CHAPTER 3

Potential Indirect Environmental Impacts from Relief, Recovery and Reconstruction

3.1 Environmental Risks, and Principles for Green Recovery and Reconstruction

The previous section outlined direct and indirect environmental impacts of the earthquake on biodiversity and the environment. However, there is an additional set of environmental risks, from relief, recovery and reconstruction activities across many different sectors. This chapter is divided by the major sectors that could have environmental impacts. Each section briefly outlines the effects of the earthquake on the sector as it relates to the environment, discusses the risks to the environment in the sector's recovery and reconstruction, and then outlines actions that the sector can take to avoid or mitigate adverse environmental impacts. The analysis in this section draws on the information collected in the field and in Kathmandu, national level consultations, and information in the PDNA. It also draws from relevant experiences in other countries.

These risks and their avoidance or mitigation have to be addressed jointly by government agencies, NGOs, the private sector, and communities as well as other agencies responsible for recovery and reconstruction. This requires close collaboration among the relevant government institutions, development partners, civil society organizations (CSOs) and the private sector. There is an opportunity to build on this collaboration and institutionalize some of these linkages to promote better practices into the future.

In the weeks, months, and years following the earthquake, it is critical that recovery and reconstruction builds on the development gains that Nepal has made in the past 65 years. Integrating environmental considerations at strategic points in the recovery and reconstruction effort will strengthen the resilience of the Nepali people and increase the rate at which the country can achieve ecosystem-based sustainable development, economic progress, and poverty reduction.

In support of promoting responsible practices, a set of ten principles was developed to ensure that recovery and reconstruction proceeds in an environmentally appropriate way. These principles are applied in the rest of this report.

Principles for Green, Resilient Recovery and Reconstruction

The following principles apply across all sectors and clusters involved in the Nepal earthquake recovery and reconstruction. They were developed jointly by the PDNA Environment and Forestry team, and the REA team.

1. Ensure that building design and construction is environmentally sustainable, appropriate to the region, and will withstand future disasters.
2. Enforce environmental impact assessment/initial environmental examination regulations during reconstruction in order to avoid future disasters.
3. Ensure that fuel wood collection complies with existing forest management plans, and promote alternative energy and energy efficient technologies to reduce pressure on forests.
4. Recycle and reuse debris as much as possible, and ensure that solid waste disposal during the reconstruction phase is managed using environmentally sound practices, including the introduction of new systems.
5. Design water and sanitation interventions to reflect post earthquake changes in water resources and future climate change scenarios, and promote IWRM.
6. Conduct land use planning, including zoning, before finalizing the locations of resettlement areas to minimize risks from landslides and floods, and ensure adequate land and natural resources to meet community needs, while minimizing environmental impacts.
7. Ensure that reconstruction of roads and hydropower take the opportunity to build back safer and greener, and take account of increasing climate variability.
8. Prioritize support for rapidly restoring livelihoods in order to take pressure off forests and biodiversity after the earthquake; in the longer term ensure livelihood restoration projects reflect principles of resilient development.
9. Build capacity for green recovery and reconstruction, and ensure consultation/coordination with relevant stakeholders in recovery and reconstruction.
10. Take into account the specific rights, needs, and vulnerabilities of women and marginalized people in relation to natural resources during recovery, promote equitable access to recovery support, and strengthen community institutions and participation.

3.2 Land Use Planning and Disaster Risk Reduction

Prior to the earthquake, many settlements and infrastructure in the earthquake-affected districts were located in hazard-prone areas subject to recurring landslides, erosion, earthquakes, floods, wildfire, and extreme weather events, and the vulnerability of affected communities has been made worse since the earthquake event. The earthquake has led to increased erosion, unstable slopes, and shifts in the availability and quality of water resources for local communities. As a result, the Government has identified 22,256 households that need to be relocated (NPC 2015).

Given that over 700,000 houses will need to be rebuilt (NPC 2015), as well as community infrastructure and government buildings, the post-earthquake recovery and reconstruction phase represents a significant opportunity to relocate at-risk communities away from natural hazards and integrate principles of environmentally sound land use planning. Land use planning will need to operate at three major planning units: (1) at the regional level where entire communities are relocated away from major geological hazards worsened by the earthquake; (2) at the community or village level where reconstructed infrastructure remains within the existing community boundaries but is located away from hazards to reduce risk (e.g., away from floodplains or potential landslides); (3) at the household level where the positioning of individual structures is designed to reduce risk and improve efficiency.

The selection and development of resettlement sites following disasters often does not consider the full range of impacts on the environment, and does not take into account the concept of sustainability. In these cases residents can experience the following problems:

- Increased impacts from hazards (e.g., flooding, landslides) that were not present or not as severe as they were before resettlement;
- Living conditions actually worse than those that existed before resettlement;
- Long-term environmental degradation (e.g., erosion, deforestation) due to insufficient consideration of land, natural resource and ecosystem service needs, resulting in further damage to land, agricultural livelihoods, ecological connectivity, and safety and security;
- Increased air and water pollution that will impact the health, welfare, and livelihoods of resettled and neighboring communities.

Resettlement requires new areas for housing and settlement, and most disaster-affected people prefer to settle nearby their old settlements. This trend often results in the conversion of fertile and cultivable land for housing; or relocation into marginal, disaster-prone areas that were not previously developed. Resettlement can degrade the productivity of locally available natural resources, and increase demand for soil, timber, bricks, stone, sand, water and other natural resources. Possible impacts from resettlement on the environment include encroachment of the surrounding forest area and cultivable lands; settlement in or near forest increasing the probability of fire; further deforestation to address increasing demand of new cultivable area; disturbance of wildlife; increased human-wildlife conflict; and disruption of ecological corridors and connectivity. In larger municipal areas there will likely be a high demand for land as people move out of high-rise buildings into lower constructions which take up more space.

Many disaster survivors will have few assets in the immediate aftermath of disaster. However, site plans should anticipate that the site residents will replace lost assets over time, and the site will eventually experience normal growth. As a result, all sites should be designed and constructed to allow space for future expansion without a reduction in the availability or value of environmental resources for site residents. This anticipation of future expansion can include plans for such things as: increased demand for water, fodder, agricultural land and energy; increased waste water and garbage generation; and increased traffic volume and overall number of vehicles (e.g., road size and safety), among other factors.

Regional, village-level and site-level spatial planning should include not only geohazards, but also water resource information, proximity to forest and biodiversity resources, proximity to livelihood areas, community activity areas, escape routes, flood hazards, solid waste sites, roads and transport routes. The Green Recovery and Reconstruction Toolkit (GRRT) (WWF and American Red Cross 2010) contains Guidelines for Sustainable Post-Disaster Site Selection and Development that should be used when planning resettlement sites.

3.2.1 Recommendations for green recovery and reconstruction

Recommendations: Land use planning and disaster risk reduction	
Near term (Now to April 2016)	1. Provide training to GoN agencies (District Development Committees (DDCs) and Village Development Committees (VDCs)) on post-earthquake land use planning including spatial planning with geohazard mapping to ensure that reconstructed settlements are designed to reduce environmental and disaster risk. 2. Harmonize and promote adoption of standardized methodologies for landslide inventory; and for hazard, vulnerability and risk mapping/assessment and land use planning. 3. Prepare land use plans with disaster-affected communities at the community and household level. 4. Categorize landslides and prioritize those that require interventions to stabilize them; undertake interventions depending on the local situation (see below for specific recommendations on landslide recovery). 5. Conduct monitoring missions with GoN and humanitarian agencies to identify and resolve situations where disaster-affected people have relocated to hazard-prone areas. 6. Monitor hazards including glacial lakes and potential landslides, and install early warning systems for floods.
Longer term (May 2016 to April 2020)	7. Review and properly implement the Land Use Policy and land use legislation, incorporating geo-hazard mapping in land-use planning. 8. Review, revise and roll-out the National Strategy for Disaster Risk Management and highlight the importance of land use planning for sustainable solutions. 9. Develop comprehensive disaster management legislation that goes beyond emergency relief to focus on disaster risk reduction. 10. Build District and VDC capacity to update and implement land use plans.

Specific recommendations on landslide recovery
1. Identify shallow and deep seated landslides and categorize them as: landslides that need to be stabilized/treated as soon as possible using low cost technology; landslides that require treatment with high cost engineering structures; and landslides that require no treatment and will stabilize on their own with natural vegetation regeneration. Landslides threatening settlements, farms, infrastructure, other economic developments and important biodiversity sites should be prioritized for treatment, where feasible. 2. Undertake detailed investigation of sites that require interventions. 3. Drain water safely from above as well as the sides of landslides and cracked areas before implementing stabilization measures. 4. For shallow landslides (up to 12 inches deep) apply bioengineering techniques as far as possible in line with green recovery. 5. Consult with local communities when planning hard core engineering and bioengineering, including on choice of plant species for the latter. 6. Plant only native species that are appropriate for specific sites; use species that will establish quickly (e.g. *Alnus* species and broom grass). Take into account likely effects of climate change on tree species distribution and avoid planting species that are already at the limit of their range, especially if they have narrow tolerance limits.

3.3 Buildings and Settlements

3.3.1 Impacts of the earthquake on the sector

By far the most impacted sector as a result of the earthquake is the building sector. Approximately 498,852 private houses were destroyed and 256,697 damaged by the earthquake. In addition to houses, approximately 6,200 government buildings, 1,227 health facilities, and 8,300 school buildings were destroyed or damaged. Table 3 shows information on the number of buildings destroyed in major building categories, as reported in the PDNA (NPC, 2015).

Photo 6: Damage caused by the earthquake in Buddha Secondary School, Gorkha

Table 3: Number of buildings destroyed in the earthquake, by major building categories

Type of building	Number destroyed	Number damaged	Number damaged + destroyed
Houses	498,852	256,697	755,549
Health facilities	462	765	1,227
Education facilities[6] (number of classrooms)	27,738	29,304	57,042
Community buildings			1667
MoFSC buildings			569

Source: NPC (2015)

A large number of buildings in the Kathmandu valley and some other affected towns are constructed of brick and concrete; in rural areas stone, mud mortar, timber, and bamboo are common building materials. While much building material is being reused (see section 3.4), there is still a greatly increased demand for traditional building materials after the earthquake. The earthquake also offers an opportunity to introduce non-traditional building materials and designs that are safer and promote environmentally sound practices.

3.3.2 Environmental risks during recovery and reconstruction

Bricks: According to the Federation of Nepalese Brick Kiln Industries, there were around 750 brick kilns in operation prior to the earthquake. Nearly 50 percent, around 315 brick kilns, suffered major damage, such as a broken chimney or ducts, and around 200 sustained minor damage. All 105 brick kilns in the Kathmandu valley (18 in Kathmandu, 26 in Lalitpur, and 61 in Bhaktapur) were damaged. According to the association, the brick kiln sector suffered financial losses of around 1.12 billion rupees.

Prior to the earthquake, the firing of bricks in kilns was a major contributor to air pollution, particularly in the Kathmandu valley which has over 105 kilns. With booming population growth and urbanization in Nepal, construction ranked as the third largest economic sector in the country in 2006 and continues to grow. The high demand for building materials has fueled a demand for cheap labor and a lack of incentives for clean or socially responsible brick production. The brick industry provides jobs to over 175,000 unskilled workers, of whom as many as 60,000 are children, mostly working in unhealthy and unsafe conditions (Global Fairness, 2015). GoN has put in place labor standards and regulations for proper construction and operation of brick kilns, and it is important that brick kilns are not re-started until it is confirmed that the kilns meet GoN standards. There is also an opportunity to introduce better technology in kilns.

[6] Public and private schools, higher education facilities, and technical and vocational education and training facilities

Photo 7: Extraction of sand from Bagmati River in Rautahat

Sand, gravel, boulders and clay: Extraction of these raw materials can lead to the pollution of water sources, increase the potential for natural hazards (e.g., landslides, erosion, flooding and changes in river courses), threaten settlements, roads, bridges and hydropower plants, or result in air quality impacts from dust and particulates that can affect human health. When soil, dust and other particulates enter streams and rivers, the passage of light through the water is reduced, negatively affecting the photosynthetic microorganisms that fish and other species depend on for food. This suspension and eventual sedimentation of particulates can also increase water temperature and fill habitat in streambeds and riverbeds that fish, crocodile and dolphin use for foraging and shelter. Snails, worms, and other invertebrates that fish species depend on for food can be buried by the influxes of deposited sediment that is caused by sand and gravel mining. Deposition of sediments in flatter reaches of rivers can also result in rivers changing course, with loss of settlements, farmland and forest. If water flows beneath the new sediment, surface water supplies may be lost for people, livestock and wildlife. Extraction of clay from hillsides can also create a landslide hazard for residents living in adjacent areas.

Timber and poles: There is a high demand for timber and poles. The REA team observed pole-sized trees being haphazardly cut in all crisis-hit districts for making temporary shelters. This included government-managed and community-managed forests, as well as PA peripheral zones (e.g. Shivapuri NP). *Sal (Shorea robusta)* was being cut in Nuwakot and Sindhupalchowk districts. There is a high risk that pressure on forests for timber supplies for reconstruction, particularly in mountain regions at mid- and high-altitude areas, will deplete forests and result in loss of valuable timber species that require many years to mature.

Haphazard cutting of timber from hillsides can result in erosion of topsoil, increased risk of landslides and flooding, degradation of watersheds and water supplies, forest fragmentation, loss of habitat for wildlife species, and pollution of streams and rivers. In this respect harvesting of bamboo rather than timber for building materials has a much lower impact, as bamboo grows back each year. The treatment of building materials, such as reeds or bamboo, may result in pesticide or chemical pollution of water and land, putting people at risk if not done sustainably. Workers involved in material

Photo 8: Logs used for temporary shelters after the earthquake

Illegal cutting of construction poles in Sindhupalchowk

In Sindhupalchowk district there were reports of timber being cut illegally for temporary shelters in 11 community forests. In Basuki Devi Community Forest 19 temporary shelters had been made by cutting pole sized trees. Quick sampling in a disturbed site recorded that 16 out of 28 pole-size trees had been cut.

(Source: REA field study)

extraction or harvesting may also experience health problems, especially in areas where safety standards are not well enforced.

Loss of forest land: Resettlement of a large number of people risks loss of forest land. Given the large number of houses that need to be rebuilt, it is recommended that a "Green Building Consortium" be developed to identify technologies that are more earthquake-resilient and environmentally sound. The consortium should include materials suppliers, civil society, engineering and environmental science programs, and government. This can build on the work that has been undertaken by Global Fairness Initiative's Better Brick Nepal program and the work of the Center for Resilient Development on green and resilient materials. These better practices can be used to inform the donor and GoN funding programs that will be supporting reconstruction of houses, schools, health facilities, community buildings and government buildings.

