September 18, 2011 Earthquake

Joint Rapid Assessment for Recovery, Reconstruction and Risk Reduction

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CONTENTS

FOREWORD

Just as Bhutan was recovering from the devastation of May 2009 floods and September 2009 earthquake, the country was hit by yet another strong earthquake on September 18, 2011. The earthquake measuring 6.9 on the Richter scale, with its epicenter in Sikkim, India, close to Bhutan's western border with India, struck at 6:41 pm. There were three aftershocks of magnitude 5.7, 5.1, and 4.6, respectively, within 30 minutes of the initial earthquake. Damage has been reported in all 20 *Dzongkhags* (districts) of Bhutan. The earthquake killed one person, injured 14, and destroyed a large number of houses, public buildings and cultural and religious monuments. Approximately 7,965 homes were affected, with Haa, Paro, Samtse, and Chhukha *Dzongkhags* reporting the most damage.

With the support of the Royal Government of Bhutan (RGoB) at the central and *Dzongkhag* levels, His Majesty's Welfare Office, and the Royal Bhutan Army, immediate relief assistance was mobilized. Damage caused by the earthquake was greater than initially estimated, thus exceeding the capacity of the Royal Government to respond on its own. On September 22, 2011 the UN System in Bhutan was requested to provide support for immediate relief and long-term reconstruction. In particular, RGoB requested technical assistance for carrying out a needs assessment in-line with international standards to provide a basis for planning short-, medium- and long-term recovery and rehabilitation efforts and mobilize resources.

In response to this request, external experts from UNDP's Bureau for Crisis Prevention and Recovery (BCPR), the World Bank/Global Facility for Disaster Recovery and Reduction (GFDRR), the UN Office for the Coordination of Humanitarian Affairs (OCHA), national experts from the resident UN Country Team (UNDP, UNICEF, WFP, and WHO), and RGoB ministries and agencies were mobilized to provide an overall assessment of the total damage and loss caused by the earthquake, as well as any residual humanitarian and early recovery needs. The Joint Rapid Assessment team was fielded on October 2, 2011. The team visited a representative sample of affected communities and structures in the four most affected *Dzongkhags* of Paro, Haa, Chhukha, and Samtse from October 5-12, 2011, and held consultations with the Royal Government officials at the central and *Dzongkhag* levels.

This Joint Rapid Assessment presents preliminary cost estimates for loss and damage as a result of the earthquake and estimates recovery and reconstruction costs. It identifies priorities for early recovery, reconstruction, and disaster risk reduction, and presents an implementation plan and time-line for addressing them. Drawing on international expertise of the UN System and the World Bank/GFDRR, and on lessons learned from recent disasters, the report identifies priorities for early recovery, reconstruction, and disaster risk reduction, and presents long-term challenges for achieving improved building and development planning practices. Finally, it provides a basis for mobilizing external financial and technical support for the implementation of these initiatives.

Given Bhutan's geographic location in the highly seismic Himalayan range, the country is exposed to serious earthquake risk. Seismically safe construction technology needs to be an integral dimension of disaster risk reduction. The extent of destruction indicates a need for comprehensive measures for 'building back better' in order to make buildings more earthquake resilient. This should form the cornerstone of recovery and reconstruction efforts.

On behalf of the Joint RGoB-UN-WB Rapid Needs Assessment Team, we would like to sincerely thank all who contributed to this report, and offer a particular debt of gratitude to the people in affected villages who welcomed the team with kindness and hospitality while they faced some of the most challenging days of their lives.

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Hon'ble Minister of Home and Cultural Affairs, Royal Government of Bhutan	UN Resident Coordinator UN System in Bhutan	World Bank Representative to Bhutan

EXECUTIVE SUMMARY

Barely two years after the 2009 earthquake in the east, Bhutan was once again reminded of its high vulnerability to seismic risks on September 18, 2011 when the neighboring region of Sikkim, India, was struck by an earthquake of magnitude 6.9 on Richter scale. While the epicenter of the earthquake was on the Indo-Nepal border, it still caused widespread destruction in all the 20 *Dzongkhags* of Bhutan, resulting in one death and 14 injuries. The earthquake also caused varying degrees of damage to nearly 7,965 houses. As a result, a large number of families continue to live in temporary/makeshift shelters outside their homes still suffering from the trauma caused by the large-scale devastation.

In the aftermath of the 2011 earthquake, 345 houses were completely destroyed, 1,660 suffered major damages, and 5,960 suffered minor damages. In addition to houses, religious and cultural heritage monuments including 13 *dzongs*, 119 *choetens* and 355 *lhakhangs* were affected to varying degrees. Several government and public buildings including 47 *gup's* offices, 31 Renewable Natural Resources (RNR) centers, and 47 other public buildings suffered damages. One hundred and seventeen school buildings including extended class rooms and non formal education centers were also affected. Sixty (later revised to 50) health facilities were also reported to have suffered damages.

Response and Relief

The RGoB responded quickly and swiftly. The *Dzongkhag* administrations quickly swung into action within the first few hours of the earthquake to assess the situation and provided immediate relief by the next day. The Royal Bhutan Army and the *doesung* (volunteers) immediately reached out to extend relief assistance to the affected families. The People's Welfare Office of His Majesty (*Gyalpoi Zimpon's* office) also responded immediately by visiting the affected areas and mobilizing relief items. Their Majesties the Fourth and Fifth Kings visited the affected *Dzongkhags* of Punakha, Paro, Haa, Samtse, and Chhukha, and consoled the affected families.

On 22 September 2011, the RGoB put forward an appeal to the UN System for immediate support in the form of 58,000 CGI sheets, 100 winterized tents for schools, and 1,000 dignity kits. In response to the appeal, emergency cash grants of US$ 50,000, US$ 1.6 million, and US$ 75,000 were quickly mobilized through various emergency funding windows from UNOCHA, CERF and UNDP-BCPR respectively. At the time of preparation of this report, the UN agencies had mobilized more than US$ 1.8 million towards meeting the immediate humanitarian needs.

Meanwhile, a request was also made by the RGoB to the UN Resident Coordinator's Office to support recovery and reconstruction upon completion of the relief phase. Following this request from the RGoB, a joint rapid assessment team was constituted with representatives from the RGoB, the UN, and the World Bank. The team comprised of international experts, UN Country Team members as well as government officials from various ministries. The objective of this assessment was to estimate the total damage and loss incurred by the earthquake on the basis of the damage data compiled by the DDM. It was also required to estimate the costs of early recovery and reconstruction and identify strategies for long-term disaster preparedness and risk reduction. The Joint Rapid Assessment mission was fielded from October 2, 2011 to October 19, 2011 with field visits to the most affected areas of Haa, Paro, Chhukha and Samtse during October 5 to 12, 2011. While the overall losses due to the widespread damage was estimated based on data provided by the DDM, field visits provided insights into the context, issues, and challenges involved, besides providing a visual understanding of the nature of damage. The DDM is still engaged in the process of gathering detailed information on the damages from the *Dzongkhags* and reconciling with differences

in damage data due to varying methodologies adopted by the *dzongkhags* for damage categorization. The findings of this report are based on analysis of damage data as provided by the DDM on 22 October 2011.

Damage and Loss

Houses, religious and cultural heritage monuments, and public buildings suffered the maximum and most visible damage in the earthquake. Based on the extent of damage, affected buildings have been classified into three categories: i) category-1: minor damage (repairable); ii) category-2: major damage (repairable); and iii) category-3: total collapse or beyond repairs. In order to estimate the losses from damaged buildings, 100% replacement costs were considered for buildings in category-3, 30% for those in category-2, and 7.5% for category-1. These cost estimates based on Bhutan Schedule of Rates (BSR) 2009 were adjusted to current market rates and also verified in the field.

In the housing sector, as per the latest damage data available with DDM, 345 houses fall in category-3, 1,660 in category-2, and 5,960 in category-1. The total damage to housing is therefore estimated to be Nu. 774 million (USD 15.8 million). This figure is based on current data provided by DDM but is likely to change as the data is refined based on more information from the *dzongkhags*.

According to the latest data provided by the DDM, among government/public buildings, 47 *gup's* offices and 47 other public buildings such as district court, bank and telecom offices, etc. were damaged to varying degrees. The total loss due to damages to government and public buildings is estimated to be Nu. 16.73 million (USD 0.34 million).

Religious and cultural heritage buildings including 13 *dzongs*, 119 *choetens,* and 355 *lhakhangs* suffered damages, thereby causing a total estimated loss of Nu. 340.91 million (USD 6.96 million).

Educational institutions, particularly schools, were affected by the earthquake. Though none have fully collapsed, a significant number of school buildings suffered damages in category-1 and category-2. The total loss due to damages to schools is estimated at Nu. 50.18 million (USD 1.02 million). Nearly 60 health facilities also suffered damages, though none of the damages are severe. The total loss is estimated at Nu. 10.23 million (USD 0.22 million).

Agricultural infrastructure such as RNR centres, and irrigation channels have also been damaged. The total loss due to these is estimated to be Nu. 5.58 million (USD 0.12 million). No damage has been reported so far on water-related infrastructure.

The earthquake has had very little impact on livelihoods except for minor losses due to impact on storage facilities in the damaged houses and disruption of irrigation due to damaged irrigation channels. Some indications of possible psycho-social impacts of the earthquake on the affected population were observed by the assessment team, particularly among school children and young monk in monasteries, during the field visits.

Therefore, based on the data provided by DDM, the total loss to various sectors is estimated to be Nu. 1197.63 million (USD 24.46 million).

Early Recovery

The early recovery needs of the earthquake affected population were ascertained on the basis of analysis of the damage data and discussions with the stakeholders, particularly the people in the affected villages in Haa, Paro, Chhukha, and Samtse. During the field visit, the assessment team met with affected families who have suffered damages to their houses, school children and teachers of the damaged schools, *gewog* and *dzongkhag* officials, as well as the monks and nuns in monastic institutions.

Based on damage data analysis and field observations, it is estimated that about 2,000 semi-permanent/intermediate shelters that would last for a period of about two years would be required to meet the interim housing needs of the affected population. The construction of intermediate shelters would require building materials such as CGI sheets, timber, etc. Community involvement should be an integral part of the construction process. Community participation in the early recovery phase not only strengthens the confidence of those affected to recover fast but also helps overcoming trauma.

Many houses that are in category-3, total collapse/beyond repairs, will require expert advice and guidance on how to dismantle the damaged structure and salvage reusable building materials. Owners of houses in category- 2 would also need guidance and support in salvaging reusable materials from the damaged structures. This would lead to efficient use of resources and also significant reduction in the costs of permanent house reconstruction.

There is also a need for safe and clean interim sanitation arrangements and adequate water storage facilities for people who continue to live in temporary shelters. As most families who have lost their houses are engaged in subsistence farming, storage facilities to store the harvested crop would be crucial in ensuring food security of the affected families.

In addition, communities require psycho-social support to overcome fear and trauma due to the earthquake. Counselors in schools and local health facilities need to be oriented and mobilized to reach out to the affected population.

The total early recovery needs is estimated to be at Nu. 67.6 million (USD 1.38 million).

Reconstruction

On account of the extensive damage suffered by the housing stock, housing reconstruction would constitute the largest part of reconstruction efforts. Considering the large number of damaged houses, spread over all the 20 *dzongkhags,* housing reconstruction would require significant financial and technical support to the affected families in rebuilding/repairing their homes. The reconstruction process should emphasize on repairs and retrofitting of damaged structures without resorting to large scale replacement of the affected houses. This may require accessing the necessary technical expertise from within Bhutan as well as outside. Seismic safety should be a non-negotiable feature of the reconstruction programme. To ensure seismic safety in the rebuilt/repaired houses, in addition to training of artisans, there is a need for socio-technical facilitation of the process by providing guidance and specific solutions for problems faced by the house owners. The reconstruction efforts should also draw from the experiences of the reconstruction process in the aftermath of the 2009 earthquake.