Meeting the timber demand

The Department of Forests estimates the total demand for timber for reconstruction is 51.8 million cubic feet; and this can be met sustainably over the next five years from private forestry, community forests and national forests in affected and unaffected districts in Nepal. However, to meet this demand people will have to use softwood instead of hardwood in some places, which will require seasoning and treatment. Timber will have to be used from fallen trees in Churia and Terai. Where forest is being cleared for transmission line projects, timber should be extracted for reconstruction. Forests will have to be well managed in order to ensure sustainable extraction. As much timber as possible should be salvaged from building debris and reused. See the section on Forestry and Conservation for recommendations.

(Source: Personal communication, Mr. Shiva Wagle, Department of Forests)

3.3.3 Recommendations for green recovery and reconstruction

Recommendations: Buildings and settlements	
Near term (Now to April 2016)	1. Reuse and recycle construction debris for building materials within the construction industry, government, NGOs, and communities. 2. Select building materials and technologies that increase safety and reduce environmental and health impacts, including sustainably harvested timber and lightweight materials (e.g., compressed stabilized earth blocks, bamboo). 3. Ensure that brick manufacturing meets minimum national environmental, health and safety standards and use the opportunity of rebuilding to incorporate best practices and technologies. Develop clusters of brick kilns in districts adjacent to the Kathmandu valley, with IEEs or EIAs, selecting sites with mud deposits and avoiding areas with good agricultural potential or conservation value. 4. Ensure that an environmental assessment is done before extracting sand, gravel and boulders, and that the operation meets minimum national environmental, health and safety standards. 5. Enforce building codes and norms during new construction, repair of damaged buildings, and retrofitting, including safety and environmental standards. 6. Ensure that building sites have acceptable soil bearing capacity for foundations, are stable and are reasonably flat. 7. Integrate environmental aspects into training for masons and carpenters, and awareness for householders. 8. Promote water efficiency and energy efficiency/alternative energy when repairing and reconstructing buildings. 9. Ensure that the sites of temporary camps are restored when they are vacated; this includes removal of temporary structures, removal and safe disposal of waste, and replanting of vegetation. 10. Allow for greater extreme weather events due to climate change when designing and constructing buildings and settlements.
Longer term (May 2016 to April 2020)	11. Plant trees in the surrounding area (MoSTE recommends two trees for each building). 12. Review, revise and roll-out the National Strategy for Disaster Risk Management (NSDRM) and highlight the importance of land use planning. 13. Develop comprehensive disaster management legislation that goes beyond emergency relief to focus on disaster risk reduction. 14. Build District and VDC capacity to update and implement land use plans.

3.4 Solid Waste and Hazardous Materials Management

3.4.1 Impacts of the earthquake on the sector

Generation of solid waste and release of hazardous materials directly by the earthquake were documented in section 2.3. The following paragraphs outline additional issues as a result of human response to the earthquake.

Building debris: A huge volume of building debris was generated by the earthquake. Fortunately at the household level, a number of earthquake-affected households are sorting through their own debris and reusing brick, wood, and other materials to reconstruct their homes. This significantly reduces the volume of waste that has to be disposed of. Steps need to be taken to ensure that the construction is done in a way that will increase resilience of buildings to future earthquakes and other hazards. Other building debris can be recycled by converting it into other construction materials (for example in Kathmandu, building rubble can be used as a base in widening the ring road). None the less, some building debris will need to be disposed of and this is a major challenge for municipalities.

Photo 8: Building debris after the earthquake in Kathmandu

Plastics and hospital waste

Situated on a mountain ridge, Chautara, the district headquarters of Sindhupalchowk, is a congested settlement with poor management of solid waste. A large volume of plastic waste was generated in the aftermath of the earthquake and it was burned haphazardly, causing air pollution. Hospital waste was mixed with other solid wastes and dumped without any treatment, posing a health hazard.

(Source: REA field study)

Waste in emergency camps: At emergency shelter camps, waste generation was estimated to be around 38 kilograms per camp on an average per day (data collected during REA field visit). Waste collection was being done using small bins with very little segregation at source. In some cases no effort was made to collect waste; in others, disposal was occurring haphazardly, and in some districts there was dumping in nearby community forests upstream from water sources.

Plastics: Much plastic waste was generated during the relief phase. Before the earthquake MoSTE had banned production, use, sale and transportation of plastic bags within Kathmandu and initiated promotion of environmentally friendly alternative bags including clothes, fiber and paper; however, following the earthquake, there was a significant increase in the use of plastic bags. Plastic waste included plastic wrappings on food, blankets and other relief materials. Immediately after the earthquake the supply of bottled water increased tremendously, resulting in considerable plastic waste. In the longer term, the many thousands of tarpaulins that were distributed in relief efforts will become a problem when they wear out. Much waste plastic is burned in an uncontrolled environment, causing air pollution and often generating dioxins and furans which are known carcinogens. Other plastic is dumped or washed into ditches, streams and rivers, where it causes blockages and affects wildlife. Eventually it may reach the ocean, where it can cause problems for marine wildlife such as sea birds, turtles and dolphins, and contribute to the growing plastic accumulation in the ocean gyres.

Corpses of people and livestock posing health hazards

In Sipaghat, in Kavre, local people complained of river pollution due to dead bodies and dead livestock. In Shyaule-Kerabari, Sindhuplachowk, dead bodies dumped in the nearby forest were posing a pollution threat; and improper cremation of corpses was reported in community forests just above residential areas and agricultural land, with unburned parts of corpses remaining.

(Source: REA field study)

Medical waste: There was a significant rise in the generation of hospital waste immediately after the earthquake as hospitals and clinics treated people injured in the earthquake. Some hospitals have incineration and autoclaving facilities to treat waste but the majority do not. Hospital waste was often mixed with municipal waste, contaminating the municipal waste and creating serious health risks for those involved in municipal waste management. Ground water and water sources near the dumping sites were contaminated. Some municipalities collect hospital waste and dump it in ditches in nearby community forests, where people, livestock and wildlife may be exposed to it. One of the worst examples was a cancer hospital that burns carcinogenic waste with other waste inside the hospital compound, stores hazardous waste using glass vials in a regular room, and has dumped surgical bio-waste on the hospital premises (REA field visits). Medical waste was also generated through used equipment, instruments and chemicals that were abandoned on site by temporary medical teams, for example in Bhaktapur (Mahendra Man Gurung, MoSTE, personal communication).

Improper disposal of hazardous disaster debris can have direct and indirect health impacts. For example, health care wastes includes infectious materials and sharps, chemical and pharmaceutical wastes, genotoxic wastes, and also radioactive wastes. Transmission of infectious diseases can occur, such as Human Immunodeficiency Virus (HIV) and Hepatitis-B as a result of injuries from sharps. This is a particular risk for people involved in waste management and communities living nearby to dumping sites. There could also be risks to livestock and wildlife if disposal sites are open.

Dead bodies and livestock: Considerable numbers of livestock died in the earthquake (see section 3.8). There were reports of decomposing livestock carcasses and dead bodies in many areas, including in streams.

Sewage: see section 3.7.

Toxic wastes: Toxic substances (section 2.3) being cleared up after the earthquake and dumped into uncontrolled landfills may leach into streams or groundwater that supply drinking water, and have serious effects on people, livestock and wildlife.

Substances such as mercury and lead persist in the environment for many years. They accumulate in living organisms with increasing concentration up the food chain and in long-lived organisms such humans.

Lead exposure can affect the blood system, nervous system, urinary system, gastrointestinal system, cardiovascular system, reproductive system, endocrine system and joints. Young children are particularly vulnerable. As lead paint deteriorates over time in building rubble, children may inhale or ingest it through dust, paint chips or contaminated soil. There is no known level of lead exposure that is considered to be safe. Childhood lead poisoning can have lifelong health impacts, including learning disabilities, anemia, and disorders in coordination, visual, spatial and language skills. Lead can also accumulate in wild animals and livestock.

Use of hazardous materials in recovery and reconstruction: There is a risk that hazardous materials may be used in reconstruction. For example, MoSTE received requests from the business community to relax the regulations on asbestos, in order to use asbestos roofing sheets for relief camps and buildings. This request was turned down. However, there is a risk that unscrupulous operators may try to use other harmful substances. Communities, government agencies and citizens should be vigilant for this.

3.4.2 Recommendations for green recovery and reconstruction

Recommendations: Solid waste and hazardous material management	
Near term (Now to April 2016)	1. Develop environmentally sound solid waste management plans for all settlements and housing construction projects in the affected districts at the municipality and VDC levels that include proper siting of waste disposal sites, minimize the potential for human-wildlife conflict, avoid impacts to vulnerable populations, and avoid water and soil pollution. 2. Encourage households and building management to minimize waste and deal with as much as possible on the premises, e.g. through reuse, recycling, and composting/vermiculture; waste waiting for collection should be properly stored. 3. Work with MoSTE and municipal governments to conduct a rapid inventory of sources for hazardous materials, including healthcare, industrial, agrochemical, and household hazardous wastes, and manage hazardous wastes to address post-disaster impacts. 4. Promote green building materials as substitutes for construction materials that cause adverse environmental impacts. 5. Ensure that in future disasters, emergency medical personnel remove their used medical equipment, instruments and chemicals from sites and ensure their safe disposal. 6. Approve the Healthcare Waste Management Regulations developed by MoSTE and promote implementation. 7. Approve the Hazardous Material Management Regulation and implement it to ensure safe handling and disposal of hazardous materials and wastes. 8. Continue to enforce the ban on import, sale, distribution, storage and use of asbestos and products containing asbestos.
Longer term (May 2016 to April 2020)	9. Improve the waste management system in Kathmandu's urban areas to enhance environmental sustainability and maximize use of building debris in reconstruction and development projects. 10. Strengthen the environmental decision support system and build capacity of involved institutions by developing inventories of sources of pollution; estimation of loads of different pollutants; infrastructure for monitoring of ambient environmental quality (air, water, and noise); damage assessment; dissemination of results to general public.

Recommendations: Solid waste and hazardous material management	
Longer term (May 2016 to April 2020)	11. Amend the Environment Protection Regulations or introduce a set of integrated pollution prevention and control regulations that requires all polluting industries and other activities to obtain environmental permits from the Department of Environment. The Department also needs to adopt the best available technologies (BATs) developed by the World Bank, European Union, United Nations Industrial Development Organization and other agencies, and make them part of the permitting system, including an effective and efficient compliance monitoring system. 12. Develop national guidelines for chemical laboratories and facilities dealing with toxic chemicals and increase capacity for enforcement. 13. Establish a Special Economic Zone or Industrial Districts for Handicraft Industries with facilities for proper storage of toxic and heavy metals, and work place that prevents the escape of pollutants to air and other medium. Provide continuous training to workers for prevention of pollution. 14. Include mandatory requirements for energy efficiency and use of environmentally friendly technologies and materials in the forthcoming Building Codes. Develop guidelines for auto workshops (including proper location) to prevent the release of toxic pollutants to the environment and enforce the occupational health and safety (OHS) guidelines to protect the health of workers. 15. Strengthen the capacity of the Department of Environment to enforce and monitor environmental regulations, including establishment of a laboratory to test for hazardous materials and chemicals. 16. Build government capacity to manage hazardous materials in event of industrial accidents and natural disasters.

3.5 Roads and Trails

3.5.1 Impacts of the earthquake on the sector

Nepal's road network is the country's predominant form of transportation, and the network suffered moderate damage as a result of the earthquake. A small percentage of the Strategic Road Network (SRN) was completely damaged or washed out due to the earthquake. Side drains, culverts, retaining walls, and pavement were damaged, and some sections were partially or fully damaged due to landslides. The total estimated damages to the SRN amount to NPR 4.6 billion (US$45.9 million), and the total losses are estimated at NPR 526 million (US$5.26 million). Losses in the SRN include the cost of equipment operation (NPR 15.3 million) to open roads after the earthquake.

There was greater damage to the Local Road Network (LRN) which had estimated damages and losses of NPR 12.5 billion (US$124.85 million) and NPR 4.2 billion ($42.74 million), respectively. Extensive road blockages were reported in the District Road Core Network (DRCN) for a number of days, while the Village Road Core Network (VRCN) suffered further blockages, and most of which were in a non-motorable condition even before the 25 April earthquake (NPA, 2015).

At the community level, the earthquake caused damage to many foot bridges, comprising mainly cracks, breakages and movements in the foundations and associated structures. Village walking trails were mainly damaged by landslides caused by

Photo 9: Roads damaged by the earthquake in Gorkha

The road to Tibet

The Syaprubesi-Rasuwagadhi road in Rasuwa district is part of a major trade route between Nepal and Tibet. Over a distance of 26 km the field team counted 81 separate landslides, including 23 rock falls. In places pebbles were falling continuously, making passage hazardous.

(Source: REA field study)

the earthquake. Some walking trails only needed clearing while others necessitated reconstruction, or rerouting. The damages to community road infrastructure are estimated to be NPR 469 million (US$ 4.7 million) for this component of community infrastructure (NPA 2015).

In terms of recovery and reconstruction of roads, the most immediate activities will be: removal of landslide debris and opening the roads to traffic; minimum restoration of roads and bridges including repair of highly vulnerable sections; and temporary repair work to avoid secondary disasters. Additional activities will include the stabilization of road embankments and vulnerable bridges to withstand the monsoon. Longer term road reconstruction activities will involve comprehensive surveys of all existing roads and bridges to assess their vulnerability to future earthquakes of similar magnitude, and planning and prioritizing the necessary repair and retrofitting work.

3.5.2 Environmental risks during recovery and reconstruction

In the period immediately following the disaster when road networks were not accessible, communities coped in ways that had some negative environmental impacts. Since there was no access to incoming supplies people sought locally available substitutes. For example, many people used firewood for fuel instead of liquid petroleum gas (LPG). While there are no data yet, the incidence of hunting very likely increased.