As part of the reconstruction/repairs of affected government and other public buildings, educational institutions, and health facilities, efforts should be undertaken to improve their adherence to regulatory mechanisms such as building codes for improved seismic safety of the physical infrastructure. Towards the incorporation of earthquake resistant features, and improved construction techniques and specifications, an additional 10% of the replacement costs have been included in the reconstruction cost estimates.

It is extremely important to devise/develop a good strategy for repairs and retrofitting of religious and cultural heritage buildings, as these play a significant role in the socio-cultural lives of the Bhutanese. Most of these structures are built using the same technologies as vernacular housing. Therefore, technical details and construction methodology for incorporating seismic safety features in religious and cultural heritage buildings would also serve as useful guidelines in housing reconstruction, repairs, and retrofitting. The restoration/repairs/reconstruction of religious and cultural heritage buildings should

emphasize the protection of the heritage value of these structures without compromising the quality of construction as well as its incorporation of seismic safety features.

Aggregated costs for reconstruction in various sectors have been estimated to be at Nu. 885.98 million (USD 18.1 million).

Disaster Risk Reduction

Bhutan is highly vulnerable to multiple hazards of geophysical as well as hydro-meteorological nature. In order to reduce the vulnerabilities of the population in the long-term, the recovery and reconstruction programme includes in it, a critical component of Disaster Risk Reduction. While it is essential for the reconstruction activities to ensure that vulnerabilities are not recreated, it is equally important to include preparedness and mitigation measures in the overall framework to enhance the value of investments in reconstruction and rehabilitation.

This report provides a wide range of recommendations to strengthen disaster preparedness and risk mitigation in Bhutan. These include – strengthening and activating the network of Emergency Operation Centers (EOCs), preparation of Hazard Vulnerability and Risk maps based on a systematic assessment process, strengthening critical public infrastructure, enhancing school safety with both structural and non-structural initiatives, developing and disseminating safe construction guidelines for vernacular building systems, training of artisans and engineers, development of psycho-social care assessment tools, WASH awareness, etc.

Many of these risk reduction measures require long term investments and will need to be prioritized in the national plan outlay over a period of time. Also, DRR measures will have to be mainstreamed not only through these programmes, but in the regular functions of all the ministries and agencies. The DDM is already working on this aspect through the Disaster Management bill. The bill once enacted will give DRR activities the right impetus. To further implementation of some of the key DRR activities as outlined above, the assessment team has estimated an amount of Nu. 82 million (USD 1.67 million).

Overall Costs and Recommendations

The overall costs estimated for early recovery, reconstruction, and risk reduction are presented in the table below:

S.N.	Programme components	Total Cost (Nu. Million)	Total Cost (USD Million)
1	Early Recovery	67.60	1.38
2	Reconstruction	885.98	18.10
3	DRR	82.00	1.67
	Subtotal	**1,035.58**	**21.15**
4	Implementation Support @7%	72.49	1.48
	TOTAL	**1,108.07**	**22.63**

Note: US$ 1 = Nu. 48.98

The assessment team has made recommendations with regards to resources for the programme, institutional arrangements, disbursement mechanism, capacity building, socio-technical facilitation, and technical assistance for earthquake-resistant construction. While it is important to keep the reconstruction process community-centric, the government needs to provide capacity building, facilitation and monitoring support with the non-negotiable objective of seismic safety. To enable implementation of early recovery, reconstruction and DRR programmes, implementation support costs have been provided. The Joint Rapid Assessment team estimates the total cost of early recovery, reconstruction, and disaster risk reduction at **Nu. 1,108.07 million (USD 22.63 million).**

While the total loss due to damage to different sectors is estimated at Nu.1,197.63 million (USD 24.46 million), the total cost of early recovery, reconstruction and disaster risk reduction is estimated at Nu. 1,108.07 million (USD 22.63 million). The difference in the two is due to the fact that some costs for early recovery, reconstruction, and disaster risk reduction will be offset by compensation through insurance claims, *kidu* or self contributions, and recovery of salvaged materials.

Acronyms and Abbreviations

BCPR	Bureau for Crisis Prevention and Recovery
BDA	Bhutan Disaster Assessment
BHU	Basic Health Unit
BSB	Bhutan Standards Bureau
BSR	Bhutan Schedule of Rates
CERF	Central Emergency Response Fund
CGI	Corrugated Galvanized Iron
CPS	Community Primary School
DDM	Department of Disaster Management
DM	Disaster Management
DoC	Department of Culture
DRR	Disaster Risk Reduction
DUDES	Department of Urban Development and Engineering Services
EOC	Emergency Operations Centre
GFDRR	Global Facility for Disaster Risk Reduction
GLOF	Glacial Lake Outburst Flood
HSS	Higher Secondary School
LSS	Lower Secondary School
MoAF	Ministry of Agriculture and Forests
MoE	Ministry of Education
MoH	Ministry of Health
MoHCA	Ministry of Home and Cultural Affairs
MoLHR	Ministry of Labour and Human Resources
MoWHS	Ministry of Works and Human Settlements
MSS	Middle Secondary School
NCDM	National Committee on Disaster Management
NCWC	National Commission for Women and Children

ORC	Out Reach Clinic
PGA	Peak Ground Acceleration
PS	Primary School
RBA	Royal Bhutan Army
RBG	Royal Body Guards
RBP	Royal Bhutan Police
RGoB	Royal Government of Bhutan
RICB	Royal Insurance Corporation of Bhutan
RNR	Renewable Natural Resources
RWSS	Rural Water Supply and Sanitation
SOP	Standard Operating Procedure
SPBD	School Planning and Building Division
SQCA	Standards Quality Control Authority
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USGS	United States Geological Survey
VHF	Very High Frequency
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization

INTRODUCTION

On 18 September 2011, an earthquake of magnitude 6.9 on the Richter scale shook the Himalayan region including Bhutan at 6:41 pm, the epicenter of which was near the Indo-Nepal border in Sikkim, India. All 20 *dzongkhags* (districts) of Bhutan suffered varying degrees of damages to homes, social infrastructure including schools, basic health units/outreach clinics, hospitals, administrative offices, *dzongs*, *lhakhangs* (temples), monasteries, and *choetens*. The earthquake caused 1 fatality and inflicted injuries to 14 people.

The Royal Government of Bhutan (RGoB) made an official request for assistance to the UN System in Bhutan, including a request for fielding a mission to the affected areas to conduct a joint rapid assessment of damage and losses in order to determine the extent and cost of the damages, and identify recovery and reconstruction needs. It was also requested that the mission assess the early recovery assistance needs of the affected population.

A Joint RGoB-UN-WB Rapid Assessment team was mobilized through support from UNDP/BCPR, UNOCHA, and the World Bank. The Joint Rapid Assessment mission conducted field visits from 5 -12 October 2011 to the four worst affected districts of Haa, Paro, Chhukha, and Samtse which suffered approximately 60% of the total damages to houses. Before the field visits, meetings were held with representatives from the Ministry of Home and Cultural Affairs (MoHCA), Department of Disaster Management (DDM), Department of Urban Development and Engineering Services (DUDES), Ministry of Works and Human Settlements (MoWHS), Ministry of Education (MoE), Ministry of Health (MoH), Dept. of Culture, Bhutan Standards Bureau (BSB), Ministry of Agriculture and Forests (MoAF), National Commission for Women and Children (NCWC), etc. to understand the damage context and extent.

After the field visits, data on damages was compiled with support from the DDM. Sectoral inputs were received from different team members. Through analysis of data, field observations, and key discussions, the assessment team compiled this report describing the extent and nature of damages caused by the 18 September 2011 earthquake, and the impact on various sectors including the extent of damage and loss. The report also presents the early recovery, reconstruction, and risk reduction needs for faster recovery and building resilience of the affected population.

The report has been organized into six sections. Section I, Context, which is introductory in nature, presents information on the disaster and its impact, the details of relief/response, the nature and composition of the Joint Assessment Team, and the methodology for estimation of damages and losses. Section II, Damage and Loss Assessment, provides the sector-wise analysis of damages and losses, and presents an aggregated financial figure of damages and losses.

Section III, The Way Forward - Early Recovery, highlights key considerations for early recovery in eight selected sectors, and presents a cost estimate for all the important early recovery interventions. Section IV, The Way Forward - Reconstruction, provides a detailed outline of the proposed reconstruction programme, describes enabling mechanisms for its implementation, and provides cost estimates of reconstruction in all the key sectors. Section V, The Way Forward - Disaster Preparedness and Risk Reduction, suggests a Disaster Preparedness and Risk Reduction Strategy and Action Plan, particularly with reference to preparedness and risk mitigation investments, institutional capacity building, and key risk financing considerations.

Section VI outlines the total costs and key recommendations for implementation of the Recovery, Reconstruction, and DRR programme in Bhutan.

OBJECTIVES, SCOPE, AND METHODOLOGY

Objectives

The objectives of the Joint Rapid Assessment mission are the following:

a. To assess the damage and loss, in the aftermath of the earthquake, with particular attention to classification of the level of damage so as to enable provision of further relief and early recovery assistance to the affected population, and to assess the recovery and long-term reconstruction requirements, and

b. Prepare damages and needs assessment report that would serve as the basis for the formulation of a recovery and reconstruction programme as well as mobilization of resources by the Royal Government of Bhutan (RGoB) and development partners.

Scope

Through a representative sample of houses, religious and cultural heritage structures, educational and health infrastructure across the various damage categories in the four worst affected *Dzongkhags* (districts) of Haa, Paro, Chhukha, and Samtse, the assessment mission would identify the needs of the affected population with regard to relief, early recovery, and recovery and long-term reconstruction. The team would prepare a post disaster needs assessment cum damage and loss assessment report for use by the Government and Development partners to help prioritize assistance and serve as a basis for the mobilization of resources.

It would facilitate the translation of the assessment findings into instruments for early recovery, reconstruction, and long-term risk reduction by providing:

- inputs into the formulation of the interagency early and long-term recovery strategic framework, and
- support to the preparation of a strategy for early and long-term recovery, including resource mobilization and planning implementation.

The assessment drew upon the damage data provided by DDM, RGoB, for all the 20 *dzongkhags* as of 22 Oct 2011. The full extent of damages is yet to be ascertained as new information and updates on damage data is still being shared by the various *dzongkhags*. The report may be modified at a later stage to reflect any changes in data.

Methodology

Damage assessment methodology adopted by the team made use of data compiled by the DDM and other RGoB sources for various sectors. The team looked into key sectors that were affected by the earthquake such as housing, government and public buildings/infrastructure, religious and cultural heritage buildings, educational and health facilities, water and sanitation, as well as agriculture and other livelihoods. The assessment mission did not come across any significant impact of the earthquake on livelihoods other than the damages to irrigation channels that might affect the last round of irrigation of the paddy fields that might have some impact on the overall productivity. Therefore, no detailed damages/losses assessment was carried out for the livelihoods sector. Similarly, in the case of infrastructure such as roads, commercial buildings, power lines, etc. due to the absence of any reported data on disruptions to such infrastructure, they were not included in the detailed damage and loss assessment.