The rehabilitation of existing roads, and construction of new roads, often requires the mining of rock, sand, and gravel for use as road base and as input for cement and asphalt. Environmental issues associated with sand, gravel and boulder extraction are outlined in section 3.3. Rerouting of roads around damaged areas may result in loss of agricultural or forest land. The establishment of road corridors on steep hillsides without sufficient engineering assessment or drainage infrastructure can significantly increase erosion and contribute to the risk of further landslides. The use of heavy construction equipment can also lead to negative environmental impacts in fragile environments if not managed properly. Road spoil is frequently dumped down slopes, especially if bulldozers are used. This results in damage to forests and agricultural land, and sedimentation of rivers (discussed in section 3.3). Most VDC level roads are currently constructed based on the skills and experience of machine operators and are not engineered, with no drainage or consideration of environmental impacts. They often create many new risks in terms of landslides, sedimentation, further loss of land, flooding, disruption of local water supplies. They result in dangerous driving conditions. They often wash out after a year or two, becoming impassable and leaving behind long-term environmental damage (WWF Nepal, 2014). These problems are exacerbated by the more extreme weather events due to climate change, such as more intense rainstorms. To reduce environmental risk during reconstruction and build back better, safer and greener, workmanship as well as in depth-knowledge of material should be highlighted strongly.

3.5.3 Recommendations for green recovery and reconstruction

Recommendations: Roads and trails	
Near term (Now to April 2016)	1. Undertake holistic geographical/geological analysis in the locality of damaged roads, and incorporate findings into design to ensure the sustainability of local/national roads. 2. Since the crux of better road construction is its design, ensure adequate effort for good design, rather than going for high cost treatment of roads (camber, slope of road, drainage, slope of embankment etc.). 3. Ensure that road structures such as side drains, cross drainage, causeways, culverts, bridges etc. are included as needed, and disruption to natural drainage systems, wetlands and water supplies is minimized during both construction and operation. 4. Use local labor for road reconstruction where possible, for example using cash for work programs: this should ensure better quality roads and will also provide a cash injection for earthquake affected households. 5. Minimize earthworks/earth movement i.e. cutting and filling, and prevent sediment runoff and erosion during construction. 6. Stabilize cut slopes, using bio-engineering where feasible as a low-cost and sustainable approach. 7. Allow for more extreme weather and flooding events in the future due to climate change in planning and designs for roads and trails.
Longer term (May 2016 to April 2020)	8. Continuation of the above 9. Integrate and mainstream biodiversity, environment and forest conservation and DRR in the Public Roads Act by amending it or enacting a new Public Roads Act

3.6 Energy

3.6.1. Impacts of the earthquake on the sector

Hydropower: Major on-grid and off-grid damage occurred in electricity generation facilities. About 115 MW hydropower generation facilities under operation out of the 787 MW total installed capacity in the country (on-grid and off-grid) were severely damaged, while 60 MW were partially damaged. About 1,000 MW of hydropower projects under construction owned by independent power producers (IPPs) and the National Electricity Authority (NEA) were partially damaged. Damage to substations, transmission lines, and civil structures was reported. Despite this, at the time of the assessment all 42 substations and 57 transmission lines were in operation. (PDNA). Additional safety assessment is needed at all major hydropower dams in the earthquake-affected areas to ensure full recovery or increased resilience to future earthquakes and to inform recovery investment plans accordingly.

Transmission and distribution activities will also be undertaken to restore and improve connections to disaster-affected households and plan new feeders in close coordination with the housing sector to ensure recovery of electricity services in new settlement areas as soon as new houses are rebuilt (NPC, 2015).

Alternative energy: Nepal has made significant progress in the promotion of renewable energy in rural areas with technologies like biogas, improved cook stoves (ICSs) and solar lighting systems, which reduces pressure on forests for firewood, saves women time and work, reduces health impacts from indoor air pollution, and reduces CO_2 emissions. Biogas brings additional benefits through improved nutrition and incomes if households use slurry for vegetable farming, and use dung from milking cows or buffalo kept near to the household.

Photo 10: Biogas as a source of alternative energy

A rapid assessment by the Alternative Energy Promotion Centre (AEPC) and its partner network revealed that the earthquake destroyed 16,721 biogas plants, 70,000 solar systems, and 146,767 houses with ICSs (NPC 2015). In addition, around 300 micro-hydro plants and 100 ongoing renewable energy projects suffered heavily. In order for Nepal to adopt a trajectory for low carbon development in the longer term, this damage needs to be repaired and alternative energy measures strongly integrated into reconstruction in order to build back better.

3.6.2 Environmental risks during recovery and reconstruction

Streamflow through settling basins past damaged dams may have higher rates of sedimentation and log debris as the settling basins are scoured, with downstream impacts. Leakage of construction fluids (petroleum products, chemical products) may have occurred from damaged hydropower sites and entered the soil and river; debris and other materials from the sites may have been entered water bodies or deposited on cultivable land, causing negative environmental impacts.

Some hydropower plants require repair and some may even need to be demolished. In order to repair plants and build back better, additional construction materials will be required. Environmental impacts of sand, gravel and boulder extraction have been outlined in section 3.3.

Lack of electricity due to disturbance in systems led to use of firewood and fossil fuels as alternatives. The use of fossil fuels, in place of hydropower, produces pollutants and contributes to carbon emissions.

Destruction of alternative energy systems, coupled with challenges in supply and affordability of bottled gas, forced many households to use firewood instead of alternative energy after the earthquake. Since many people were living in the open because their houses were destroyed or unsafe, additional firewood may have been used to keep warm at higher altitudes. Increased use of firewood placed additional pressure on forest resources, particularly in areas near to settlements. Cooking over open stoves inside temporary accommodation will have exposed women and young children to indoor air pollution. Increased use of open fires may have increased the risk of uncontrolled forest fire, as the earthquake occurred at the end of the dry season during peak fire season.

3.6.3 Recommendations for green recovery and reconstruction

Recommendations: Energy	
Near term (Now to April 2016)	1. Promote low carbon development practices during reconstruction, including clean energy technologies for women's health and environmental benefits. 2. Ensure that new and rehabilitated housing includes alternative energy and energy efficiency measures (solar, biogas, ICS as appropriate, depending on location and household situation).
Longer term (May 2016 to April 2020)	3. Promote local electrification through domestic solar panels to reduce the impact of disasters in the future. 4. In the re-establishment of hydropower projects and licensing of new hydropower, undertake a full assessment of downstream and upstream impacts and minimize negative environmental impacts in design and implementation. 5. Allow for shifts in climate and more extreme weather events when planning and restoring hydropower projects. 6. Select small scale/micro hydropower over large scale hydropower. 7. Ensure that dams in storage reservoirs are earthquake resistant to avoid downstream floods in future earthquakes. 8. Plan hydropower on the basis of river basins rather than individual projects; undertake strategic environmental assessments (SEA) of basin hydropower development once SEA legislation is introduced. 9. Promote the transfer of environmentally sound and cleaner technologies in industry. This includes improved technologies in the brick kiln sector; and improved energy efficiency in cement, and iron and steel industries. 10. Strengthen partnerships in the energy sector to ensure that alternative energy can be rapidly deployed and focused in areas where it is most needed in post-disaster situations.

3.7 Water, Sanitation and Health

3.7.1 Impacts of the earthquake on the sector

Water supplies and water quality: According to the Department of Water Supply and Sanitation and district level Water Supply and Sanitation offices' estimation, out of a total 11,288 water supply systems in the 14 most-affected districts, 1,570 sustained major damages, while in the 17 moderately affected districts, 747 sustained major damage, and 1,761 were partially damaged (NPC 2015). Landslides destroyed water supply sources in all the affected districts. Freshwater sources for drinking water supply disappeared or were greatly reduced in parts of Dolkha, Gorkha, Nuwakot and Rasuwa districts. In some places the water level in tube wells was affected and the water changed color. In urban areas, damage to sewage systems and drinking water supply systems contaminated water in some places. In addition, ground and surface water is likely to have been polluted by hazardous chemicals in locations near or downstream from damaged laboratories, factories and cottage industries that released harmful substances into the environment (see section 3.4). Hundreds of thousands of people have been forced to look for alternative sources of drinking water, without knowing the quality of new sources.

Photo 11: Public toilet damaged by the earthquake in Rasuwa

Sanitation: Prior to the earthquake, there was significant progress in installing latrines in all houses and in declaring many open defecation free (ODF) villages. The earthquake resulted in complete damage of over 220,000 toilets and partial damage to around 168,000 toilets in all affected districts (NPC 2015), forcing people again to defecate in the open. Only around 40 percent of camps had proper sanitation facilities, the majority at best being served through pit latrines. This will also have resulted in contamination of drinking water sources.

No water or sanitation facilities in Bungtang village

In Nuwakot district, Bungtang village had old but inactive landslides. The earthquake reactivated them, and 42 families were immediately shifted to a safe site. However, the lack of water and sanitation facilities was a serious environmental problem.

(Source: REA field study)

Damage to health care centers further adds to the problem. Health infrastructure were severely damaged (section 3.3), depriving thousands of affected people of access to regular health facilities, and putting them at risk of illness from contaminated drinking water and soil due to improper management of debris (section 3.4). A total of 446 public health facilities (consisting of five hospitals, 12 Primary Health Care Centers, 417 Health Posts, and 12 others) and 16 private facilities were completely destroyed and a total of 765 health facilities or administrative (701 public and 64 private) structures were partially damaged (NPC 2015).

Nutrition: Loss of stored food, impacts on agriculture and livestock, and disrupted access caused short-term food shortages in many places in the affected districts; longer term impacts on agriculture due to lack of seed for planting, loss of livestock and damage to irrigation systems will mean that food shortages will continue for a while (section 3.8). Although relief food supplies were provided to many communities, the nutritional status of affected populations will have been affected, particularly children under five years of age, and pregnant and lactating women who constitute the primary vulnerable groups for undernutrition. Preliminary assessment found approximately 250,000 children from the ages of six months to 59 months, and 135,000 pregnant and lactating women were affected by the earthquake in the 14 districts (NPC 2015).

3.7.2 Environmental risks during recovery and reconstruction

Contamination of water supplies through fecal contamination and inappropriate disposal of hazardous materials poses a health risk to people, livestock, wildlife, and aquatic systems. There could be a risk of disease or parasite transmission among wildlife, people and livestock.

Fecal water source contamination makes people highly vulnerable to waterborne diseases and parasites, especially infants and young children, people who are debilitated or living in unsanitary conditions, and the elderly. There is a risk of outbreaks of waterborne disease.

People's responses to the changes in water sources brings risk of environmental impacts. Where water sources have lower flows there is a risk that people will extract a higher proportion of the water, reducing the amount left to flow downstream to forests and wetlands, or possibly leaving no water at all. Wildlife may be affected, along with aquatic communities downstream. Vegetation changes may occur locally, and the viability of climate refugia (areas where species are more likely to survive as climate change advances) could be affected. Where water sources have dried up completely people may tap new sources, with similar impacts. There is a risk of increased conflict over local water resources among nearby communities, especially in areas where water is scarce. Earthquake impacts on water sources are in addition to longer term changes that were already occurring in many places due to increased climate variability and land use changes.

The full impacts of the earthquake on water sources may not yet have been felt – it is possible that more changes will become apparent during the coming dry season.

3.7.3 Recommendations for green recovery and reconstruction

Recommendations: Water, Sanitation and Health	
Near term (Now to April 2016)	1. Ensure that construction of latrines is at least 30 m horizontal distance from water sources and the bottom of the pit is at least 2 m above the groundwater table. 2. Deploy improved, appropriate technology when reconstructing water supply and sanitation systems, including water use efficiency, rain water harvesting ponds and tanks, septic tanks, treatment wetlands, and multiple use systems where feasible. 3. Make inventories of water sources including new sources; sources that have dried up; and sources with changes in flow. Identify water needs and assess environmental impacts of extraction, particularly in areas where changes have occurred; promote sustainable, environmentally appropriate levels of extraction, coupled with water efficiency measures when needed. Design interventions to avoid/resolve conflicts among users. 4. Include sustainability plans for all WASH interventions in consultation with the community, especially women. Women's role in maintaining water supply and use is inextricably linked with household welfare, including specification of roles and responsibilities for operation and maintenance (e.g., community water committees).
Longer term (May 2016 to April 2020)	5. Properly store and dispose of hazardous materials arising from WASH activities such as water treatment chemicals and sludge. 6. Promote Integrated Watershed Management (IWM) and Integrated Water Resource Management (IWRM) in the recovery and reconstruction phase that takes into account changes in water sources; protects and where necessary restores watersheds and recharge areas; and reconciles the needs of different users and biodiversity requirements.

3.8 Agriculture and Livelihoods

3.8.1 Impacts of the earthquake on the sector

With the exception of the Kathmandu Valley, the areas affected by the earthquake are essentially rural, with a high dependence on smallholder agriculture. Around one million poor farming households were affected by the earthquake in 24 districts. The earthquake and ensuing landslides damaged or obliterated crop lands; resulted in the loss of over 17,000 cattle and about 40,000 smaller domesticated animals (Ministry of Agricultural Development (MOAD 2015a); damaged or destroyed physical infrastructure such as irrigation systems, livestock shelters and poly houses; and damaged service centers and laboratories. Major losses occurred to livestock, poultry, stored grain and seed, and eggs. Other losses occurred to fish, vegetables, honey, animal fodder, and fruit production.

Loss of land and food

Kerabari, a small village in Syule VDC, Sindhupalchowk, lost 235 quintals of food (paddy, maize and millet) and 12 ha of agriculture land. This will increase the dependency of local people on nearby forests and natural resources.

(Source: REA field study)

Photo 12: Solar dryer for *Sisnu* (common nettle) which has been damaged along with the factory by the earthquake in Barpak, Gorkha

Many farms were not tended after the earthquake due to death or injury in the household, or more pressing needs to secure survival and shelter, resulting in loss of the currently planted crops. Farmers could not harvest, let alone cure, thresh and store wheat as the threshing floor and stores were destroyed by the earthquake. Loss of stored seed and inadequate distribution of replacement rice seed also meant that many households could not plant the rice crop in time for the 2015 monsoon (PDNA, 2015). At the same time, the disaster disrupted access to markets, including roads and trails. As a result, local trade was severely constrained. In Nuwakot, tens of thousands of newly hatched chicks were buried and the emerging hatchery industries were badly affected as the egg market plummeted.

The REA team field study during May 2015 found significant loss of stored grain, particularly recently-harvested wheat and barley. In Rasuwa and Nuwakot districts, up to 80 percent of stored grain was buried under rubble. Loss of stored seed has strong implications for agrobiodiversity. The mountain areas in Nepal are critically important for maintaining indigenous land races of crops such as millet, rice, wheat, buckwheat, and barley, which have developed in these environments and are adapted to local conditions. With so many livestock casualties there is also a risk that the gene pool of local livestock breeds may have shrunk, at a time when many farmers are already destocking in rural areas.