The assessment of damages to buildings/infrastructure was based on a standardized classification of the levels of repairs required in three damage categories as specified by the DDM. The DDM has been working on assessment methodologies and after deriving lessons from the 2009 earthquake, it has been decided to collect damage data in three categories as follows:

i) Category I (Minor Damage/Repairable) – This includes slight damage to the structure in the form of a few small cracks, which do not pose any structural threat and can be easily repaired. This may include fall of the plaster, small cracks in walls, diagonal door and windows cracks, hairline corner cracks, and shifting of some roof elements. It may also include partial failure of some non-structural elements of the building. DDM has categorized it as slight to moderate damage.

ii) Category II (Major Damage/Repairable) – This category includes significant damage to the building including sometimes partial collapse of some wall or other key elements. Though damaged, most of the walls remain in plumb. The structure doesn't require to be pulled down and can be rebuilt by repairing or replacing some parts. DDM has categorized it as substantial to heavy damage.

iii) Category III (Total Collapse / Beyond Repairs) – This category includes those buildings that have been so severely damaged and have either collapsed or need to be pulled down. Structures in this category would need replacement. This damage category includes multiple failures to various supporting structural walls of the building. DDM has classified this category as Near/ Total Collapse.

The damage data compiled on damage categories as defined by the DDM was used to develop an overall picture of nature and extent of damage. By considering replacement value for damaged structure, overall estimates of damages were arrived at.

The Joint Assessment team comprised of representatives from the Royal Government of Bhutan namely the DDM, Ministry of Health, Ministry of Education, and Department of Culture, UN agencies (UNDP, UNICEF, WFP, and WHO) in Bhutan, and international experts from UNDP/BCPR, UNOCHA, and the World Bank (GFDRR). The RGoB extended support in data collection, provision of necessary information and assistance, as well as logistical support to the assessment team.

The assessment team held initial briefing meetings with officials from the Ministry of Home and Cultural Affairs (MoHCA), Department of Disaster Management (DDM), Ministry of Works and Human Settlements (MoWHS), Department of Urban Development and Engineering Services (DUDES), Bhutan Standards Bureau (BSB), Ministry of Education, Ministry of Health, National Commission for Women and Children (NCWC) and Department of Culture. These discussions provided insights into the context and the extent of damage as well as the response to the earthquake. It also provided the opportunity to review data and information already collected by the Royal Government of Bhutan. The assessment team also held consultations with the UN Country Team and the development partners. The team was also briefed on the earthquake by the Honorable Secretary, Ministry of Home and Cultural Affairs.

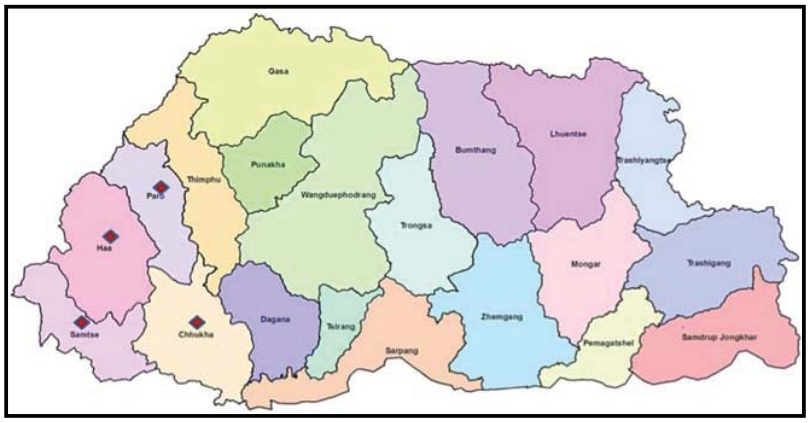
In consultation with DDM officials, a mission program was prepared to visit villages (in 13 *Gewogs*) in the worst affected *Dzongkhags* of Haa, Paro, Chhukha, and Samtse .

The joint rapid assessment mission conducted its work from 03 October to 20 October, including 8 days of field visits and extensive consultations with all concerned RGoB organizations in Thimphu and in the *Dzongkhags*. In order to cover a greater number of villages in the affected *dzongkhags* within the limited time frame, the team was divided into

two sub-groups. Taking into account and the remoteness of many of the affected villages which could only be reached on foot, and recognizing the detailed primary data collection on physical damages undertaken by the RGoB through *Dzongkhag* and *Gewog* administration staff, the joint rapid assessment team, in consultation with the Department for Disaster Management, made the decision of relying on the primary data provided by the RGoB for damages and losses. Thus, the fieldwork was used to gain first hand information on the damages and losses and validate the data provided by the RGoB.

Field Visits

The methodology adopted by the Joint Assessment Mission for its field work consisted of physical visits to earthquake-affected areas followed by discussions with the affected population as well as *dzongkhag* and *gewog* officials. In view of the widespread geographical area affected by the earthquake (all 20 *dzongkhags*), a difficult mountainous terrain, accessibility challenges and dispersed nature of villages and individual dwellings, and the limited timeframe for conducting the assessment, two sub-teams planned to cover the four worst affected districts of Haa, Paro, Samste, and Chhukha as indicated in the map below. The team visited these 4 districts during 5 - 12 October, 2011.



Above: Map of Bhutan indicating the 20 *dzongkhags*, with the 4 worst affected districts visited by the assessment team highlighted

The assessment team used a check-list with sector-wise indicators to assess the damages and losses as well as early recovery and reconstruction needs of the affected communities. Rather than administrating the check-list systematically to affected households and government officials, it served as a general guide. The check-list used by the assessment team is included as Annexure-4. The teams took adequate care to visit a representative sample of households, public buildings, and religious and cultural heritage monuments across the damage categories and elicited information through structured interviews with several groups which included village elders, women, school teachers, and government officials. Provision of temporary shelter, water, sanitation, and health facilities, food security, psycho-social impacts, livelihoods, etc. were some of the issues that were discussed during the visits. Interviews were also conducted by the assessment team members with community members including children and women in order to assess the level of trauma they suffered.

Upon completion of the field visits, consultations were held with concerned stakeholders in Thimphu to share the findings of the assessment mission and to seek comments on the draft assessment report.

Sources of Data

The assessment team received data from various sources. The primary source was the data compiled by the DDM. In addition, the team also gathered data from various ministries. This

additional data allowed the team to validate/verify the data compiled by the DDM. In case of any significant differences or gaps, it was discussed with appropriate authorities and clarified.

In addition to this, the assessment team also used other sources of information such as field observations to validate the data provided by the DDM. During the field visit, primary data on damages and needs were captured through interaction with local community members. The Bhutan Disaster Assessment (BDA) tools were piloted in all 13 *gewogs* of the 4 *dzongkhags* visited by the assessment team.

The data from various sources was reconciled to arrive at the number of affected structures. Descriptions of damages by the *dzongkhag* and *gewog* authorities, and field observations with respect to different categories of damages helped in reconciliation. However, it must be noted that the total number of houses affected in each *dzongkhag* is likely to change as understanding of damage and its categorization lacked in the initial days after earthquake. In order to rectify such problems, all the *dzongkhags* based on directions from the DDM will be verifying the number of houses damaged and the extent of damage as per the prescribed indicators. At the time of preparation of this joint assessment report, damage categorization and number of damaged houses were not finalized.

Bhutan Disaster Assessment Tool

As part of the Joint Rapid Assessment, the Local Authority form of the BDA tool was used to gather baseline data at the *gewog* level. The BDA, a Post Disaster Needs Assessment tool, was developed following the 2009 earthquake that hit Eastern Bhutan and customized to the Bhutanese context to meet the need for a standard format for collecting and compiling data for humanitarian assistance. The BDA is a multi-sectoral disaster needs assessment tool comprising of three tools.

The BDA Local Authority form, which was used by the assessment team aim to provide a more in-depth multi-sectoral overview of key needs and priorities based on information provided at the *Gewog*-level. In total, 11 forms were completed by the assessment team in discussion with *gewog* officials at the 13 *gewogs* in Paro, Haa, Chhukha, and Samtse *Dzongkhags* during the field visit. It was, however, a challenge to obtain the desired information as this was not readily available or known to the *gewog* officials. In addition, due to the nature of impact of the earthquake and the focus on structural damages, attention to other sectors such as transport, communication, food security, and livelihoods, was less pressing or relevant and therefore not yet considered by *Dzongkhag* and *gewog* authorities. Qualitative information gathered through the 11 forms has been incorporated in the report; however, because of the small sample size, the quantitative data was insufficient to make any generic observations on damages and losses for all 20 *Dzongkhags*. For more details about the BDA tool and recommendations for future use, please refer Annexure-5.

Damage Assessment and Valuation

The assessment team arrived at the total damage estimate for structures across the categories based on the replacement value of totally or partially destroyed physical assets. The unit cost of each asset category was provided by respective government departments/agencies. For housing, a detailed costing exercise was also carried out in the field in consultation with house owners and artisans, which was validated by both private and government engineers. After the 2009 earthquake, the assessment team had arrived at Nu 0.55 million as the average unit cost for houses. The costing exercise carried out in Chhukha, and Samtse indicated varying costs ranging from Nu. 0.3 million to 0.75 million. The *dzongkhag* engineer in Samtse also carried out a valuation exercise for the damaged houses. This helped in vetting the unit costs to be used for this assessment. Based on this, the average cost of construction per sq.ft. was worked out to be between Nu 450/sq.ft. and Nu 750/sq.ft. depending on the quality of construction. As there is no data available on the average size of the houses, the average house size used by the assessment team for

calculating the damages and losses was based on field observations. The houses were found to be smaller in size in Samtse (400 to 1200 sq.ft.), compared to the houses in Chhukha, Haa, and Paro (800 sq.ft to 2000 sq.ft.). The assessment team used a cost of Nu. 0.6 million for an average house size of 1000 sq.ft. .

The costs for educational buildings, health facilities, and other government buildings were arrived at either on the basis of construction costs provided by the respective ministries or if unavailable, by using the Bhutan Schedule of Rates (BSR), 2009. These were then adjusted to the present market rates. The current construction rate was estimated to be at Nu. 13,700 per sq.ft. in consultation with the engineers in the team. In case of schools and hospitals where there are clusters of blocks, average cost of two blocks was considered as full unit. This was based on observation of extent of damage, which was minor in most cases, and the replacement value sufficient for repair of the damages.

Through careful observation of the damages in major and minor damage categories as well as estimated costs for the repairs, the losses for these categories were arrived at based on rule of thumb and past experiences of the assessment team. For the three different categories of asset losses, certain percentages of unit cost were applied in consultation with the government officials of respective departments. In case of total collapse and beyond repairs category, losses were calculated on the basis of 100% of the unit cost, as they would have to be reconstructed. In the major and minor damages categories, 30% and 7.5% of the unit cost was applied for calculating asset losses, respectively. The determination of 30% and 7.5% of the unit cost in these categories was arrived at on the basis that the total value derived through these percentages would be adequate for repairing the damages.

The average value of the cost of construction for different asset categories was used as it offered the most practical way of estimating the damages and losses. It provides an approximate basis for calculating damages and losses, however in the absence of a detailed survey, it represented the best approximation.

Limitations

The methodology employed here implies several limitations. The team did not collect the baseline socioeconomic data. In view of the scale of disaster and the limited timeframe for the rapid assessment, it was not possible to undertake such an exercise. Similarly, the assessment has not estimated indirect economic impacts, which arise due to flow disruptions. The impact of the disaster on commercial enterprises was not examined in detail as no interruption to provision of services or price fluctuations were reported and as majority of the households in the affected areas engage in subsistence farming. The affected area has a largely informal rural economy, and the earthquake has not led to output losses of any significance. The earthquake has no macro-economic or fiscal impact of any significance, except to the extent that the RGoB would have to allocate some of the resources for recovery and reconstruction. Therefore, the assessment team did not use the PDNA methodology and did not assess the impact of the 2011 earthquake on macro economic and fiscal parameters.