Many off-farm livelihoods were disrupted by the earthquake, including nature-based tourism. It remains to be seen how quickly tourism will recover after the earthquake. In the meantime, it is likely that many people who depended on tourism for their livelihoods currently have increased dependency on forests. Farm and non-farm based micro-enterprises were also severely affected.

MOAD (2015b) has planned recovery activities for 12 months and reconstruction activities for 36 months. The broader recovery activities include distribution of time critical inputs for crops, livestock and fisheries to re-establish livelihood support for the poor and marginal farmers; distribution of millet, wheat, barley, and potato for next cropping season; seasonal vegetable seeds to the farmers who have missed rice farming in monsoon, grain bags and metal bins for storing recently harvested wheat and barley crops; carcass management support; support for the treatment of injured animals, animal shelters, livestock feed and vaccinations; cash/voucher transfer for subsidized supply of vital agricultural inputs; restocking of rainbow trout and other fish stock in fish hatcheries; and immediate repair and rehabilitation of small irrigation channels.

3.8.2 Environmental risks during recovery and reconstruction

Opening of new farms in forest land: A major risk associated with resettlement is the opening of new agricultural land in the resettled areas where there is no firm base for agriculture, which could result in forest loss and disruption of ecosystem services and processes. Depending on distance from the former settlements, it may be difficult for people to continue to farm their old land, since land holdings are small and scattered. There are 2,214 households to be resettled from 11 VDCs in Gorkha alone (Kathmandu Post 20 May 2015).

Plastic tomato tunnels in Rasuwa

Rasuwa, a popular hub for high mountain tourism, has been self-sufficient in tomatoes in recent years. There are about 600 plastic tomato tunnels in the district contributing some 700 kg of tomatoes per day during the tomato season. When houses were destroyed or damaged by the earthquake many local people took shelter in these tunnels. A case study carried out to assess the impact of this on tomato production found that 110 tunnels were used as temporary shelters, providing important refuge but resulting in soil compaction and loss of tomato production. People may have been exposed to health risks from pesticides and fertilizers inside the tunnels.

(Source: REA field study)

Livestock in forests: While a large number of livestock were killed in the earthquake, many others were injured and livestock shelters destroyed. The REA team reported that as people tried to cope with basic survival after the disaster their remaining livestock were often let loose to graze, with potential for conflict with farmers if livestock ate their standing crops, and damaging forests through browsing and trampling. There is also a risk of attack by wildlife as livestock are unprotected (REA interviews).

Introduction of unsuitable landraces and breeds: There is a risk of introducing crop seed and animal breeds that are not suited to specific agro-climatic conditions, affecting sustainable agricultural production systems. Further, farmers may be forced to accept genetically modified (GM) seed, with risk of long-term negative impacts on the environment and/or dependence on private companies for agricultural inputs. The MOAD expressed serious concern about the free distribution of rice seed in the earthquake affected districts (The Kantipur Daily, July 8, 2015, p.2). GM seeds require heavy use of fertilizer for good yields; chemical fertilizer may affect local soils, and cause eutrophication of water bodies.

Abandoning of farm land: Farm land may be left fallow due to resettlement, migration, and unavailability of labor for cultivation. External food support for an extended period is also likely to be a disincentive for farmers to return to production of food crops. While abandoned farm land may revert to forest, it could become a haven for invasive alien species, diseases and/or pests. Human-wildlife conflict could increase for nearby farmers. In other cases farm land may be used for extraction of construction materials such as soil, sand, and boulders during the reconstruction period. Fertile topsoil may be lost due to increased demand for brick-making and other building materials. Unplanned and poorly designed and constructed infrastructure such as trails, roads, irrigation channels, and ponds in farm land may accelerate soil erosion and landslides resulting in flooding and loss of crops, livestock, forest areas and spring sources.

Fertilizers and pesticides: Use of chemical fertilizer is likely to increase due to the diminished supply of farmyard manure resulting from extensive losses of livestock and animal shelters in the earthquake affected areas. This will be further aggravated by the current policy and practice of increasing fertilizer and pesticide supply, especially with aid agencies providing agricultural inputs. There is a risk that the change to chemical fertilizer will damage soil structure and fertility, increase the risk of erosion, and pollute local water bodies. Pesticides may bring risks to human health and to non-target species; there is a high risk that banned or restricted pesticides will be provided to farmers at a time when they are vulnerable.

Greater dependence on forest products: Forest resources are likely to be more heavily used for food and livelihood activities in many places where farming and local micro-enterprises of poor and vulnerable people have been disrupted. This may result in forest degradation and poaching. Due to the timing of the earthquake and the recovery period in late summer and autumn, some forest resources, particularly NTFP species such as chiraito (*Swertia chirayita*), jatamansi (*Nardostachys grandiflora*) and kutki (*Neopicrorhiza scrophulariiflora*) could be impacted from premature and overharvesting because of the immediate needs of local people who cannot wait until the normal harvesting season during autumn.

Irrigation impacts: There is risk of affecting freshwater biodiversity when water is taken from different sources to rehabilitate irrigation schemes; this may also affect wildlife. It also enhances the risk of transmitting water-borne diseases.

Labor impacts: reconstruction will provide many job opportunities, yet because of out-migration there is already a labor shortage in many areas. There is a risk that people who were involved in forest management before the earthquake will take jobs in reconstruction, and have no time to manage their forests. This could make forests vulnerable to illegal activities. At the same time, while there will be a surge in temporary employment many jobs will not last long, and people will become unemployed. Some, with new skills from post-earthquake training, may leave the area for employment elsewhere. Others, having become accustomed to a regular income, may fall back on forests to provide them with a livelihood. The situation is likely to be complex and location-specific.

3.8.3 Recommendations for green recovery and reconstruction

Recommendations: Agriculture and Livelihoods	
Near term (Now to April 2016)	1. Plan resettlement in small clusters close to people's areas of origin if possible, with access to their own farm lands. It should be supported by alternative livelihood options that do not place extra pressure on the environment. 2. Distribute only tested crop varieties and livestock breeds and do not extend food distribution systems for longer than necessary. Identify threatened agricultural breeds and landraces, collect and store seed in gene banks and promote in-situ conservation. 3. Promote labor saving technologies like mini tractors, planters and harvesters and other farm machineries 4. Develop early detection and surveillance systems for spread of invasive alien plant species, disease and pests, and take action to control them. 5. Promote organic agriculture and optimum use of chemical fertilizers based on NARC recommendations combined with organic manure, green manure and capacity building for composting. 6. Regulate and monitor pesticide use. 7. Promote cash for work in the recovery process such as cleaning up streams, repairing agriculture farm lands and community infrastructure, for forest-dependent communities. 8. Revitalize the tourism sector by supporting repair or reconstruction of damaged tourism infrastructure including trails, hotels and lodges, and marketing of tourism destinations that have not been affected by the earthquake. 9. Support small and medium sized enterprises to restart affected businesses. This could include, for example, loans at low interest rates, simplification of loan disbursement procedures, fixed subsidies to support start-up businesses, and facilitating the insurance process. 10. Skills and capacity development program in the affected area could be initiated with the objective of maximizing the use of local expertise and people in the recovery and reconstruction process. 11. Promote cash for work programs to support households to restore their lives and livelihoods. 12. Take climate change into account when redeveloping agriculture: take advantage of new opportunities and avoid perpetuating systems that were already struggling because of climate change before the earthquake.

Recommendations: Agriculture and Livelihoods	
Longer term (May 2016 to April 2020)	13. In addition to supporting local production systems, promote employment that enhances the environment in recovery programs, such as green jobs (e.g. ecosystem restoration activities); and sustainable livelihoods in-forest, on-farm and off-farm depending on local opportunities, to reduce forest dependency. 14. Promote recovery of nature-based tourism, reconstructing homestays and lodges, trails and other infrastructure. Where tourist staff have been lost, train others to work in tourism. 15. Support intensive agriculture under protected structures to reduce the possibility of horizontal expansion of agricultural land, and rehabilitate farm and non-farm based micro-enterprises to create employment opportunities for disaster affected communities. 16. Improve food supply chain to ensure a greater quantity of food available in the local market, building capacity and diversifying the agro and forest-based industries to other products and services, and promote sustainable harvesting practices for forest resources to take pressure off forests. 17. Assess and rehabilitate irrigation schemes, considering possible impacts on freshwater biodiversity and water demand for agriculture, and addressing the risk of transmitting waterborne diseases from livestock to wildlife and vice versa. 18. Develop guidelines for agriculture land use based on Land Use Policy, 2012, and formulate and enact an agricultural act, strictly complying environmental regulations including collection of sand and boulders only from designated areas not damaging ecosystem services. Revisit policies and amend regulations regarding community infrastructures, use of landscape and geological information in designing green community infrastructures.

3.9 Forestry and Conservation

3.9.1 Impacts of the earthquake on the sector

Impacts of the earthquake on the environment, conservation and forestry were covered extensively in Chapter 2. The PDNA estimated tangible damages and losses of NPR 32,960 million and NPR 1,061 million respectively, and in addition, intangible loss of ecosystem services at a value of NPR 34,021 million (NPC, 2015).

3.9.2 Environmental risks during recovery and reconstruction

Many environmental risks during recovery and reconstruction are covered in other sections of Chapter 3. Here, risks from the environment and conservation sector's own recovery work are outlined.

Spread of invasive species: There is a risk of introducing species that are not native in sensitive sites, and/or could become invasive (e.g. in tree planting in landslide and other sites). There is also a risk that invasive species already present in an area could become established on landslide sites and prevent native species from regenerating (e.g. *Lantana camara).*

Photo 13: Spread of invasive plant species *(Ageratum spp.)*

Tourism: If there is a rush to rebuild in order to restart tourism, with no consideration of esthetic values, there could be a risk of unsightly redevelopment in protected areas (e.g. tall buildings, buildings on skylines, architectural designs that are not in keeping with the local environment).

Risk of erosion from trails in protected areas: Further erosion/landslides could occur from restored or rerouted trails in protected areas, if they are not well constructed and maintained.

3.9.3 Recommendations for green recovery and reconstruction

Recommendations: Forestry and conservation	
Near term (Now to April 2016)	1. Urgently restore law enforcement in protected areas and in government and community managed forests, with temporary posts where necessary in order to maintain a presence during the post-disaster time when greater illegal extraction and poaching are likely. 2. Rebuild capacity for community forest management, including appointing and training new executive committee members where needed, replacing lost equipment, and replacing lost documents if electronic back-ups are available. Ensure that important documents are backed up electronically in the future. 3. Undertake prioritized rapid assessments of post-earthquake natural resources, ecosystem services, biodiversity, forest-dependent communities, land use, water and future hazards and make the information available for planning purposes. 4. Revise/implement management plans of PAs taking into account restoration of damaged forests; special needs of critically endangered species; enhancement of the forests' DRR and other ecosystem service functions including carbon sequestration; and mainstreaming of climate change to build resilience for the future. For PAs where harvesting is part of the management plan, ensure sustainable offtake to help meet demand for building materials, fuelwood and NTFPs during reconstruction. 5. Revise/implement management plans of government and community forests taking into account sustainable offtake to help meet demand for building materials, fuelwood and NTFPs during reconstruction; restoration of damaged forests; promotion of sustainable forest management in the future; enhancement of the forests' DRR and other ecosystem service functions including carbon sequestration, and mainstreaming of climate change to build resilience for the future. 6. Enhance capacity and knowledge on climate change resilience and adaptation to promote mainstreaming of climate change into recovery and reconstruction. 7. During reconstruction, promote technologies for improved, seasoned and treated wood products. 8. Make full or partial exemption on royalty on forests products for a few years to help affected forest-based enterprises to recover. 9. Restore landslides and other degraded forest sites where it is safe to do so (see section 3.2 for recommendations on restoring landslide sites). 10. Source seedlings and saplings from nearby nurseries rather than transported from other places, especially areas where invasive plants are common, to avoid the risk of spreading invasive species. 11. Actively promote green recovery and reconstruction practices in all sectors, working to promote a balance between development and conservation in order to maintain ecosystem services and reduce risk of future disasters, and taking climate change into account; using sites with green practices as demonstrations for others.

Recommendations: Forestry and conservation	
Longer term (May 2016 to April 2020)	12. Rebuild management infrastructure in PAs and district forest offices, ensuring safe, esthetically attractive buildings and incorporating green building approaches (e.g. environmentally sound building materials, alternative energy and water efficiency) that can be used to demonstrate green practices to others. 13. Build capacity nationally for EIA and IEE; include training in REA so that REAs can be rapidly implemented and their results used quickly after future disasters. 14. Rebuild tourism facilities taking esthetic issues into account and avoid developments that will have an adverse impact on scenic vistas. 15. Avoid erosion and landslides from restored trails in protected areas by ensuring trails are well constructed and adequate for the amount of use they are likely to get. Promote re-establishment of vegetation cover adjacent to trails, using bioengineering where appropriate. 16. Establish long-term socio-ecological and environmental monitoring program in selected areas, including Langtang valley, to address information data gaps and support conservation and development planning to help policy and decision makers and planners.

3.10 Education Sector

3.10.1 Impacts of the earthquake on the sector

The earthquake severely affected the education sector. Nearly 7,000 schools were completely or significantly damaged, and educational services were severely disrupted in schools, colleges, universities and training centers in the affected areas. The earthquake is likely to have increased the number of children out-of-school. On the positive side, the fact that the earthquake happened on a Saturday meant that educational institutions were closed; had it occurred when they were in session, the death toll of young people could have been much higher (NPC, 2015).

Photo 14: After the earthquake many schools faced severe challenges to remain open

Need to revise earthquake safety education?

The REA field survey heard reports that some school children playing outside rushed back to their homes and took shelter under beds and tables, having learned at school to "duck, cover and hold". Tragically they lost their lives as their poorly built houses fell on them; they would have been safe outside. Thus, there should be a review of earthquake safety education and awareness in light of the experience from this earthquake.

(Source: REA field study)

3.10.2 Environmental risks during recovery and reconstruction

The main environmental impacts of recovery and reconstruction in the education sector are likely to be from the debris disposal and reconstruction of buildings. Reconstruction of buildings is covered in section 3.3, and debris disposal in section 3.4. In addition, temporary learning centers could have adverse environmental impacts through extraction of building materials such as poles and timber from forests, extraction of sand and gravel (section 3.3), inadequate sanitation (section 3.7), and inadequate waste disposal (section 3.4).

There are many opportunities for the conservation and education sectors to work together to promote green recovery and reconstruction. A positive occurrence in the aftermath of the earthquake was the way that youth immediately mobilized to support relief and early recovery work. Involving children and youth in recovery work through schools and other educational institutions can reduce environmental impacts of reconstruction in their communities, help them come to terms with the disaster, and provide them with an outlet to help to rebuild their communities and country.

3.10.3 Recommendations for green recovery and reconstruction

The recommendations below, mostly drawn from Nepal Education Cluster 2015, are in addition to recommendations on buildings, waste management and water and sanitation relevant to educational institutions.

Recommendations: Education	
Near term (Now to April 2016)	1. Highlight green recovery and reconstruction issues such as energy conservation, watershed conservation, and environmental health, which are already in the school curriculum (Bhuju et al. 2015), in classes and in practice during reconstruction of schools. 2. Use local curriculum time and courses on the environment, as well as traditional curriculum subjects such as math, science, social studies, Nepali and English, to highlight environmental issues including climate change. Invite local experts to participate. 3. Mobilize child clubs and Eco-clubs to take on environmental activities and issues; hold special environment events; and organize environmental competitions to raise awareness. 4. Encourage students in higher education institutions to do projects and theses on green recovery and reconstruction.
Longer term (May 2016 to April 2020)	5. Encourage schools to plant and tend trees to replace timber and poles used in school reconstruction; to help stabilize degraded areas or landslides; and/or provide shade in the school grounds or community. 6. For schools with piped water, help restore and protect forest in the recharge area or watershed. 7. Encourage water efficiency, for example through rainwater harvesting. 8. Green the school compound, by planting hedges, using climbing plants and trees for shade, planting vegetable gardens, etc.

3.11 Financial Sector

3.11.1 Impacts of the earthquake on the sector

Of all the financial institutions, the credit portfolios of microfinance and cooperatives were likely the most severely affected, because people with low incomes in rural areas lost lives and livelihoods. Many borrowers in the affected areas have had income flows affected, and lack alternative income-earning opportunities to make repayments. Many depositors are likely to have withdrawn savings to deal with the emergency, which could impact capacity to assist communities. Many people need loans to help them recover, but no longer have stable sources of income to guarantee the loans (NPC, 2015).

Larger financial institutions suffered massive damage mainly because of credit exposure to housing and real estate as well as exposure to development projects like hydropower. The share of housing sector in total loss was more than 50 percent due to earthquake. Similarly, several hydro projects were damaged due to landslides, rock slides, cracks in dams, damming of rivers, leakage in tunnels and breaking of transmission lines (NPC, 2015).

More recently, financial institutions have reported large cash holdings from overseas remittances after the earthquake.

At the International Conference on Nepal's Reconstruction in June 2015, a total of $4.4 billion was pledged for reconstruction support. Major donors included: India, China, the World Bank, Japan, Asian Development Bank (ADB), United States, European Union and United Kingdom. The total cost of reconstruction across all sectors is estimated at US$ 6.695 million (NPR, 2015).

3.11.2 Environmental risks during recovery and reconstruction

At a local level, small-scale rural borrowers who are faced with repaying loans, and others who cannot secure loans for recovery, may try to raise funds by using forest resources. This is likely to put unsustainable pressure on forest resources, especially in easily accessible areas, and could increase the future hazard risk from landslides and floods (see also section 3.8).

On a larger scale, the huge influx of funds for reconstruction and development, while essential for Nepal's recovery, can bring environmental, social and economic problems if not carefully designed and implemented.

Banks mainly use financial rate of return and economic viability of the projects in their funding procedures. They have direct involvement in most of the development projects, but also have indirect hand in the potential problems arising from the disaster.

3.11.3 Recommendations for green recovery and reconstruction

Recommendations: Financial sector	
Near term (Now to April 2016)	1. Support recovery of households with loans by restructuring loans or altering the payment schedule to delay repayments. 2. Support small and medium sized enterprises to restart affected businesses. This could include, for example, loans at low interest rates, simplification of loan disbursement procedures, fixed subsidies to support start-up businesses, and facilitating the insurance process. 3. Banks and financial institutions (BFIs): consider adopting or strengthening corporate environmental and social responsibility, developing innovative ways to encourage green recovery and reconstruction. 4. Donors should ensure environmental conditions in recovery funding, promoting safe and green recovery and reconstruction.
Longer term (May 2016 to April 2020)	5. BFIs should ensure IEEs and EIAs are a pre-requisite in developing projects, and entertain the option of dropping projects, or changing them to mitigate unacceptable environmental impacts. This must be done before loans are approved. 6. BFIs should ensure that the recommendations in IEEs/EIAs are adhered to during design, implementation and decommissioning of projects. 7. BFIs should promote regular post-project environmental audits to verify the predictability of the impacts of the project, encouraging borrowers to institutionalize systems for monitoring and controlling environmental damage. 8. Government should encourage provident and pension fund investment in longer-term 'green' projects, promoting corporate environmental and social responsibility.

3.12 Climate Change

3.12.1 Background

Nepal is facing increased risk of climate induced hazards such as erratic rainfall, flash floods and prolonged drought (United Nations Development Programme (UNDP) 2003, World Bank 2008). Average temperature increased between 1977 and 1994 at a rate of 0.06°C per year; and is projected to increase by another 1.2°C by 2030, 1.7°C by 2050, and 3.0°C by 2100 (Ministry of Environment, 2010). Maximum temperatures are increasing faster than the minimum temperatures indicating a widening temperature range (Xu et al. 2007). These changes are already affecting forest-dependent communities and ecosystem services, and changes will continue to occur as climate change advances. Major changes are projected for several forest types in Nepal (Wikramanayake *et al.*, in press).

3.12.2 Links between climate change and the earthquake

While the earthquake occurred as a result of tectonic processes and was completely independent of climate change, climate change can exacerbate the effects of the earthquake on the environment. Similarly, the earthquake also exacerbated the risk of some climate hazards.

The earthquake reduced the stability of many slopes. There is a high risk that very heavy rainfall, typical of increased climate variability, will trigger landslides in these areas. Extreme weather events such as intense precipitation are likely to increase in intensity and frequency in the future as climate change advances. At the same time, the earthquake exacerbated the risk of glacial lake outburst floods (GLOFs). Climate change has resulted in glacial lakes forming behind moraine deposits as glaciers retreat because of increased glacial melt. In some cases the earthquake weakened the dams and there is a higher risk of GLOFs. A recent survey of three potentially dangerous lakes (Imja, Tsho Rolpa, and Thulagi) revealed that the earthquake and aftershocks further destabilized the already deteriorating moraines of all three lakes with massive cracks, shifted boulders, and impacts on the outlet channel, while further destabilizing existing potential GLOF triggers such as overhanging ice, and calving rates of the glacier. The survey

recommended that all three lakes should be re-classified from potentially dangerous to dangerous (Byers et al. 2015).

These types of enhanced risks should be taken into account during recovery and reconstruction, in order to build back better, safer and greener.
Upward shifting of ecological zones is expected with the rise in temperatures (Gaire et al. 2014). As the upper grassland is replaced by upward moving tree species, this may bring direct and negative impact on the livelihoods of the high mountain farmers who depend on pastureland for grazing their cattle.

High altitude species such as Jatamansi (*Nardostachys grandiflora*) and Kutki (*Neopicrorhiza scrophulariiflora*) are likely to become more vulnerable with increase in climatic and human induced stresses (Ghimire et al. 2005), as well as landslides that have destroyed vegetation cover and removed top soil, for example in Lho, Prok, Chumchet, Chhekampar and Sirdibas VDCs in Manaslu CA. Habitats for mountain fauna such as the critically endangered snow leopard are increasingly threatened due to increased temperature (Forrest et al. 2012), and could be adversely affected from reduction in the population of prey after the earthquake.

3.12.3 Recommendations for integrating climate change in green recovery and reconstruction

Recommendations: Climate change	
Near term (Now to April 2016)	1. Mainstream climate change into recovery and reconstruction work, including land use planning, agriculture, DRR, buildings and settlements, solid waste management, roads, energy, water and sanitation, and forestry and conservation, allowing for more extreme weather events, erratic rainfall, and rising temperatures in the future. The longer the reconstruction project is expected to last, the more climate change will have advanced during its lifetime. Follow the National Adaptation Program for Action (Ministry of Environment, 2010). 2. Promote low carbon development practices during reconstruction, including clean energy technologies for women's health, and environmental benefits. This will reduce carbon emissions and contribute to efforts to slow the advance of climate change. 3. Conduct detailed scientific surveys of all glacial lakes, updating the hazard levels following the earthquake.
Longer term (May 2016 to April 2020)	4. Improve the network of weather stations in the country, in order to provide more reliable weather forecasting and climate projections; ensure that forecasts and projections are readily available to all who need them. 5. Design Himalayan-specific methods to reduce the risk of GLOFs, taking an interdisciplinary and participatory approach; develop detailed flood hazard maps; undertake local adaptation plans of action (LAPAs) targeted at GLOFs and other natural hazards with downstream communities to increase their capacity for disaster management planning and implementation; develop and install effective and user-friendly early warning systems; and build in-country capacity to manage the increasing risks of GLOFs (Byers et al. 2015). 6. Ensure development of a National Adaptation Plan in line with adaptation needs and following the guidelines of the United Nations Framework Convention on Climate Change.

3.13 Gender Equality and Social Inclusion

3.13.1 Impacts of the earthquake on women, poor and marginalized people

The PDNA documents general impacts of the earthquake on women, children, senior citizens, people living with disabilities, and minorities (NPC, 2015). This section looks more specifically at the impacts on these vulnerable groups in relation to the environment.

Water issues: In places where water sources dried up after the earthquake, women and girls had to walk longer distances to fetch water for household purposes. Collection of water, looking after the injured and aged increased the workload of women, leaving them little time to network and participate in community activities and decision-making process. Women were reported to be very economical in their use of water and this also has implications for their personal hygiene. It will also impact girls' education, as they may be withdrawn from schools to help in household work with the increase in women's workload. As families slowly begin to return to normal life, women's time will be more geared towards household welfare and non-market activities resulting in time poverty. This will automatically exclude them from participating in skill development, capacity building initiatives, and seeking employment opportunities. It will further exacerbate their poverty and make them more dependent on male earning members of the family.
The REA team reported conflicts in use of water in the post-disaster setting arising out of caste discrimination, despite the existence of the strong Caste-Based Discrimination and Untouchability (Crime and Offences) Act, 2011 which prohibits such discriminatory practices against Dalits.

Forest produce: Community Forest Users' Committees responded to the needs of the community people by allowing them to cut trees for building temporary shelters with priority given to single women, poor, Dalits and marginalized people. As monitoring systems were relaxed, indiscriminate felling of trees could lead to deforestation.

Energy: The disruption in the supply of LPG gas and damage to biogas plants forced people to switch to firewood for energy. The REA team reported that wood recovered from destroyed houses was meeting fuel wood needs. While women were being very economical with firewood use, if they are burning unbroken pieces of timber, ultimately more wood will need to be harvested for reconstruction. Once that supply ends, in the short and medium term the energy needs for cooking and heating will necessitate heavy reliance on forest resources, which means more work and time for women and girls to collect firewood. There is the possibility to encounter wildlife during this activity during a time when wildlife is targeting livestock left out in the open. Also, cooking on open fires, sometimes inside temporary shelters with poor ventilation, exposes them to smoke with the increased risk of respiratory infections.

Although solar lamps had been distributed; not every household had received them at the time of the survey, posing challenges for women in carrying out household work and childcare in the evenings and at night.

NTFP enterprises: Many NTFP enterprises were badly affected by the earthquake: for example, the sisnu (nettle) powder enterprise in Barpak, Gorkha. Decline in engagement of women and poor people in NTFP enterprises will weaken household income and their resilience to overcome household poverty.

Ecotourism: Ecotourism will also suffer a setback with fewer tourists visiting the affected areas, and thus impacting the operation of home-stays which were providing stable income to women. Income from home-stays had motivated men to share household responsibilities; this may now stop if men migrate in search of employment.

Remittances: In the months following the earthquake there was a decrease in outbound labor migration. The Department of Foreign Employment registered an overall drop of 46.86 percent in people going abroad through overseas companies and a drop of 27 percent in people going on their own. Loss of potential remittances reduces individual household capacity to withstand shocks, at a time when this capacity has already been impacted by the earthquake. Given the extreme poverty levels of some women, poor and marginalized groups, they are likely to increase pressure on forest and biodiversity resources to meet household consumption and energy needs, in the absence of alternative livelihoods and remittances.

Land distribution and ownership: Many households lost agricultural land, often their main source of livelihood and food security. As the majority of women are engaged in agriculture, their primary source of

livelihood now hangs in the balance. This situation will be further exacerbated by the fact that most survivors have not been able to retrieve important documents such as those for citizenship or land ownership. Land ownership is very rare for women as patriarchal norms and values confer the right to property and lineage to men and boys despite women's active role in agriculture. According to the 2011 Census (Central Bureau of Statistics (CBS), 2012), only 19.71 percent of households reported the ownership of land or house or both in the name of female household members. (This was an increase from 11 percent recorded in the 2001 Census (CBS, 2011)).

The recovery and reconstruction phase provides a strategic opportunity to tackle structural poverty, inequality and discrimination by ensuring equitable land distribution, allocation and ownership for poor women and marginalized groups. Ignoring the equal contributions of women, the poor and marginalized groups in the agriculture sector will further deepen inequality, exclusion and poverty.

Forest encroachment: It was reported to the REA team that influential pockets of people were already engaging in land encroachment of forest areas as whole villages had been flattened, rendering the majority of people homeless.

Gender-based violence: The REA team was informed that alcohol production had returned to regular levels prior to the earthquake, a causal factor in domestic violence at a time when households are already under abnormal stress. As girls and women walk longer distances in search of firewood, water and fodder for the cattle, their vulnerability to sexual violence is amplified, especially in light of the breakdown in forest monitoring systems. The destruction of toilets is particularly challenging for women and girls not only from health, sanitation and hygiene point of view but also in terms of security and safety as they will have to wait until dark to relieve themselves and this also makes them vulnerable to sexual violence. As users and managers of forest resources, women are proactive in prohibiting the misuse and protecting coveted forest resources. In normal times there have been attacks on CFUG women leaders when they have followed CFUG rules and attempted to tackle unlawful extraction of forest resources. The post-earthquake situation poses heightened risks and vulnerability of CFUG women leaders to gender based violence (GBV) in the absence of mechanisms to respond to cases of GBV in the forestry sector. This is of particular concern, as the demand for wood during post-earthquake reconstruction may result in choices made by the majority male members of CFUGs to produce construction timber rather than wood that meets household consumption needs. This could also lead to an increase smuggling of wood and possibly deforestation. Such trade-off decisions may result in violence as has been seen in the past when women have taken the initiative to protect forest resources. This necessitates establishing mechanisms such as Anti-GBV Co-ordination Committees as a priority.