Although no major disruptions to roads and other infrastructure such as power lines were reported, due to the unavailability of any data on damages to such infrastructure, the team was unable to ascertain the impacts of any possible disruption to these. Similarly, in the absence of gender disaggregated data on earthquake-affected population (including homeownership/ women-headed households), school children, injured, etc. the gender dimensions of the earthquake impacts could not be captured by the mission. However, interactions with community members during field visits to Haa, Paro, Chhukha, and Samste indicated that specific needs of women, children and elderly could be overshadowed by the community's reconstruction needs if sufficient attention is not paid. It also emphasized the need to gather gender disaggregated data at the local level and analyze the earthquake

impacts through a gender lens during the early recovery and reconstruction phases in order to provide them the necessary support.

All twenty *dzongkhags* were expected to complete the second round of damage assessment by 10 October 2011. However, of the 20 *dzongkhags*, only 13 could provide updated information to the DDM by 12 October 2011. After the earthquake, the RGoB decided to reduce the number of damage categories used after the 2009 earthquake, simplify it, and change the indicators for the damage categorizations. Due to lack of training in this regard at *dzongkhag* and *gewog* levels, there is a lot of confusion about damage categorization and varying understanding of the extent of damage across the *dzongkhags*. Therefore, the data collected requires re-verification once the damage categories are refined in terms of damage description and indicators. Due to the discrepancies in data across various *dzongkhags*, the damage details and the categories assigned, the assessment team went through a detailed process of data reconciliation based on data from the DDM, *dzongkhags*, and various ministries/departments in order to arrive at reliable data set. With the data across the various damage categories (as defined by RGoB) likely to undergo further changes, the overall damage and loss presented in the report would require revision based on the latest available data. However, on the basis of overall understanding of damages as observed in the field, efforts have been made by the team to arrive at numbers that seemed reliable and consistent with the situation in the field.

The mountainous and difficult terrain also restricted the ability of the team to cover a large area within the limited time during the field visits.

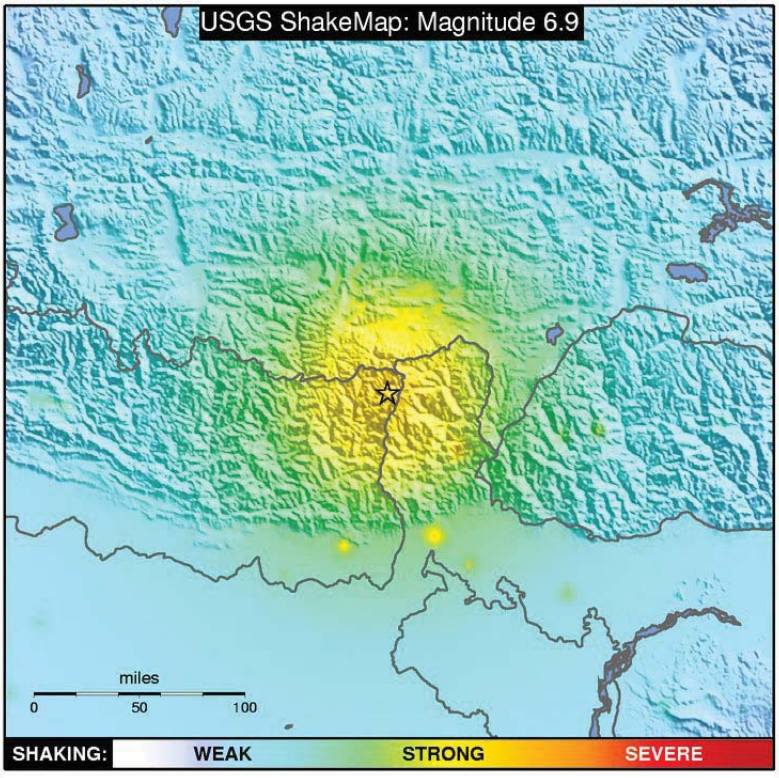
Due to the national holidays (13-15 October 2011, Royal Wedding Celebrations), the assessment team was unable to validate its findings with the Ministries/Departments concerned before the draft report was shared with the stakeholders. The holidays also caused further delay in getting updated damage data from the remaining *dzongkhags* before the stakeholder meetings on 17 and 18 October, 2011.

Stakeholder and High-level consultations were held on 17 and 18 October. Comments from the meetings and also received in writing by 20 October were incorporated in the final report.

SECTION 1: Context

1.1 The Earthquake of 18 September 2011

On 18 September 2011, an earthquake measuring 6.9 on the Richter scale with its epicenter on the Indo-Nepal border close to Mangan, Sikkim (India) jolted the Himalayan region. It was felt across many states of India, Nepal, Bhutan, and Tibet. The thrust of the Indian plate against the Eurasian plate, which has created the Himalayas, the tallest mountain range in the world, also makes the region highly prone to earthquakes. This earthquake was unusual as it was an intra plate earthquake of slip strike type, which means it was caused by horizontal motion within the plate vertical to thrust faults of the Indian and the Eurasian plates. The following map indicates that the shaking experienced in Bhutan can only be considered light to very light based on the Peak Ground Acceleration (PGA) recorded by USGS. Still the damage caused by this earthquake in Bhutan was widespread and significant.



All 20 *dzongkhags* (districts) in Bhutan suffered damages to homes and social infrastructure including schools, basic health units/outreach clinics, hospitals, administrative offices, *dzongs*, *lhakhangs* (temples), monasteries, and *choetens*. The earthquake caused 1 fatality and inflicted injuries to 14 people.

1.2 Seismic Risk Profile of Bhutan

Nestled in the Himalayan ranges, Bhutan has difficult mountainous terrain with dispersed population. Bhutan has a total population of 695,822 and an annual population growth rate of

1.7%. The country is sparsely populated with a population density of 17.9 persons per sq. km.

Due to its unique geophysical characteristics, Bhutan is prone to multiple natural hazards like earthquakes, Glacial Lake Outburst Floods (GLOFs), fire and landslides. Bhutan is located in one of the most seismically active zones in the world, in the Himalayan Mountains, along the boundary between the Indian and Eurasian tectonic plates. The Indian plate is moving northwards relative to the Eurasian plate, pushing the Himalayas upwards as the plates collide. As a result, large earthquakes are frequent in the area. Although a detailed and comprehensive seismic zonation map of Bhutan is unavailable, its proximity to the north-eastern parts of India, which is in the 'most active' seismic Zone V (according to Bureau of Indian Standards), indicates that the majority of Bhutan is either in Zone IV or V.

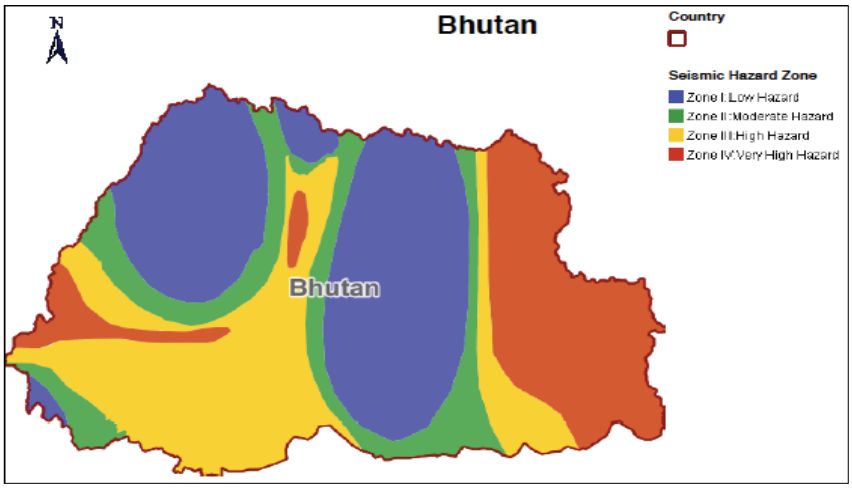


Figure: Seismic Zonation Map of Bhutan, Source: SAARC Disaster Database

During the past 4 decades, the country has experienced several earthquakes of magnitudes in the order of 3.7 – 5.5 as indicated by the epicenters below:

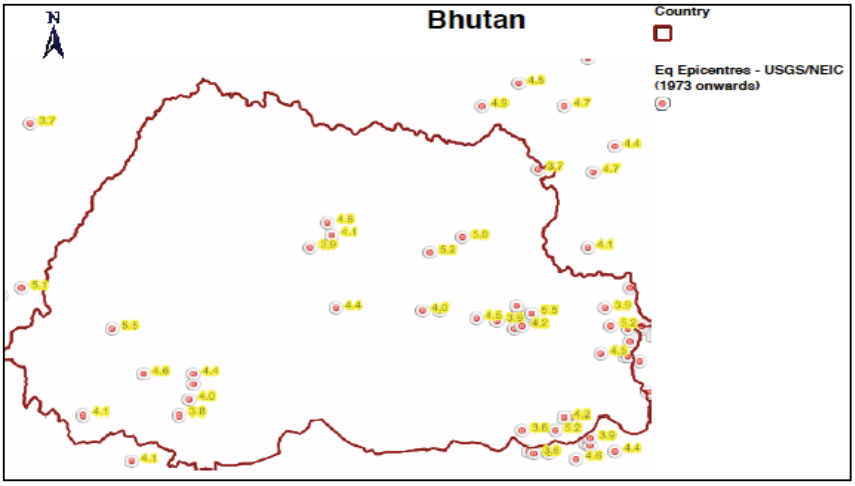


Figure: Earthquake epicenters in Bhutan, Source: SAARC Disaster Database

Though these events did not cause any major damages to lives or assets, in the last 5 years, the country has been impacted by three major earthquakes on 24 February 2006 (5.8), and 21 September 2009 (6.1), and most recently on 18 September 2011 (6.9). The September

18, 2011 earthquake despite the light to very light peak ground acceleration in Bhutan, the extent of damage has been widespread and all the *dzongkhags* have been affected to varying degrees, indicating the high level of vulnerability of Bhutan.

1.3 Immediate Response to the 2011 Earthquake

National Response

Following the 18 September 2011 earthquake, the Royal Government of Bhutan (RGoB) responded quickly and swiftly. In all the 20 *dzongkhags*, the administration immediately set up control rooms and deputed human resources to visit the *gewogs* (sub-districts) and affected villages for a rapid situation analysis. At the request of the Department of Disaster Management (DDM) under the Ministry of Home and Cultural Affairs (MoHCA), the *dzongkhags* directed the *gewog* administrations to launch a rapid assessment of the damages on 19 September. The Department of Disaster Management contacted all 20 *dzongkhags* regarding the impact of the earthquake, based on which a Preliminary Damage Report was submitted to the Government at 01:00 AM on 19 September 2011.

A High-level Emergency Meeting was held on 19 September 2011, chaired by the Acting Prime Minister in-charge (Lyonpo Yeshey Zimba, Minister for Works and Human Settlements). On 19 September 2011, the Prime Minister in-charge, Cabinet Secretary, Home Secretary, and Director, DDM, addressed the nation through a live press conference and committed the Royal Government's immediate support to all affected families. The Acting Prime Minister in-charge, accompanied by the Home Secretary and Director, DDM, visited the most affected *dzongkhag*, Haa, on 20 September 2011, and interacted with the affected communities.

The Royal Bhutan Army and *Doesung* (volunteers) were deployed in all the affected areas to extend immediate assistance to the affected families as per the command of His Majesty the King. The People's Welfare Office of His Majesty (Gyalpoi Zimpon's office) responded immediately by visiting the affected areas and mobilizing relief items. Both their Majesties the 4th and 5th Kings visited the affected *dzongkhags* of Punakha, Paro, Haa, Samtse, and Chhukha.