Women's leadership roles in NRM groups: Since the earthquake has led to an extra work burden for women, the capacity of women office bearers in NRM groups to participate in management and attend executive committee meetings has been severely impacted and the gender imbalance in community forest decision-making may well increase. Women's absence in users' committees may affect the use of natural resources both in terms of ensuring household welfare, and sustainable harvesting of natural resources. This may happen in various ways:

- Women suffer from time poverty as a result of the unequal distribution of household and care work, and unequal entitlement to household resources, impacting on women's leadership.
- Women are relatively poor and are therefore more engaged in subsistence livelihood/wage earning which does not leave them time to attend meetings and influence decision-making by stating their position, which is likely to be ensuring welfare of households in the CFUG rather than market oriented activities such as selling of timber products for reconstruction to increase CFUG funds.
- Capacity building initiatives that were encouraging men and boys to engage in promoting women's leadership, which had been successful in transforming the gender division of labor, are likely to decline as efforts are focused on reconstruction, further perpetuating gender stereotypes.
- These dynamics may create a huge gap and reverse the gains achieved in women's leadership roles in users' committees over the past few years.

Poaching and smuggling: Loss of regular livelihoods may make poor people vulnerable to targeting by organized poaching groups to poach and smuggle timber, valuable NTFPs and wildlife. There may be an increase in legal actions against poor poachers and smugglers who will have no legal recourse and face incarceration in jails.

© SSICDC, Gorkha

Photo 15: Women harvesting *Chiraito (Swertia chirayita)* in Barpark, Gorkha

Governance and policy issues: The 2071 Forest Policy and the Community Forestry Development guideline have provisions to enhance access to forest resources by the poor, marginalized, Dalits and those belonging to ethnic groups and women. It also has provisions to ensure their participation and representation in decision-making through a mandatory 50 percent participation of women in forest committees; and representation of women in one of the two posts of President or Secretary. The management participation provision has facilitated participation of women and marginalized groups to a large extent but recently, prior to the earthquake, there was a move to revise the policy on having at least 50 percent representation of women, on the grounds that it was difficult to comply with this provision. This marks a regressive move, and with the earthquake claiming more women's lives, there is a high possibility that decision makers will find further justification to reverse implementation of this rule. This could impact equitable sharing of benefits in the absence of the voice and agency of women and marginalized groups.

Exposure to hazardous materials: Release of hazardous materials into the environment was covered in section 3.4. Exposure to these substances can lead to reproductive health problems such as infertility, birth defects, still birth and miscarriages, and reproductive cancers in both men and women. Chemicals that act as endocrine disrupters can affect the development of fetuses, young children and youth. The poor, who often live in marginal areas and may have a greater exposure to hazardous materials, may suffer the most, for example, by drinking from contaminated ground or surface water; living near to waste disposal sites or on contaminated soil. As the poor do not have the means to secure health insurance and in the absence of safety nets, it will further strain their financial capacities when they seek medical treatment. This will lead to penury and social exclusion of these vulnerable groups.

3.13.2 Recommendations for green recovery and reconstruction

Recommendations: Gender and social inclusion	
Near term (Now to April 2016)	1. Promote the use of alternative energy and energy efficiency in reconstruction, reducing reliance on fossil fuel and firewood, and reducing women's work loads and health risk. Types of alternative energy include biogas, improved cook stoves, metal stoves, micro-hydro and solar power, depending on household location and situation. 2. Prioritise restoration of water supplies to reduce women's and girls' workloads. This will also enable girls to concentrate on their education for securing a better future. 3. In line with the government's commitment to declare Nepal an Open Defecation Free Zone, accelerate the building of toilets in villages and schools particularly for girls and women to ensure their safety and privacy, and improve environmental health. 4. Activate security cells and impart training to forestry and security personnel on protecting and promoting women's human rights and their right to freedom from violence. 5. Ensure that new housing projects place equal emphasis on housing needs of the poor and are not built near dump-sites or landfills which pose health and sanitation risks. 6. Reconstruction policies vis-à-vis land reforms and land distribution must take into account issues regarding women's control over natural resources and the products such as trees, crops, animals, shrubs, food, timer, medicine etc. as most of the women are actively engaged in subsistence agriculture. Extra care must be taken to ensure that poor women and marginalized families are not given land that has low agricultural productivity in the absence of their voice and agency in decision-making.

Recommendations: Gender and social inclusion	
	7. Incorporate women and marginalized groups' vulnerability to climate change in recovery and reconstruction plans in order to build their resilience and help them to adapt. 8. In order to build back safer, better and greener, fundamental principles of human rights must form the basis of all recovery and reconstruction efforts (universality, indivisibility, equality, transparency, accountability, participation and non-discrimination regardless of sex, gender, race, creed class and caste). Recovery and reconstruction strategies should prioritize meeting practical gender needs of the most vulnerable populations while addressing strategic gender interests in the redistribution of roles, responsibilities, resources and power to redress historical disadvantages, in line with international conventions to which Nepal is signatory.
Longer term (May 2016 to April 2020)	9. Promote and monitor the implementation of 2071 Forestry Policy and guidelines provisions to mainstream GESI issues, enhance women's leadership in community forests for alleviating poverty and achieving gender equality. 10. Nepal is a leader on gender budgets and planning should continue to incorporate gender budgets to prioritize the practical needs and strategic interests of women, children, poor, marginalized and the socially excluded groups such as the sick, elderly, and differently-abled people. Gender budget audits should be a regular practice of monitoring effective and equitable implementation of all development plans and programs including aid effectiveness particularly in the environment, forestry and agriculture sectors.

CHAPTER 4

Policy and Governance

4.1 Policy and Governance Challenges for Recovery and Reconstruction

This section outlines general challenges for recovery and reconstruction due to policy and governance constraints. Further discussion of policy and governance is contained in Volume 2.

Weak implementation of policies and legislation: Although the National Strategy for Disaster Risk Management (NSDRM) was adopted by the GoN in 2009, most of its strategic activities are yet to be implemented. The REA team found that district level stakeholders responsible for disaster risk management (DRM) are not familiar with the NSDRM, and it is not being effectively implemented by DDCs or VDCs. The National Building Codes have been only partially implemented by a small number of municipalities, and there is lack of effective monitoring by municipality officials due to limited human resources and rent seeking.

Gaps in policy and legislation: Laws on disasters and relevant institutions are ineffective in anticipating, planning for and reducing disaster risk in order to effectively protect citizens and communities, and their health, livelihoods and natural assets. The main reason is that they tend to focus on rescue and relief rather than disaster prevention, preparedness and reduction. International Federation of the Red Cross and Red Crescent Societies (IFRC) (2011) states that the main gaps in the legal and institutional framework for DRR in Nepal concern disaster management legislation, land use planning and relocation of high-risk communities; and there are legal barriers to the participation of international and national civil society, and community information on impending disasters. The stipulations of the Natural Calamity (Relief) Act, 1982, and the institutional mechanism it has created, were not adequate to manage emergency response during medium disasters such as the Udayapur Earthquake of 1988, or the flood disaster in south-central Nepal in 1993, let alone a disaster on the scale of the 2015 Gorkha Earthquake. The Act, even with amendments, does not incorporate the shifting emphasis from relief to preparedness and mitigation and mainstreaming DRR into the development efforts of the country (Ministry of Home Affairs, 2009). A DRM Bill drafted prior to the adoption of NSDRM it is yet to be enacted.

The Building Act needs to incorporate scientific and technological innovations.

Inadequate institutional arrangements for disasters: The powers and functions of the Central Disaster Relief Committee (CDRC) and District Disaster Relief Committees (DDRCs) are focused on relief rather than the full disaster cycle of preparedness, DRR, rescue, relief, recovery and reconstruction, thus limiting their scope. It is essential to strengthen the Central, District, municipality and VDC level Disaster Relief Committees by providing them with appropriate powers and resources, if the government is still not in favor of establishing a National Commission for DRM, National Authority for DRM, District Disaster Management Authorities, Municipal Authorities for DRM and Village Development Committees as it committed to do in the NSDRM approved in 2009. The PDNA, however, envisages establishment of an institutional mechanism with a line of reporting to Cabinet and other high-level political bodies (NPC, 2015).

4.2 Policy Challenges for Green Recovery and Reconstruction

Enforcement of environmental impact assessment legislation: Environmental impact assessment (EIA) and initial environment examinations (IEE) are the only tools that the GoN has been utilizing to mitigate the potential adverse environmental impacts of development projects. However, they have only been partially implemented due to lack of resources in MoSTE for monitoring and oversight. There has been discussion of suspending the EIA component of the Environment Protection Act during recovery and reconstruction. To avoid significant adverse impacts of recovery and reconstruction activities on the environment, it is essential to comply with the EIA legislation for recovery and reconstruction activities, in order to build back better and safer. Ministries such as Urban Development, Energy, Irrigation, Physical Infrastructure and Transport and the private sector need to sincerely comply with environmental requirements. At the same time, processes need to be accelerated to avoid significantly holding up the reconstruction process.

Implementation of other relevant policies and laws: Most of the officials and representatives of CSOs consulted during the REA felt that the implementation of conservation and disaster related laws and policies have been weak and consequently only partially implemented. There are neither dedicated human resources with required expertise in DRR nor enough financial resources. Another issue is that the political parties have little regard for conservation when it comes to development projects; their approach is to promote infrastructure development projects at any cost.

The Soil and Watershed Conservation Act, which was enacted in 1982 but only entered into force 26 years later in 2008, is yet to be fully implemented. Effective and full implementation of this law could have assisted in reducing the devastating effects of the earthquake in some of the hardest hit districts. In spite of the fact that there have been solid waste management problems in most of the urban areas including Kathmandu, implementation of the Solid Waste Management Act 2011 is very poor in most municipalities.

Priority also needs to be given to enforce more strongly and monitor compliance with environmental requirements in the Solid Waste Management Act 2011, Local Self Governance Act 1999, Environment Protection Act 1996, Forest Act 1993, Pesticides Act 1991 and National Parks and Wildlife Conservation Act 1973.

New legislation: While Nepal has EIA and IEE legislation, it has no provision for environmental assessment of larger scale processes such as complex hydropower development in a whole river basin, or road networks. There is an urgent need to develop and implement a system of strategic environmental assessment to promote more sustainable development, which will be more robust in the face of future hazards.

Integration of conservation and DRM in sectoral mandates: There is no concerted effort to integrate DRR, sustainable development and climate change into the development sector's policies, laws, programs and activities, in spite of the fact that it was the second strategy of the Three Year Plan (2011/12-2013/14) and the sole objective of the Thirteenth Plan (2014/15-2017/18). Sectoral, local, regional and national land-use and development plans and processes that do not take into account ecosystem approaches often accumulate disaster risk and intensify the impacts of natural disasters. It is vital that such plans and processes are aligned with DRR-specific efforts such as ecosystem restoration (Partners for Resilience, 2014) in order to ensure ecosystem services in reducing disaster risk. The government needs to take appropriate measures to reduce exposure to disaster risk for the protection of people, infrastructure and natural and other assets, in addition to mainstreaming biodiversity, environmental considerations and DRR into laws, policies, plans, and scopes of work of the development sector and ministries such as energy, industry, irrigation, physical development and transport, and urban development.

The PDNA's medium and long term priorities include measures to mainstream DRR into the development sector (NPC, 2015); unfortunately it overlooked mainstreaming of environmental considerations. Most of the people consulted by the policy experts in the REA team advised that the government needs to integrate biodiversity, environmental considerations and DRR in the development sector's laws, policies, institutional mandate, programs and projects.

Local government's role in conservation, environmental protection and DRM: The Local Self Governance Act (LSGA) 1999 requires VDCs to prepare and implement programs with regard to forests, vegetation, biodiversity, soil conservation, and environment conservation in the village

development area. They are also required to take action to control natural disasters, and DDCs and municipalities are required to work on disaster prevention. Although the LSGA has been in force for the past 15 years, VDCs, municipalities and DDCs have not given priority to preventing deforestation and forest degradation; nor have conservation and DRR generally been integrated in the local development planning process. Nevertheless, some DDCs, municipalities and VDCs have started good initiatives such as the preparation of DRM plans that also address climatic hazards, implementation of community based disaster management programs, and training (DPNet Nepal, 2013). Immediately after the earthquake, local government structures reoriented their work to coordinate relief work initiated by the government as well as NGOs (NPC, 2015).

The new Guideline on Environment Friendly Local Governance (EFLG) Framework, published by Ministry of Federal Affairs and Local Development (MoFALD), aims to help local authorities to design and integrate environmental activities into their 14 step planning process, and help households use environmentally friendly practices. Empowering DDCs, municipalities and VDCs with powers and functions by law for conservation and DRR and institutionalizing them should be very effective at the local government level both for conservation and DRR.

Community based conservation and DRM: Many rural communities are scattered in rugged terrain and difficult to reach after a major disaster; yet efforts to promote community based disaster management are almost non-existent. This is in spite of the fact that local communities are in most cases the first responders when a disaster happens; most top-down risk reduction programs fail to address the specific needs and demands of at-risk communities; and local actors have skills, knowledge and resources which are often underutilized in DRR interventions by external actors (Partners for Resilience, 2014). Almost all the government officials and NGO representatives consulted during the REA recommended promotion of community based disaster and environmental management through policy, legislation, capacity building and financial resources.

4.3 Recommendations for Green Recovery and Reconstruction

Recommendations: Policy and governance	
Near term (Now to April 2016)	1. Strictly enforce environmental impact assessment (EIA) and initial environment examinations (IEE) during recovery and reconstruction. 2. Raise awareness about the EIA/IEE process among local communities and others most affected by development projects, including their roles and rights.
Longer term (May 2016 to April 2020)	3. Enact and effectively implement a new DRR law in accordance with the Sendai Framework for Disaster Risk. Reduction that anticipates, plans for and reduces disaster risk in order to effectively protect all citizens including women and marginalized groups, their health, livelihoods, and natural assets. 4. Integrate biodiversity/environmental considerations and DRR in the development sector's policies, legislation, institutional mandates, programs and projects. 5. Ensure that the provisions of policies, plans and laws (including DRM, biodiversity and environment) are effectively complied with and implemented in order to ensure disaster risk prevention, preparedness and reduction, as well as greener recovery and reconstruction. 6. Strengthen the role of local governments to enable them to mainstream conservation and DRR by revising the Local Self Governance Act 1999 and providing necessary human and financial resources.

Recommendations: Policy and governance	
Longer term (May 2016 to April 2020)	7. Empower communities to play a greater role in disaster risk reduction and relief, recovery and reconstruction, ensuring the specific needs of women and marginalized people are covered. 8. Establish a National Commission for DRM, National Authority for DRM, District Disaster Management Authorities, Municipal Authorities for DRM and Village Development Committees as stipulated in the NSDRM. Strengthen them with powers and resources to prevent new and reduce existing disaster risk; develop and implement disaster risk informed policies and programs; tackle disaster risk drivers; prevent and control unsustainable use of natural resources; restore or maintain ecosystem services; and promote building back better, safer and greener after disasters. 9. Develop and implement a system of pollution prevention and control as envisaged in the Environment Protection Act 1996 and Environment Protection Regulations 1997. 10. Develop and implement a system of strategic environmental assessment for Nepal, for complex developments. 11. Enact the Agriculture Management Act and Biodiversity Management Act as recommended respectively by the Strategic Framework for Sustainable Development (awaiting GoN approval) and National Biodiversity Strategy and Action Plan 2014, to ensure conservation of biodiversity, sustainable use of natural resources, equitable benefit sharing, and farmers' rights. 12. Appoint and fund at least two gazetted-level staff (more where needed) to District Disaster Management Authorities and Municipal Authorities for DRM, to ensure compliance with DRR and environment related laws and policies, with authority to prevent any project that is likely to trigger disaster and/or have significant adverse impact on environment. 13. Establish institutional presence of MoSTE at the district level in order to support integration of environmental aspects in development, and provide monitoring and enforcement of environment legislation. 14. Build capacity in environmental legislation in the disaster response sector and ensure that international actors responding to disasters are aware of the legislation.

CHAPTER 5

Action Plan

5.1 Green Recovery and Reconstruction Action Plan

An action plan has been prepared as a follow on to the assessment. The goal of the plan is:

To promote environmentally sensitive measures across all sectors involved in recovery and reconstruction from the 2015 Gorkha earthquake.

The plan is presented at the end of this chapter. Its activities are based on the recommendations presented by sector in Chapters 3 and 4. In order to implement the plan, capacity building, outreach, partnerships, learning, and monitoring and evaluation are required, and these are outlined below.

5.2 Capacity Building

The rapid environmental assessment has shown that while significant environmental damage occurred as a direct result of the earthquake and in the immediate aftermath as people responded to the disaster, there is a high risk of further damage during recovery and reconstruction. At the early recovery phase, now that the immediate rush of the emergency relief work is over, there is a very good and urgent opportunity to build capacity to promote sound practices for reconstruction that take the environment into account; building back not only better and safer, but also greener. Disaster preparedness should also be included, since there will inevitably be future disasters. Capacity building is needed in many institutional sectors including government, donor, contractor, private sector, NGOs and community in order to implement, monitor, and enforce resilient recovery and reconstruction activities in earthquake-affected districts, and build preparedness capacity for future disasters. There are also opportunities to mainstream DRR, climate change and green recovery and reconstruction in curricula of education institutions to raise awareness about disaster risk management including green approaches.

5.2.1 Enhancing government, donor, contractor, private sector, NGO, media and community capacity

During the course of interactions with other sectors working in relief and early recovery, for example the humanitarian clusters, the REA team has encountered broad concern about the potential for further environmental impacts, and interest in practical ways to avoid or mitigate them. This was the same when the Department of Urban Development and Building Construction (DUDBC), the Center of Resilient Development (CoRD) and the Hariyo Ban Program worked together to promote green recovery and reconstruction practices after the serious floods in the western Terai in August 2014. At that time the partners trained trainers at national level and promoted green recovery and reconstruction practices in the affected districts through two field-level training workshops. Roll-out of the practices was being initiated before the earthquake happened.

For the earthquake we propose a similar approach but on a larger and more comprehensive scale. Recommendations from the REA will be incorporated into the training, which will be as practical and relevant to Nepal as possible.

Green recovery and reconstruction training program: There will be a formal training series that is likely to take the form of cascading capacity building courses, starting with national level training of trainers and cascading down to district and local level. While the main focus of the training will be on green recovery and reconstruction after the earthquake, the training will also take into account other types of disasters including flooding. It will also incorporate climate change, and preparedness

for future disasters. The cascading training is likely to comprise:

Training for conservation professionals in green recovery and reconstruction: Training on issues likely to arise in the different sectors, and how to work with other sectors to promote green recovery and reconstruction.

Training of trainers at national level: Participants should come from major ministries, departments, national training institutions, and national and international NGOs. Training should cover the principles of green recovery and reconstruction, and disaster preparedness, drawing heavily on the Green Recovery and Reconstruction Toolkit that was developed originally by the American Red Cross and WWF US after the large Asian tsunami in 2004. It has been applied in many other disasters including earthquakes in Haiti and Chile. The training content should be carefully adapted to the Nepali context, and cover the major impacting sectors and practical solutions to avoid or mitigate impacts. It should include field visits to affected areas, where participants design interventions that reduce environmental impacts and promote sound environmental practices.

Training for government departments and humanitarian cluster members: Training should focus on environmental issues and green recovery and reconstruction approaches in individual sectors. Priority clusters are: housing, food security, WASH, health, and education.

Training for other sectors: As needed, training should be provided for members of sectoral associations and unions, for example, trade unions, tourism associations. Training should be held for media reporters and media associations such as the Nepal Forum of Environmental Journalists.

District level workshops: Workshops should be held in the severely affected districts, drawing participants from the District Disaster Relief Committees, district government line agencies, NGOs, networks of civil society organizations, and private sector companies involved in reconstruction. The workshops should focus on practical approaches relevant for the earthquake situation, and include field visits within the districts. They should also emphasize disaster preparedness.

Local level training: Trainers should provide training at local level, including VDC staff, local NGOs and civil society organizations. Training should have a very strong practical focus, based on the local context. Wherever possible, green recovery and preparedness training sessions should be integrated with other recovery events at this level.

Technical training in individual organizations: Trainers who participated in the national level training of trainers course will be encouraged to provide training within their own organizations, as well as taking part in training at district and local levels. For training organizations such as the Council for Technical Education and Vocational Training, which has the potential to promote green practices in the large number of vocational trainings needed for earthquake recovery and reconstruction (e.g. plumbers, carpenters, masons, electricians), opportunities should be sought to mainstream green approaches into the curricula.

5.2.2 Production of training materials

To support the training program, the following training materials should be produced:

Nepal green recovery and reconstruction manual: This is for national level participants (English and Nepali versions), and lays out the issues and provides practical green approaches to avoid or mitigate impacts after a disaster, and promote disaster preparedness. The manual should allow for greater extremes due to climate change. It should include practical tips, and cover the major impacting sectors. Target audiences include government, UN and NGOs involved in disaster preparedness, relief, recovery, reconstruction and DRR.

Specific training materials for different sectors: These are for sectors such as construction; WASH; disaster risk reduction; agriculture and livelihoods; and tourism. They should be produced in English and/or Nepali depending on the target audiences.

5.2.3 Mainstreaming green recovery and reconstruction, DRR and climate change in curricula of education institutions

Nepal is extremely vulnerable to disasters. Besides earthquakes, it is at risk of floods, landslides, avalanches, drought, and other disasters related to its topographical fragility, relatively high population density, high poverty level, and advancing climate change. Inadequate attention to safety and environmental issues during recovery and

reconstruction can lead to increased risk of future disasters. In order to reduce disaster risk, it is very important to increase technical capacity in the country for disaster management that incorporates green approaches. Trainers from relevant educational institutions will be encouraged to participate in the training of trainers workshop, and then to incorporate DRR, preparedness and green approaches into their curricula. For this, a brief assessment of relevant training institutions is needed.

5.3 Outreach

In addition to the formal training, there should be a program of awareness raising and outreach to decision makers, senior government officials, donors, NGO leaders, parliamentarians, media reporters, and other key audiences. The aim is to raise general awareness, and more specifically, to reach key decision-makers who can be instrumental in helping to promote the strategy for green recovery and reconstruction. These include donors, political decision makers, and policy makers. Outreach has already been started as part of the outreach and consultations during the REA.

5.3.1 Outreach to National Reconstruction Authority and other government ministries and departments

Outreach should continue to key decision makers and government staff who will be involved in recovery and reconstruction. The National Reconstruction Authority should be a high priority.

5.3.2 Outreach to donors

Many bilateral and multilateral donors have environmental standards as an integral part of their compliance, but others do not. Even those that do may not be aware of the specific environmental risks in Nepal's recovery and reconstruction. Hence there is an urgent need to reach out to major donors and donor forums to raise awareness of these risks, and help ensure that donor support for recovery and reconstruction is environmentally sensitive in order to promote a better, safer and greener Nepal.

5.3.3 Outreach to communities

Local community members should be informed about environmental risks during recovery and reconstruction, including reconstruction of houses since they will be contracting and overseeing masons and others who rebuild for them. They should also be informed about opportunities, for example cash for work and livelihood development activities that are environmentally friendly. They should also be made aware about any earthquake recovery related loans and grants that can help them re-establish their lives and reduce dependence on natural resources.

Outreach materials

As part the of outreach efforts, communication materials should be produced, including briefing sheets for government departments and humanitarian clusters that are likely to impact the environment, on issues and ways to reduce impacts. This should build on the briefing sheets that have already been produced for the education, food security/livelihoods, shelter and WASH sectors.

5.4 Private Sector Involvement

Private sector involvement, and public-private partnerships should play a big role in ensuring that recovery and reconstruction is environmentally sensitive. The private sector will be heavily involved in recovery and reconstruction, both building back businesses affected by the earthquake, and in reconstructing, repairing and/or retrofitting buildings and infrastructure affected by the earthquake. There is good potential to work with the private sector to promote green practices, where these practices make sense economically, and/or where companies see an advantage to adopting corporate social and environmental responsibility. There is a growing involvement of the private sector in environmental issues in Nepal, as evidenced for example through the work that WWF Nepal is doing with trade unions, and the payments for ecosystem services being developed in the Phewa catchment with the Hotel Association of Nepal. There is an urgent need to identify key private sector segments involved in the recovery, and companies and trade associations likely to be 'early adopters' of green practices. Trade associations can play an important role in informing their members and encouraging best practices. Once leverage points have been identified, work can be planned and started.

5.5 Monitoring, Evaluation and Learning

Monitoring of the environmental impacts of recovery and reconstruction, and the application of green practices contained in the implementation plan of this assessment, will be led by MoSTE. Environmental monitoring should be embedded in all recovery and reconstruction projects. Evaluation of recovery and reconstruction work should include environmental aspects; and where needed projects that are found to

be having significant environmental impacts should be modified in order to mitigate impacts.

Since green recovery and reconstruction is a new approach for Nepal, the effectiveness of different approaches should be assessed, and lessons learned about which approaches work well, which do not, and why. Results should be documented and communicated in a timely way so that those involved in recovery and reconstruction can use adaptive management to change their work accordingly. Lessons will be relevant for GoN agencies, NGOs, donors, local communities, community based organizations and their networks, the private sector, and academic organizations. The media can play an important role in communicating about green recovery and reconstruction approaches. As well as Nepali audiences, results should be communicated beyond Nepal to help build the growing body of global knowledge on green recovery and reconstruction.

5.6 Action Plan

The action plan is presented in Table 4 below.

Table 4: Action plan for post-earthquake green recovery and reconstruction

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Land use planning	NRA	NPC, MoLRM, MoFSC, MoHA, MoFALD	
Train local GoN agencies (DDCs and VDCs) on post-earthquake land use planning			ST
Harmonize and promote standardized methodologies for landslide inventory, and for hazard, vulnerability and risk mapping/assessment and land use planning			ST/LT
Prepare land use plans for disaster-affected communities and households			LT
Review and implement Land Use Policy and land use legislation, incorporating geo-hazard mapping in land-use planning			ST
Capacitate DDCs and VDC to update and implement land use plans			ST/LT
Disaster risk reduction	NRA/MoHA	MoSTE, NPC, Donors, CSOs, NGOs, Private Sector	
Monitor hazards including glacial lakes and potential landslides, and install early warning systems in strategic sites for floods			ST/LT
Review, revise and roll out the National Strategy for Disaster Risk Management			ST/LT
Develop comprehensive disaster management legislation			LT

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Identify and support disaster-affected people relocated from hazard-prone areas			I/ST
Landslide recovery	NRA/MoFSC	MoUD, MoFALD, MoAD	
Assess landslides and prioritize them for treatment			ST
Launch immediate recovery programs for landslides threatening settlements, farms, infrastructure, other economic developments and important biodiversity sites			ST
Drain water safely from above as well as the sides of landslides and cracked areas before implementing stabilization measures			LT
Capacitate local community to promote low cost bioengineering techniques for shallow landslides			NF
Promote native species that are climate resilient and appropriate for specific sites			NF/LT
Buildings and settlements	NRA/MoUD	MoSTE, MoLR, MoHA, MoI, NPC, Donors, Private sectors	
Promote reuse and recycling of construction debris for building materials			ST
Encourage use of materials and technologies that increase safety and reduce environmental and health impacts			ST
Ensure minimum national environmental, health and safety standards in brick manufacturing			ST
Develop clusters of brick kilns in districts adjacent to the Kathmandu valley, with IEEs or EIAs, and avoid productive lands including agricultural land and biodiversity important areas			LT
Ensure minimum national environmental, health and safety standards while extracting building materials			ST/LT
Enforce building codes and norms during new construction, repair of damaged buildings, and retrofitting			ST
Waste and hazardous material management	NRA/MoSTE	MoUD, MoLD, MoHP, MoI, NPC, Donors, NGOs, Private sectors	