To meet the immediate needs of the affected population, the DDM in coordination with *dzongkhag* administrations mobilized immediate relief materials like tarpaulin sheets, Corrugated Galvanized Iron sheets (CGI-Sheet), Emergency Kits (UNICEF) and Dignity Kits (UNFPA) and distributed those to the affected *dzongkhags*. *Dzongkhag* officials were also directed by the Gyalpoi Zimpon's office to procure the necessary relief supplies for distribution to the needy families.

In the aftermath of the earthquake, two rounds of structural assessments were carried out in all the *dzongkhags*. The first assessment was carried out by the *gewog* officials in their respective *gewogs* with inputs from the community members, immediately after the earthquake. The second level of assessment was carried out a week later, by a 3-4 member team including 1 sectoral head from the dzongkhag, and 1 engineer. In the case of Paro *Dzongkhag*, the *Gup*s were also part of the assessment teams. A *Gup* from a particular *gewog* was assigned to other *gewogs* to minimize bias. The assessment team conducted field visits to the houses/structures categorized under major damages by the 1st assessment, in each *gewog*. This information from the *gewogs* was then consolidated at the *dzongkhag* level and shared with the DDM. The *Gup*s along with district engineers and other staff of the district administration were given the responsibility to collect information on preliminary damages.

The DDM on 22 September 2011 made an initial request to the UN for support to conduct a Joint Rapid Assessment as well as for CGI-sheets, school-in-a-tent, and dignity kits. On 27 September 2011, the RGoB specified the need for 58,000 CGI sheets, 100 nos. of "school in a tent," and 1,000 dignity kits.

UN Support

The UN Country Team (i.e. the UN Agencies, Funds, and Programs, and the World Bank) offered its support to the RGoB in meeting the immediate and long-term recovery needs of the affected population and in mobilizing additional resources, if required.

Upon receiving the request for assistance from the Royal Government of Bhutan on 22 September 2011, the UN System mobilized a UNOCHA emergency cash grant amounting to USD 50,000 to cover immediate relief needs for temporary shelter, and funds from UNDP-Bureau for Crisis Prevention and Recovery (BCPR) for emergency coordination amounting to USD 75,000, which was approved as of 29 September 2011. In addition, the UN through UNDP and UNICEF mobilized USD 1,605,535, through the Central Emergency Response Funding (CERF) Rapid Response window to cover immediate as well as early recovery needs such as CGI-sheets, Emergency Family kits, and school-in-a-tent. UNFPA has in addition secured USD 106,795 to mobilize 1,000 dignity kits to be distributed to the most-affected population in the *dzongkhags*.

In response to the request from the Royal Government of Bhutan for assistance in assessing the damages and losses and identifying the recovery and reconstruction needs, the UN System in Bhutan fielded a mission to the affected areas to conduct a joint rapid assessment of damage and losses in order to determine the extent and cost of the damages and recovery and reconstruction needs, as well as the need for further relief and early recovery assistance to the affected population. The Joint RGoB-UN-WB Rapid Assessment team was mobilized through UNDP/BCPR, UNOCHA and the World Bank. The team also comprised of officials from the Department of Disaster Management, sectoral ministries/agencies of the government as well as representatives of various UN agencies in Bhutan. The Joint Rapid Assessment mission conducted field visits to the four worst affected districts of Haa, Paro, Chhukha, and Samtse from 5 -12 October 2011.

SECTION 2: Damage and Loss Assessment

2.1 Overview of Damage and Loss

As per the estimates from the Department of Disaster Management (DDM), the earthquake caused damages to 7,965 houses, 117 schools, 60 health facilities, 31 RNR centres, 407 metres of irrigation channels, 13 *dzongs*, 119 *choetens*, 355 *lhakhangs*, and 47 public buildings (including *Gup* offices). The earthquake caused 1 death (due to landslide) and injuries to 14 people. It is estimated that approximately 7% of the total population has been directly affected by the earthquake.

The assessment mission did not come across any significant impact of the earthquake on livelihoods other than the damages to irrigation channels that might affect the last round of irrigation of the paddy fields and therefore have some impact on the overall productivity. Therefore, no detailed damages/losses assessment was carried out for the livelihoods sector. Similarly, in the case of infrastructure such as roads, commercial buildings, power lines, etc. due to the absence of any reported data on disruptions to such infrastructure, they were not included in the detailed damage and loss assessment.

The report presents the findings of the assessment on the basis of damage categorization followed by the RGoB. However, different building typologies in sparse habitations and lack of personnel conversant with the damage categories and assessment process at the *dzongkhag* level necessitates the need for re-verification of the categorization of affected buildings, especially houses. This process is currently under progress and the data might be updated further.

Attempts have been made by the DDM to coordinate with *dzongkhag* administrations to bring uniformity in the assessment methods adopted. Due to confusion about the damage categories and complex nature of damages itself, there have been repeated assessments to categorize the damaged buildings. As significant costs are incurred in the process of data collection, it is important to have a reliable assessment tool. Although it is not possible for the Joint Assessment team to estimate the financial implications of these repeated assessments on the *dzongkhags*, it is clear that due to repeated assessments, authorities have incurred significant expenses and has also overwhelmed the affected communities.

As of 22 October 2011, the latest data was provided by the DDM based on updated damage data resubmitted by the *Dzongkhag* administrations. As per field observations, the assessment team found some inconsistencies with regard to the extent of damage reported. This is most likely due to lack of understanding of local engineers about the possibility of repairing stone masonry and rammed earth houses which has often led to structures in the major damage category be assigned the total/near collapse category. As a result houses with severe damage (that are technically in the major damage/repairable category) were indicated as requiring replacement, thereby inflating the overall damage estimate. Though the numbers of structures in each damage category as provided by the DDM were used for calculation of damage and loss, it is recommended that a rigorous re-verification of damage categories for the affected structures be undertaken after imparting training to *Dzongkhag* engineers in damage assessment. In the joint assessment team's view, the reconstruction/recovery process will be far more cost effective, even with the best expertise in the world providing the necessary guidance, if instead of pulling down the houses (that are not technically in the total/near collapse category), they be repaired, thereby minimizing the wastage of scarce environmental and economic resources. Lack of technical knowledge on how to repair these structures should not serve as the basis for the decision to replace these houses. The field observations in the four most affected *Dzongkhags* do not corroborate

such a need. While indicating clearly the rationale for its disagreement with such an approach for reconstruction, the assessment team has used for the preparation of this report, the data as provided by the DDM since the primary responsibility to arrive at a decision regarding the reconstruction approach/policy lies with the RGoB. Please refer Annexure-8 for note on damage categorization.

2.2 Housing

Housing is the most significant aspect of people's lives that has been affected by the earthquake. 7,965 houses have been reported to be damaged to varying degrees as per the data provided by the DDM on 22 October 2011. The process of collecting data based on damage categorization and field verifications by the district authorities is still going on, and therefore, this data is expected to further get updated as more information is received and the re-verification process is completed. It is important to recognize the complexities involved in the assessment of housing damages due to difficult access, dispersed nature of settlements and houses, multiple housing typologies, and limited human resources.

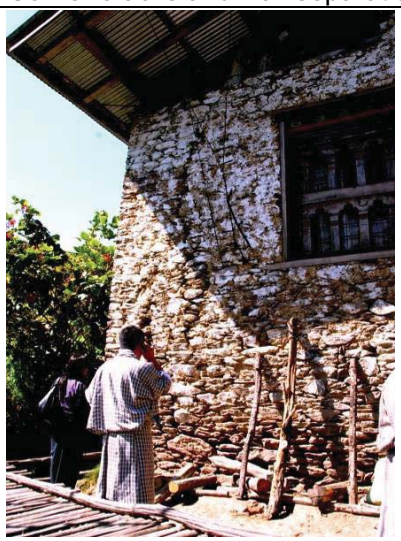
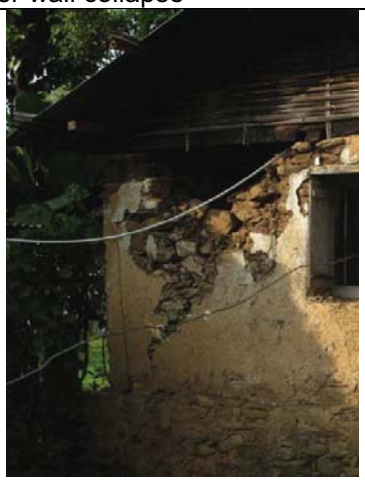
Housing Typologies and the types of Damages

The rural housing stock is a mix of different building typologies. Three predominant methods of construction are: (1) random rubble stone masonry with mud mortar, (2) rammed earth construction, and (3) wooden frame wattle and daub paneled *eckra* construction. For the first two typologies, usually only the outer envelope of the house is made with these technologies forming the main structural walls. Internal walls are wooden frame wattle and daub paneled *eckra* construction. In addition to these three typologies, the team also observed houses with hybrid or mixed typologies where more than two types of walling techniques have been adopted as the main structural system. There are also a small number of houses that use brick masonry or stone masonry with cement mortar.

(1) Houses with Random Rubble Stone Masonry in Mud Mortar

This typology is predominant in many *dzongkhags* of Bhutan, including Chhukha and Samtse. During the field visit, these houses were observed to be the most affected. The houses in Chhukha were generally found to be much bigger than houses in Samtse. During the 2009 Mongar earthquake, many of the affected houses were of random rubble stone masonry.

Some of the common failures in stone masonry houses were wall cracks, corner separation, corner failure, delamination of walls, upper part collapse, bulging of walls, diagonal opening cracks, wall collapse, etc. as illustrated by the pictures in the following pages:

Corner cracks and wall separation	Stone wall gone out of plane
	
Bulging of stone walls	Upper wall collapse
	
Corner collapse	Delamination of stone walls
	

Wall cracks are a result of the stresses within the wall. Where the joints of the wall are not staggered properly, the masonry tends to open up. Diagonal opening cracks occur when the lintel band above the opening is absent. As a result, due to shear stress at the opening, these cracks may appear.

Stone walls are typically thick, with sometimes more than 45cm. Most of these walls are made of two wythes (vertical layer of stones placed on the inner and the outer face during masonry) and the space in between the two layers is filled with smaller stones. Lack of through stones connecting the two faces often results in the two faces – inner and outer – of the walls not being integrated with each other. Due to the earthquake, these two faces (wythes) open up, resulting in bulging in stonewalls. Also, when there are long stone walls without sufficient cross walls to reinforce the structure in shear, the horizontal movement due to the earthquake can cause the long walls to go out of plane.

Corner separation and corner failure are commonly observed earthquake damages in stone masonry walls. If the cornerstones are not long enough, two walls tend to open up at the corners. In case of weak corners, owing to the very high shear stress at the corners during earthquakes, there may also be failure of the corners leading to partial collapse of the corner parts of the walls.

Delamination of stone walls was also observed where the two faces (wythes) – inner and outer – separate from each other and one of these falls/collapses. This is mainly due to poor bonding and lack of through stones.

During the field visit, partial collapse of the upper part of walls was also observed particularly in high structures with 2 or more storeys. The upper part of the wall sways more in an earthquake and therefore, if it is not held together by horizontal bands at the roof level of the wall, the upper part of the wall may partially collapse. This failure if severe can also dislodge roofing.

These were some of the typical damages observed in stone masonry houses. Depending on the extent of damage, these walls can be repaired and retrofitted including partial reconstruction, provided the main structural system of the house holding the timber floors and roofs has survived.

(2) Rammed Earth Construction

The assessment team found this housing typology to be predominant in Haa and Paro, in the western parts of Bhutan. Some rammed earth houses were seen in Chhukha also. Typically these houses are relatively bigger with two storeys. The rammed earth houses have a unique appearance, often reflective of the skills of the builders as well as the choice of soils used for construction. Traditionally, people in this region have a good understanding of the properties of soils, and as a result, many rammed earth walls remain unaffected despite heavy rainfall every year.

Some of the typical damages observed in rammed earth construction were vertical cracks in walls, separation of walls at the corner, tilting of high walls that have separated at corners, diagonal opening cracks, cracks at the point where timber beams rest on the walls, and wall collapse.

Rammed earth construction is a cohesive and integrated walling system. However, there are also limitations because such walls are often brittle and weak in shear, and therefore more likely to develop cracks at the corner separating the two walls. This is primarily due to flaws in the construction methodology. The rammed earth walls are constructed in layers. At the corners, in one layer first wall is made till the outer edge and second perpendicular wall starts from the inner edge. In the next layer, the second wall will be made from the outer edge and

the first wall will be made from the inner edge. This integrates both the walls with each other. However, in order to speed up the construction process and to minimize the effort involved, these rules are often compromised whereby some artisans tend to build the first wall from one side and then add the second wall, weakening the corner joint. During an earthquake, the cracks tend to appear at such joints. Due to severe stress after the separation of walls, corner failures also occur. Also, in rammed earth, when extensions are made at a later point of time, old and new walls are not integrated well. This results in vertical cracks or separation. Once the walls separate, due to the absence of any horizontal tie bands that holds then together from the top, tilting of walls can occur. However, it is possible to repair and retrofit the walls that have separated or developed vertical cracks. In case of tilting of walls, a portion of the wall may be removed and rebuilt.

Some of the typical damages to rammed earth houses are illustrated in the following pages:

Corner cracks	Separation of old and new walls
	
Diagonal cracks at the openings	Separation of corner walls
	

Vertical wall cracks	Corner failure
	

Another typical damage is displacement of *rabsey*. *Rabsey* is typical a full height window, usually placed on the upper floors. It is large and generally rests its weight on the walls. The top part of *rabsey* is usually anchored in the walls to hold it from out of plane movement. However, the assessment team found that *rabsey* is often not anchored very well in the structure and mostly kept in place with its weight only. This in many cases had resulted in the *rabsey* being displaced, leading to gaps from the wall that can however be repaired. This emphasizes the need to improve the anchorage of the *rabsey* with the earth walls.

(3) Wooden frame Wattle and Daub paneled *Eckra* construction

In the western and southern parts of Bhutan, *eckra* houses are commonly found, and this technology is also used in almost all the housing typologies for making partition walls particularly on upper floors. The methodology includes making a rectangular timber frame grid and then filling each rectangle with bamboo lattice. The bamboo lattice is then plastered with mud on both sides commonly known as wattle and daub or *eckra*. From the perspective of seismic safety, this is one of the safest walling methods. The timber frame with wattle and daub panels makes the walls behave like an integrated plane that is strong to resist in-plane shear caused by the earthquakes. Also, being a lightweight wall, it is safe for the occupants, even in case of collapse. This typology is used only for smaller structures. During the field visit, the assessment team did not come across any damage to *eckra* structures.


Figures above: Houses with *Eckra* type of construction

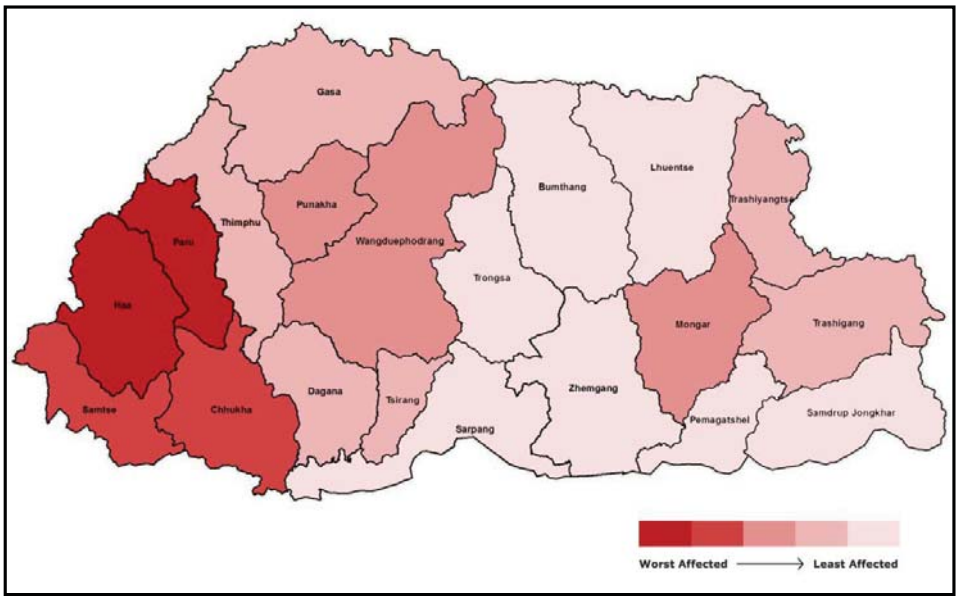
Damages to Housing

The DDM has been compiling damage data from all *dzongkhags*. The latest updates (as of 22 October 2011) indicate that all the 20 *dzonkhags* have been affected with 345 houses totally collapsed or beyond repairs, 1,560 houses having suffered major damage, and 5,960 houses with minor damage. These figures may change after re-verification of the extent of damage for each house.

S.N.	Dzongkhags	Houses Affected			
		Total Collapse/ Beyond Repairs	Major Damage - Repairable	Minor Damage - Repairable	Total Houses Affected
1	Haa	170	250	805	1,225
2	Paro	90	706	1,238	2,034
3	Wangdue phodrang	2	52	0	54
4	Samtse	34	263	590	887
5	Chhukha	9	83	712	804
	Phuentsholing Thromde	0	16	69	85
6	Gasa	19	38	171	228
7	Trongsa	9	17	35	61
8	Bumthang	0	0	62	62
9	Sarpang	5	3	48	56
10	Samdrupjongkhar	0	0	18	18
11	Trashiyangtse	7	52	324	383
12	Lhuentse	0	1	59	60
13	Mongar	0	26	434	460
14	Thimphu	0	0	131	131
	Thimphu Thromde	0	10	44	54
15	Punakha	0	17	691	708
16	Tsirang	0	23	225	248
17	Dagana	0	0	117	117
18	Trashigang	0	100	115	215
19	Pemagatshel	0	0	32	32
20	Zhemgang	0	3	40	43
	TOTAL	345	1,660	5,960	**7,965**

Based on data from the Department of Disaster Management as of 22 October, 2011

The data indicates that Haa, Paro, Samtse, and Chhukha suffered maximum damage to houses, with nearly 62% of the total damage in all 20 *dzongkhags*. The extent of damage decreases towards the east, however, Mongar and Trashigang *Dzongkhags* have more damages reported than their neighbouring *Dzongkhags*. This could be due to the fact that many houses that were weakened or already damaged in the 2009 earthquake suffered further damages in this earthquake thereby resulting in a higher number of affected houses this time. The extent of damage to housing across the 20 *dzongkhags* is indicated in the following map.



Map: Extent of damage to housing across the 20 *dzongkhags*

The majority of houses are of two or more storeys. The rural housing stock in general is very weak and vulnerable as seismic safety features have often not been incorporated. Rammed earth walls are made mainly in form of large in-situ blocks and many vertical joints are not staggered. Also, perpendicular walls are not interlocked well. Sometimes the practice of using wooden block on the corners is observed and these houses seem to have performed better. Stone walls are very poorly constructed either with weak mortar or almost no mortar. The quality of stones used is also often questionable as round boulders were found quite often in the damaged walls. Most of the stone walls do not have through stones or corner stones. However, the critical weakness of the rural houses has been the absence of continuous horizontal bands at any level (sill, lintel or other). As a result, various elements of the houses did not behave as an integral unit and walls tended to fall apart at the time of the earthquake from the shaking.

The assessment team also observed many issues with the quality of workmanship in construction. The field observations suggest that though architectural features such as motifs on the building façade has continued to be used, traditional building skills and construction details have deteriorated or been diluted over a period of time. Due to the absence of regulatory mechanisms (such as building codes) or other policy interventions with respect to the use of traditional building materials and construction practices at the present time, the quality of structures built in accordance with traditional construction methods vary widely and are largely dependent on the workmanship of the building artisans.

The assessment team has estimated the monetary value of shelter damage and losses based on an average house of 1,000 sq.ft. size and an estimated construction cost of Nu. 0.6 million for such a housing unit.

Based on the extent of damage, the houses have been categorized in three categories described earlier as i) minor damage, ii) major damage, and iii) total collapse/ beyond repairs. For the purpose of costing, Category III (Total Collapse/ Beyond Repairs) has been considered at full cost i.e. Nu. 0.60 million. Category II (Major Damage) is put at 30% of the total cost and Category I (Minor Damage) at 7.5% of the total cost. These costs have been proposed by the assessment team based on field observations on the extent of damage, understanding of damage categorization by the *Dzongkhag* officials, and discussions with the building artisans. The following table summarizes the estimate of the housing damage on the

basis of total numbers of houses in each category and applicable percentages of the housing unit cost.

S.N.	Damage Category	Number of Houses	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
1	Minor damage	5960	0.05 (7.5%*0.60)	268.20	5.48
2	Major damage	1660	0.18 (30%*0.60)	298.80	6.10
3	Total Collapse/ Beyond repairs	345	0.60	207.00	4.22
	TOTAL	**7965**		**774.00**	**15.80**

The total cost of the housing damage is thus calculated to be **Nu. 774.00 million or USD 15.80 million.**

2.3 Government / Public Buildings and Other Infrastructure

A number of government buildings, mostly at *gewog* level, were damaged in the earthquake. However, it is important to note that government buildings have not suffered the damage as much as private housing. Many other public buildings such as a Bank of Bhutan office, a telecom office, staff quarters for government employees, a border check post, and RBP offices have also suffered some damage.

Two *gup* offices were damaged beyond repairs, 7 have suffered major damages, and 38 suffered minor damages. Considering 110 sq.mt. area for a typical *Gup* office and costs of Nu. 13,700/sq.ft., the unit cost for a *Gup* office was calculated at Nu 1.5 million. Three other public buildings have suffered major damages and 44 suffered minor damages. Considering the size of these public buildings, average unit cost of Nu. 1.5 million was used for the purpose of loss estimation.

For major damages, 30% of the unit cost was considered while for minor damages 7.5% of the unit cost was used to calculate the damage and loss estimate. This is based on the observation of damage in the buildings and discussion with engineers in the assessment team.

S.N.	Damage Category	Numbers Affected	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
Gup Offices					
1	Total Collapse/ Beyond repairs	2	1.50	3.00	
2	Major damage	7	0.45 (30%*1.5)	3.15	
3	Minor damage	38	0.11 (7.5%*1.5)	4.28	
	Subtotal	**47**		**10.43**	**0.21**
Other Public Buildings					
1	Total Collapse/ Beyond repairs	0	1.50		
2	Major damage	3	0.45 (30%*1.5)	1.35	
3	Minor damage	44	0.11	4.95	

			(7.5%*1.5)		
	Subtotal	**47**		**6.30**	**0.13**
TOTAL				**16.73**	**0.34**

Based on the unit costs and extent of damage to various government and public buildings, the total loss has been estimated to be **Nu. 16.73 million or USD 0.34 million** as presented in the table above.