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Develop environmentally sound solid waste management systems for all urban areas and rural settlements, and for housing construction projects in the affected districts			LT
Conduct a rapid inventory of sources of hazardous materials, including healthcare, industrial, agrochemical, and household hazardous wastes			I
Approve and implement healthcare waste management regulations and hazardous material management regulations to ensure safe handling and disposal of hazardous materials and wastes			ST
Continue ban on import, sale, distribution, storage and use of asbestos and products containing asbestos			I/ST/LT
Introduce integrated pollution prevention and control regulations that require all polluting industries and other activities to obtain environmental permits			LT
Develop national guidelines for chemical laboratories and facilities dealing with toxic chemicals and increase capacity for enforcement			NF
Establish a Special Economic Zone or Industrial District for Handicraft Industries with facilities for proper storage of toxic and heavy metals, and provide continuous training to workers for prevention of pollution			LT
Provision for mandatory requirements for energy efficiency and use of environmentally friendly technologies and materials in the forthcoming Building Codes			LT
Develop guidelines for auto workshops to prevent the release of toxic pollutants and enforce the occupational health and safety guidelines			I
Strengthen the capacity of MoSTE - Department of the Environment to enforce and monitor environmental regulations			I
Build national capacity to manage hazardous materials released during industrial accidents and natural disasters			I
Roads and trails	NRA/MoPIT	MoFSC, MoFALD, MoAD, NPC, Donors, Private sector	

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Undertake holistic geographical/geological analysis in the locality of damaged roads, and incorporate findings into design to ensure the sustainability of local/national roads			LT
Ensure adequate investment in road design			I
Ensure standards for road construction including drains, cross drainage, causeways, culverts, bridges and avoid natural drainage systems, wetlands and water supplies during both construction and operation			ST/LT
Capacitate and engage local labor for road and trail reconstruction, for example using cash for work programs			ST
Minimize earthworks/earth movement i.e. cutting and filling, and prevent sediment runoff and erosion during construction			I/ST/LT
Stabilize cut slopes, using bioengineering where feasible			I/ST/LT
Amend Public Road Act to integrate and mainstream biodiversity, environment and forest conservation, and DRR			LT
Energy	NRA/MoEN	MoI, MoFSC, MoAD, NPC, Donors, NGOs, Private sectors,	
Promote low carbon development practices during reconstruction			NF
Promote energy efficiency measures (solar, biogas, ICS as appropriate) in new and renovated buildings			NF
Promote local electrification through domestic solar panels			LT
Undertake assessment of downstream and upstream impacts while re-establishing existing hydropower projects and licensing new ones			LT
Promote small scale/micro hydropower over large scale hydropower			LT
Ensure that dams in storage reservoirs are earthquake resistant to avoid downstream floods			LT
Promote the transfer of environmentally sound and cleaner technologies in industry			NF

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Rapidly deploy alternative energy in areas where it is most needed in post-disaster situations			I
Water, sanitation and health	NRA/MoH	WECS, NPC, Donors, Private sectors	
Ensure safe construction of latrines (at least 30 m horizontal distance from water sources, with the bottom of pit a minimum of 2 m above groundwater table)			I
Support improved, appropriate technology when reconstructing water supplies and sanitation systems, including water use efficiency, rain water harvesting tanks, septic tanks, treatment wetlands, and multiple use systems where feasible			I
Inventory water sources including new sources, sources that have dried up, and sources with changes in flow			ST
Identify water needs, and assess environmental impacts of extraction, particularly in areas where changes have occurred			I/NF
Promote sustainable, environmentally appropriate levels of water extraction, coupled with water efficiency measures when needed			ST
Design interventions to avoid/resolve conflicts among water users			I
Include sustainability plans for all WASH interventions in consultation with the community, especially women			LT
Ensure proper storage and disposal of hazardous materials arising from WASH activities such as water treatment chemicals and sludge			ST/LT
Promote IWM and IWRM in the recovery and reconstruction phase			ST/LT
Agriculture	NRA/MoA	MoFSC, NPC, Donors, NGOs	
Support resettlement in small clusters close to people's areas of origin with access to their own farm lands			ST
Distribute only tested crop varieties and livestock breeds			I

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Establish seed banks to fulfill needs during future disasters			ST
Develop early detection and surveillance systems for spread of IAPS, disease and pests, and take immediate action to control them			NF
Promote organic agriculture and capacity building for composting			ST
Support intensive agriculture under protected structures to reduce the possibility of horizontal expansion of agricultural land			ST
Assess and rehabilitate irrigation schemes taking into account possible impacts on freshwater biodiversity, water demand for agriculture, and addressing risk of transmitting waterborne diseases from livestock to wildlife and vice versa			LT
Engage local expertise and people in the recovery and reconstruction process			ST
Livelihoods	NRA	MoT, MoI, NPC, Donors, NGOs, private sectors	
Support recovery of nature-based tourism, reconstructing homestays and lodges, trails and other infrastructure			ST/LT
Promote cash for work programs to affected households to restore their lives and livelihoods			
Support small and medium sized enterprises to restart affected businesses			I
Support rehabilitation of farm and non-farm based micro-enterprises to create employment opportunities for disaster affected communities			LT
Improve food supply chain to ensure a greater quantity of food available in the local market			I
Build capacity to diversify agro and forest-based industries to expand to other products and services, and promote sustainable harvesting practices for forest resources to take pressure off forests			NF/LT
Increase employment opportunities in recovery programs focusing more on green jobs			LT

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Develop guidelines for agriculture land use based on Land Use Policy, 2012			LT
Review and amend policies and regulations to ensure green community infrastructure			LT
Forestry and conservation	NRA/MoFSC	NPC, MoSTE, Donors, CSOs, NGOs, CBOs	
Immediately restore law enforcement in PAs and in GoN and community managed forests, with temporary posts to avoid risk of greater illegal extraction and poaching			I
Rebuild capacity for community forest management, including replacement of lost/damaged equipment, and documents; ensure that important documents are backed up electronically in the future			ST
Revise/implement management plans of PAs taking into account restoration of damaged forests; and special needs of critically endangered species			LT
Promote technologies for improved, seasoned and treated wood products during reconstruction			ST
Make provision for full or partial exemption on royalties for forests products for a few years to help affected forest-based enterprises to recover			ST
Restore landslides and other degraded forest sites			ST
Encourage use of seedlings and saplings from nearby nurseries to avoid the risk of spreading invasive species			ST/LT
Rebuild management infrastructure in PAs and district forest offices, and re-equip them			ST
Build capacity at national level for EIA and IEE			ST
Rebuild tourism facilities in and around PAs avoiding developments that will have an adverse impact on scenic vistas			LT
Promote re-establishment of vegetation cover adjacent to restored trails, using bioengineering where appropriate			ST
Establish long-term socio-ecological and environmental monitoring program in selected areas, including Langtang valley			LT

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Education	NRA/MoE	NPC, MoFSC, MoFALD, Donors, Private secores, Universities	
Highlight green recovery and reconstruction issues such as energy conservation, watershed conservation, and environmental health in classes and in practice during reconstruction of schools			LT
Use local curriculum time and courses on the environment, as well as traditional curriculum subjects			ST
Mobilize child clubs and Eco-clubs to take on environmental activities and issues			ST
Encourage students in higher education institutions to undertake projects and theses on green recovery and reconstruction			LT
Encourage schools greenery programs with tree planting to help stabilize degraded areas or landslides, and/or provide shade in the school grounds or community			ST
Restore and protect water catchments that supply drinking water to schools			ST
Promote rainwater harvesting			ST/LT
Financial sector	NRA/MoF	NPC, Donors, NGOs	
Support recovery of households with loans by restructuring loans or altering the payment schedule to delay repayments			ST
Support small and medium sized enterprises to restart affected businesses			ST
Adopt and strengthen corporate environmental and social responsibility, developing innovative ways to encourage green recovery and reconstruction			ST
Engage donors to ensure environmental conditions in recovery funding, promoting safe and green recovery and reconstruction			ST
Engage banks and financial institutions to ensure IEEs and EIAs are a pre-requisite in developing projects			ST

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Encourage provident and pension fund investment in longer-term 'green' projects, promoting corporate environmental and social responsibility			ST
Climate change	NRA/MoSTE	NPC, Donors, Private sectors	
Consider climate change principles in recovery and reconstruction work, including land use planning, agriculture, DRR, buildings and settlements, solid waste management, roads, energy, water and sanitation, and forestry and conservation			
Enhance capacity and knowledge on climate change resilience and adaptation to promote mainstreaming of climate change into recovery and reconstruction			ST
Promote low carbon development practices during reconstruction, including clean energy technologies for women's health, and environmental benefits			LT
Conduct detailed scientific surveys of all glacial lakes, updating the hazard levels			LT
Develop detailed flood and geo hazard maps for GLOFs and prioritize for intervention			
Develop and install effective and user-friendly early warning systemsfor GLOFs and other floods			
Build in-country capacity to manage the increasing risks of GLOFs			
Gender and social inclusion	NRA/ MoWCSW	MoHP, MoFSC, AEPC Donors, CSOs, NGOs,	
Promote use of alternative energy and energy efficiency in reconstruction, reducing reliance on fossil fuel and firewood, and reducing women's work loads and health risk			ST/LT
Support restoration of water supplies to reduce women's and girls' workloads			ST
Declare Nepal an Open Defecation Free Zone, accelerate the building of toilets in villages and schools particularly for girls and women to ensure their safety and privacy, and improve environmental health			ST
Activate security cells and impart training to forestry and security personnel on protecting and promoting women's rights including freedom from violence			ST/LT

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Ensure emphasis on housing needs of the poor and strictly avoid building housing near dump-sites or landfills which pose health and sanitation risks			ST
Ensure recovery and reconstruction strategies meet practical gender needs of the most vulnerable populations while addressing strategic gender interests in the redistribution of roles, responsibilities, resources and power to redress historical disadvantages			LT
Promote and monitor the implementation of 2071 Forestry Policy and guideline provisions to mainstream GESI issues			LT
Ensure gender budgeting and gender auditing to prioritize the practical needs and strategic interests of women, children, poor, marginalized and the socially excluded groups			LT
Policy and governance	NRA	MoSTE, NPC, CSOs, NGOs	
Strictly enforce EIA and IEE during recovery and reconstruction, and monitor			ST/LT
Raise awareness about EIA/IEE process among local communities and others most affected by development projects			ST/LT
Enact and effectively implement a new DRR law in accordance with the Sendai Framework for Disaster Risk Reduction			ST/LT
Integrate biodiversity/environmental considerations and DRR in the development sector's policies, legislation, institutional mandates, programs and projects			ST/LT
Implement provisions of policies, plans and laws to ensure disaster risk prevention, preparedness and reduction, as well as GRR			ST/LT
Strengthen the role of local governments to enable them to mainstream conservation and DRR by revising the Local Self Governance Act 1999 with adequate human and financial resources			ST/LT
Empower communities and engage them in disaster risk reduction and relief, recovery and reconstruction, ensuring the specific needs of women and marginalized people are covered			ST/LT

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Establish and strength National Commission for DRM, National Authority for DRM, District Disaster Management Authorities, Municipal Authorities for DRM and Village Development Committees as stipulated in the NSDRM			ST/LT
Develop and implement disaster risk informed policies and programs			ST/LT
Tackle disaster risk drivers			ST/LT
Prevent and control unsustainable use of natural resources			ST/LT
Restore or maintain ecosystem services; and promote building back better, safer and greener after disasters			ST/LT
Develop and implement pollution prevention and control system as envisaged in the Environment Protection Act 1996 and Environment Protection Regulations 1997			ST/LT
Develop and implement a system of SEA for Nepal for complex projects			ST/LT
Ensure adequate human resources for District Disaster Management Authorities and Municipal Authorities for DRM, for implementation of DRR and environment related laws and policies			ST/LT
Ensure MoSTE's district level presence to support integration of environmental aspects in development, and monitor and enforcement of environment legislation			ST/LT
Build capacity in environmental legislation in the disaster response sector			ST/LT
Training in green recovery and reconstruction			
Capacitate government departments and humanitarian cluster members at national level and local level			ST
Provide training for other sectors (e.g. infrastructure, tourism)			ST/LT
Provide training at district level for DDRCs and partners			ST/LT
Provide environmental inputs for skill-based training curricula (e.g. masons, carpenters)			ST/LT
Provide GRR training for media and encourage media coverage of GRR work			ST

Major Activities	Responsibility		Timeline I = Immediate (<6 months); ST = Short Term (6 months-2 years); LT = Long Term (2-5 years)
	Lead Agencies	Supporting Agencies	
Outreach	MoESTE	NPC, Donors	
Undertake outreach to National Reconstruction Authority, ministries and departments			ST
Undertake outreach to donors			ST
Training and outreach materials	NRA	MoSTE	
Produce specific GRR training materials for priority sectors			ST
Mainstream green recovery and reconstruction, DRR and CC in education curricula			LT
Produce outreach materials including sectoral briefing sheets			I
Partnerships with the private sector	NRA	NPC	
Develop a strategy to work with the private sector to promote green recovery and reconstruction			LT
Learning and communication	NRA	MoSTE	
Test green approaches, document results and lessons, and share widely			ST
Monitoring and evaluation	NRA	MoSTE	
Develop mechanism to monitor recovery and reconstruction efforts across sectors for early signs of adverse environmental impacts			LT
Promote mitigating actions to address adverse environmental impacts			ST/LT

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3. Gorkha District

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Mr Shiva Kumar Shrestha
Ms Shrimaya Gurung, Barpak
Mr Kamal Shrestha, Child Rights Officer
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4. Kavre District

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Mr Raj Kumar Humagain, DLSO
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Mr Jibanath Nepal, Rayobari, Mahadevsthan
Mr Raj Kumar Humagain – DLSO
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Mr Binod Sapkota – FECOFUN
Ms Shanta Neupane – FECOFUN
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Mr Binod Sapkota, President, FECOFUN
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Mr Murari Sapkota, Local
Ms Prithivi Devi Nepal
Mr Jay Narayan Silwal, District office of women and children development
Different units of Kathmandu University
Ms Rashmi Giri
Mr Rajendra Tuladhar

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Mr Ram Badhur Rana, Deputy Director, Cottage Industries, Bidur
Mr Bharat Babu Shrestha
Mr Rabindra Bohra
Ms Bhula Bhandari
Ms Kamala Nyaupane
Ms Shyam Sundar Shrestha
Mr Khagendra Raj Bhatta
Ms Debaki Rai
Mr Daman Bahadur Lama
Mr Gopal Prasad Lamsal, Fisheries Office
Mr Mahesh Kumar Karn, Fisheries Officer
Mr Singh Narayan Chittarakar, Proprietor, Poultry Farming
Mr Laxman Bajgai, Proprietor, Poultry Farming
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Mr Shree Krishna Pyakurel, Engineer
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District Technical Office; Gharelu tatha Sana Udyog;

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Mr Lok Nath Regmi, Director, Nuwakot
Ms Debaki Rai
Mr Bishwojit Kayastha
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Mr Narayan Jaisi Tiwari, Project Chief, Trishuli
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