Communications

There has not been any damage to communication infrastructure. However, immediately after the earthquake, the mobile phone network was down for a few hours which hampered the connectivity. Though some of the *dzongkhags* could use landlines, landline access was largely limited. Very High Frequency (VHF) sets provided to *dzongkhags* could not be used as these are yet to be installed. Considering the significance of undisrupted communication facilities in the aftermath of a disaster, DDM is in the process of preparing a master plan to set up an independent telecommunication system for the whole country.

Roads, Bridges, and Hydro-power infrastructure

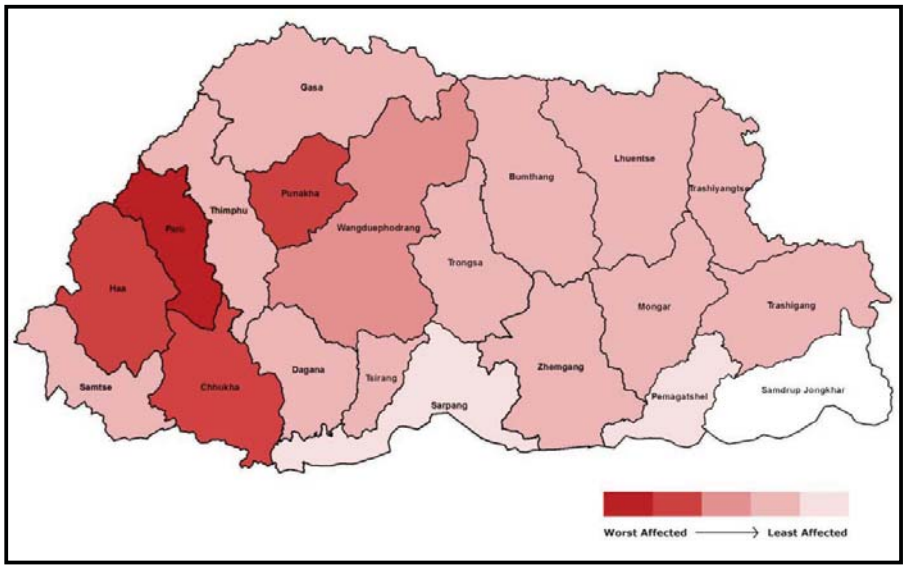
Some road blocks due to landslides were reported. The highway to Phuentsholing was blocked at three points due to falling boulders. The students of Kamji LSS in Chhukha Dzongkhag faced difficulties due to the road blocks while accessing medical services. During field visit to Chhukha *Dzongkhag*, officials indicated that road access to some houses continues to be blocked and is yet to be reinstated.

Field assessment indicated that though there were many challenges for immediate response due to lack of connectivity and communications, there has not been any significant damage to infrastructure, and the services could be restored quickly. There is no data yet available on damage to roads and bridges. Similarly, no damages were reported to hydro-power dams and reservoirs. Therefore, no loss estimates are calculated for these sectors. Connectivity is an issue particular for the *gewogs* that are not yet connected by motorable road. Communication with these *gewogs* has been a challenge for the *dzongkhag* officials, and therefore, prepositioning of emergency stockpiles at the *gewog* level was suggested by officials in local governments.

2.4 Religious and Cultural Heritage Buildings

In Bhutan, the *dzongs*, *lhakhangs*, *choetens* (stupas), and *manidungkhors* (prayer wheels) are some of the predominant religious and cultural assets. Communities rely on these for their ritual performances and spiritual solidarity. These living monuments are critical components of the cultural fabric of Bhutan. The heritage sites are either private-, community-, *latruel* (ownership based on reincarnate Rinpoches / Lams) or government owned. People value these cultural assets as much as their own properties.

The damage data reveal that religious and cultural heritage structures suffered maximum damages in the earthquake, second only to rural housing. 355 *lhakhangs* (temples), 119 *choetens*, and 13 *dzongs* have been affected, many of which suffered severe damages and are beyond repair. The extent of damages to religious and cultural heritage structures vary widely across the 20 *dzongkhags*, with the maximum impact in terms of total number of structures affected felt by Haa, Paro, Chhukha, and Punakha, as indicated in the following map.



Map: Extent of damage to religious and cultural heritage buildings across the 20 *dzongkhags*

It is very difficult to assign a monetary value to the losses from damages to cultural heritage buildings, as there are aspects of antiquity, tradition, people's sentiments, art, crafts, and aesthetic values to be considered. The assessment team has taken into consideration only the physical damage to buildings for estimating the losses. The team found it difficult to assess the actual damaged condition of the *lhakhangs* where the walls are covered with *reja* (canvas). Although major cracks can be observed from the outside, in case of minor cracks, because of the canvas covering the walls, it is difficult to assess the extent of damages beneath them. Therefore, removal of the canvas (mural paintings) will help to better understand the actual condition of many structures. Though the assessment gives a generic overview of the damages, a detailed technical assessment by the *dzongkhag* administrations will be extremely important to assess the extent of damage and to prepare accurate estimates for repairs.

Unit costs of *dzongs*, *choetens*, and *lhakhangs* are difficult to arrive at as there is a significant variation in their sizes. However, based on the field visits and from the experiences of the 2009 earthquake, the assessment team suggests considering unit costs of Nu. 20.0 million for *dzongs*, Nu. 0.2 for *choetens,* and Nu. 3.0 for *lhakhangs*. The loss estimates for structures in the major damage category have been considered at 30% of the unit cost and minor damage category at 7.5% of the unit cost. This is based on the observation of damage in the structures and discussion with engineers in the assessment team.

S.N.	Damage Category	Numbers Affected	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
Dzongs					
1	Total Collapse/ Beyond repairs	0	20.00	0.00	
2	Major damage	5	6.00	30.00	
3	Minor damage	8	1.50	12.00	
	Subtotal	**13**		**42.00**	**0.86**
Choetens					
1	Total Collapse/ Beyond repairs	33	0.20	6.60	
2	Major damage	32	0.06	1.92	

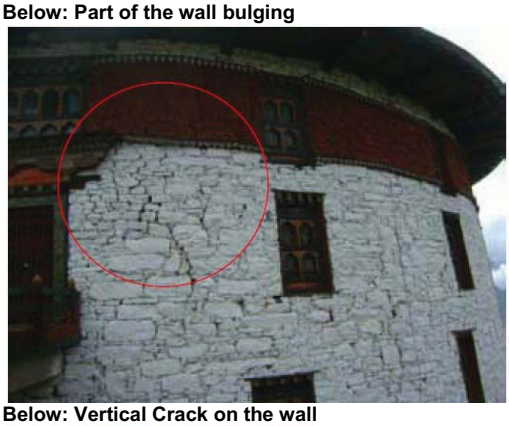
3	Minor damage	54	0.02	0,81	
	Subtotal	**119**		**9.33**	**0.19**
Lhakhangs					
1	Total Collapse/ Beyond repairs	51	3.00	153.00	
2	Major damage	101	0.90	90.90	
3	Minor damage	203	0.23	45.68	
	Subtotal	**355**		**289.58**	**5.91**
	TOTAL			**340.91**	**6.96**

The total loss for religious and cultural heritage buildings is estimated to be at **Nu. 340.91 million or USD 6.96 million.**

Tadzong, Paro Dzongkhag

Collapse of masonry walls and dislocation of window frames

Below: Part of the wall bulging



Below: Vertical Crack on the wall

The Joint Assessment team visited the Paro *Tadzong* on 6 Oct 2011 as part of the field visit. Paro *Tadzong* has suffered major damage on some parts of its structure from the 2011 earthquake.

The Paro *Tadzong* was built in 1649 by La-Ngoenpa Tenzin Drugda (2nd Desi) together with Chhogyal Minjur Tenpa (3rd Desi) after the completion of the Paro Rinpung *Dzong*. Situated at a strategic location on a hillock above the Paro *Dzong*, *Ta-dzong* was constructed above the main dzong as a watch tower against intrusion of enemies and protection. Known for its emblematic architectural design, this seven storeyed structure with a unique front facade shaped to resemble the sun and moon, is an important heritage building of Bhutan. Since 1968 it houses the National Museum of Bhutan.

The assessment team made the following observations. Walls, 2.5 m thick at the base with stone masonry and mud mortar, between windows on the 5th floor level (above the entrance) on the north side of Ta-dzong have collapsed leaving the windows precariously standing. The partial collapse of the wall over the window has partly damaged the roof below and has also broken the ceiling on the third floor causing water leakage. Several cracks have developed on masonry walls inside the building on the east side of third floor. Since these parts of the wall are covered canvass and thick mud plaster, it is difficult to assess and infer on the extent of damage on the walls.

Because of its heritage value and unique architectural features, restoration of the Tadzong is of great national significance. This would entail removing and rebuilding parts of damaged walls, including parts of the inner wall that might have been damaged and using earthquake safe features such as through stones and staggered masonry.

Photo credits: Division for Conservation of Heritage Sites, Department of Culture, Ministry of Home and Cultural Affairs, RGoB

2.5 Education

The majority of damage to education infrastructure was suffered by schools (under the Ministry of Education). Other educational institutions such as Institutes and Colleges under the Royal University of Bhutan as well as institutes under the Ministry of Labour and Human Resources (MoLHR) have not suffered any significant damages. The College in Samste suffered minor cracks. The impact of the earthquake on the students in the monastic schools, and their early recovery and reconstruction needs are discussed under the section on religious and cultural heritage properties.

The affected number of schools has been compiled by DDM. Where detailed data was available at the dzongkhag level, such information has been used to validate the figures. The assessment team has used the damage data compiled by DDM. However, damage data from Ministry of Education indicates a total number of 141 schools in categories 1 and 2 (Major damages : CPS/PS 34, LSS 12, MSS 4, and HSS 1; Minor damages: CPS/PS 58, LSS 17, MSS 9, HSS 6).

Figures above: Damages to school buildings; Below: Yoeseltse HSS, Samtse, with cracks on the beam in the biology lab.

Typically, schools are designed as a cluster of blocks. Generally, only one or two blocks of school complexes have suffered damages in the earthquake, and therefore, for costing purposes, instead of including the cost of the whole school, only the costs of the blocks have been considered. This was found to be a more realistic approach based on the field visits. The unit costs of the educational blocks are based on the 2008 Guidelines for School Buildings prepared by School Planning and Building Division (SPBD), Ministry of Education, Royal Government of Bhutan. A 20% increase in rates has been applied to all categories of schools to account for the increase in material and labour costs. For primary schools, Nu. 3.0 million has been considered as the cost of two blocks and Nu. 5.0 million for secondary schools.

S.N.	Damage Category	Numbers Affected	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
Primary Schools (including CPS)					
1	Total Collapse/ Beyond repairs	0	3.00	0.00	
2	Major damage	17	0.90 (30%*3.0)	15.30	
3	Minor damage	70	0.23 (7.5%*3.0)	15.75	
	Subtotal	**87**		**31.05**	**0.63**
LSS/MSS/HSS					
1	Total Collapse/ Beyond repairs	0	5.00	0.00	
2	Major damage	7	1.50 (30%*5.0)	10.50	
3	Minor damage	23	0.36 (7.5%*5.0)	8.63	
	Subtotal	**30**		**19.13**	**0.39**
	TOTAL	**117**		**50.18**	**1.20**

The total loss due to damage to schools is estimated to be at **Nu. 50.18 million or USD 1.02 million**.

2.6 Health

The earthquake had limited impact on the health sector. One fatality was reported where a woman was buried under a landslide in Gamana village in Darla *Gewog* of Chhukha *Dzongkhag* after the earthquake. Five people suffered major injuries and nine people suffered minor injuries.

Hospitals, Basic Health Units (BHU), and Out Reach Clinics (ORC) have sustained minor damages which have not affected normal functions of the health facilities and the provision of health care to the communities. All communities have access to health care facilities such as BHUs, District Hospitals and the National Referral Hospital. In case of casualties that required immediate medical attention, appropriate referrals were done.

Damage to hospitals has been limited. However, according to the assessment by the Ministry of Health, nine hospitals (Bumthang, Tsimalakha, Gedu, Dagapela, Paro, Punakha, Sipsu, Gomtu, and Wangdue) have developed minor cracks that would require minor repairs. The average cost of construction of a hospital, Nu 5.25 million, has been used to calculate the losses, considering the nature and extent of damage, which is mostly confined to a block or a ward.

For BHU's and ORC's, the unit cost has been considered as Nu. 2.1 million and 0.3 million respectively. The costs have been derived from the "Guidelines for the construction of Basic Health Units and Out Reach Clinic" prepared by the Ministry of Health, Royal Government of Bhutan in 2011.

S.N.	Damage Category	Numbers Affected	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
Hospitals					
1	Total Collapse/	0	5.25	0	

	Beyond repairs				
2	Major damage	0	1.58 (30%*5.25)	0	
3	Minor damage	9	0.39 (7.5%*5.25)	3.55	
	Subtotal	**9**		**3.55**	**0.08**
Basic Health Units (BHU)					
1	Total Collapse/ Beyond repairs	0	2.1	0	
2	Major damage	0	0.63 (30%*2.1)	0	
3	Minor damage	40	0.16 (7.5%*2.1)	6.3	
	Subtotal	**40**		**6.3**	**0.13**
Out Reach Centres (ORC)					
1	Total Collapse/ Beyond repairs	0	0.3	0	
2	Major damage	2	0.09 (30%*0.3)	0.18	
3	Minor damage	9	0.0225 (7.5%*0.3)	0.20	
	Subtotal	**11**		**0.38**	**0.01**
	TOTAL			**10.23**	**0.22**

The total loss to the health sector infrastructure is estimated to be at **Nu. 10.23 million or USD 0.22 million** as summarized in the table above.

In interactions with community members and representatives of local governments (at the *dzongkhag*, *gewog*, and village levels), the assessment team did not find any signs of food insecurity or malnutrition due to the earthquake. However, it may appear in the future if appropriate measures are not undertaken to address food shortage as a result of improper storage facilities and insufficient food production due to time devoted to reconstruction of shelters/houses of communities.

2.7 Psycho-Social Impacts

The assessment of psycho-social impacts has largely focused on children, and in particular, those in the schools that the assessment team visited. The format of rapid assessment poses certain limitations for assessment of the extent of psycho-social trauma as the process requires a significant amount of time in order to gain the confidence of children and let them express their feelings in an uninhibited manner. Therefore, during this assessment it was difficult to get a true sense of the impact on the children. Children who were present at the field visit sites were interviewed for a short period of time. These interactions indicated that children and adults were affected by shock and anxiety during and immediately following the earthquake. The earthquake has dislocated their life and caused anxiety and worries about the reconstruction of their houses (especially in the case of adults). Furthermore, children who had witnessed their houses being damaged or cracks develop in their houses were more scared than children who did not witness such damages in their houses. However, there does not appear to be any long-term trauma as a result of the earthquake.

Figures above: Children in schools and monasteries share their experiences with the 18 September 2011 earthquake

In the immediate aftermath of the earthquake, school authorities in most cases found themselves unprepared to deal with psychological counseling needs of the students. It was also reported that most of the teachers did not have the knowledge or skills to cope with the stress and also provide counseling to the students. The principal of Kamji Lower Secondary School in Chhukha Dzongkhag shared with the team the dilemma he experienced as to rush to his family or to take care of the students. This case indicates that disasters pose complex situations to deal with even for the care-providers. The need for counseling was felt in the boarding schools as the earthquake struck late evening on a Sunday. In many schools, the school authorities are still struggling to restore normalcy in the lives of the children as many children still have fear of earthquake. Rumors of another major earthquake have also aggravated the situation.

Damages to spiritual statues, temples, and relics due to the earthquake have also had psycho-social impacts on the community, instilling a sense of fear and anxiety. The spiritual leaders / monks have an important role to play in reassuring the community.

"Only God Can Help Us Now"

An account of a family affected by the 18 September 2011 earthquake

Thirty eight years old Pasang, his wife and their 5 year-old son Jigme were having dinner. At the same time, they were also excited about the impending religious ceremony to consecrate their USD 5,000 worth mural painting in the altar room. They never finished eating their dinner because on that fateful day of 18 September 2011, they were among the thousands of people in Bhutan who experienced one of the worst earthquakes in recent decades.

Pasang, His Wife Tshering and their son Jigme Yoezer infront of their crumbled house

Pasang is from the small Tshenkha village in Haa *Dzongkhag*. Haa was one of the worst affected districts in Bhutan. "We had just sat down for dinner when the house started to shake so violently. Then the lights went off. All we could do was run under the door and hug ourselves tightly and pray," said Pasang adding that he could hear the crumbling walls of his newly renovated ancestral home.

Now living in a temporary shelter outside their house, Pasang said that he was at least fortunate that no harm came to his wife and son. The shelter was built by the Royal Bhutan Army following the visit and command of their Majesties the Fourth and Fifth King of Bhutan. The District Administration also provided CGI sheets and timber to the family to construct the shelter.

Pasang's house is one among many in his village that have been destroyed beyond repair. As an excavator arrives in the village to level the ground, Pasang cries unsure of how he would rebuild his house and his family's lives.

Like Pasang, many of the villagers have lost their homes. In the temporary shelters, many have to walk longer distances to fetch water. Most are forced to defecate in the open thus exposing themselves and especially their children, to diarrhea and other diseases. With the winter months already approaching, the crude temporary shelters are not as warm as their homes. This poses further risks to children being affected by respiratory illnesses.

As Pasang wipes away his tears his five-year old son runs up to him. Pasang lifts his son and says, "he is so scared of the earthquake that he cannot stay alone. He needs someone around him all the time." Pasang's wife said that their son now had to be hugged tightly when sleeping. As night falls, Pasang and his family slowly walk to the tarpaulin shelter. He turns to take a final look at the crumbled walls which still has bits and pieces of a freshly painted mural of gods and goddess. "Only God can help was now," he says as he leaves.

By Kencho Namgyal, UNICEF Bhutan, October 2011

2.8 Water and Sanitation

Water

The earthquake had very little impact on the existing drinking water supply. However, the team observed that there were large variations in supply coverage across the *gewogs* visited - from 50% to 98%. A substantial proportion of the population does not have access to safe drinking water, are more vulnerable to health emergencies and are likely to face greater difficulties in case of future disasters. The minimum water requirement for drinking, cooking, and personal hygiene is 30 liters per person per day. Although there has been no report of outbreak of water-related diseases in the communities since the earthquake, these communities remain vulnerable if un-safe and inadequate drinking water supply continues for long in the earthquake affected areas.

The assessment team also observed from visits that the water supply in institutional buildings was not affected by the earthquake.

Sanitation

There is no data available on how many houses have lost sanitation facilities. During the field visit, the assessment team observed that some houses have toilets as part of their houses, while some have it as a separate block. Toilets varied depending on the region and affordability of the family. During the field visit, damages were observed in some toilets. When attached with the house, some toilets were rendered useless in case of houses with major damages due to fear of collapse of the house while entering houses.

Figures above: Damages to sanitation observed during field visits

It is difficult to estimate the cost of loss of sanitation facilities. However, this is not considered to be significant in terms of proportion to the housing damage, and may therefore be considered as part of the housing damage costs.

2.9 Agriculture and Other Livelihoods

The majority of the households in the affected earthquake area are engaged in agricultural activities, mainly in subsistence farming. Based on the reports from the Department of Agriculture, field observations by the assessment team as well as reports from the *dzongkhag* officials, there has been minimal damage to crops and livestock as a direct result of the earthquake. There were one or two instances of damages reported to land and crop in Punakha, where 40 decimals of paddy field was damaged due to landslide and 3 terraces of land developed cracks. In Haa and Thimphu, 3 cows and 3 yaks respectively were killed by

falling boulders. In addition, there has been only one reported case in Chhukha where damage to storage structure resulted in the loss of nearly 100 kg of potatoes.

It is likely that due to the attention paid to more visible damages including that to infrastructure, farmers and households may not have had the time to realize the long-term impact on their food supply, income or next season's harvest. However, the immediate reaction appears to be that there is minimal impact of the earthquake on the sector, little impact on productivity, cropping patterns, forest produce, or on agricultural land. Those most affected by the earthquake have moved out of their homes into temporary shelters, but it does not seem to have affected their farming activities since most temporary shelters are located near the original house.

RNR Centres

A total of 32 RNR Centres were damaged by the earthquake, out of which 3 are in the category of total collapse, 4 are in the category of major damages and 25 in the minor damage category. For an average size RNR centre of 60 sq.mt. with construction cost of Nu. 13700, the unit cost of RNR centre is estimated at Nu. 0.80 million. The construction costs have been calculated based on the BSR 2009 and adjusted to the current market rates.

S.N.	Damage Category	Numbers Affected	Unit Cost (Nu. Million)	Total Cost (Nu. Million)	Total Cost (USD Million)
RNR Centres					
1	Total Collapse/ Beyond repairs	3	0.80	2.40	
2	Major damage	4	0.24 (30%*0.80)	0.96	
3	Minor damage	24	0.06 (7.5%*0.80)	1.44	
	Subtotal	**31**		**4.80**	**1.0**

The loss due to damage to RNR centres is estimated to be at **Nu. 4.80 million or USD .10 million.**

Irrigation Channels

The Ministry of Agriculture has compiled information on damage to irrigation canals and channels. Though information from all the *dzongkhags* is not yet complete and may get updated, the assessment team has used the available data. In total, 407 m. of length of irrigation channels has been damaged mainly in Samtse and Punakha *Dzongkhags*. This has affected about 252 families who will not be able to irrigate their crops till the irrigation channels are repaired.

Dzongkhag	Gewog	Canal name	Length (km)	Number of HH affected	Damage to canal (meters)
Samtse	Ugyentse	Sirangkula	1.00	21	7
	Yoeseltse	Lamitar-Ghalleygaon	3.00	66	50
	Biru	Peljorling-Jogimari	2.00	66	200
	Chargharey	TerchoKulo	14.00	16	
Punakha	Guma	Wolakha	0.10	58	100
	Shengana	Manikha	0.05	25	50
		Total	**20.15**	**252**	**407**

Based on costs specified in BSR 2009 and after adjusting to current market rates, the cost of random rubble masonry irrigation channels is considered at Nu. 1906 per metre. For the purpose of loss estimation, a total loss of 407 meters is assumed. The loss due to damage to irrigation channels is estimated at **Nu. 0.78 million or USD 0.02 million**.

Markets and Micro Enterprises

The functioning of micro enterprises, shops, restaurants, and lodging accommodations during a disaster is important not only in terms of providing essential supplies of goods and services to the surrounding community during an emergency situation but also for the welfare of the households that are engaged in non-farm activities. Other than some disruption to road access due to landslides and one or two reported instances of damage to the buildings such as a meat shop, little impact to access and operation of markets by the earthquake was observed. The assessment team observed no impacts on the availability of goods or any differences in price levels after the earthquake.

Total loss for Agriculture and Other Livelihoods

The total loss in this sector is estimated at **Nu. 5.58 or USD 0.12 million** considering the above estimations for RNR centres and irrigation channels. Based on more detailed information on losses in this sector, these figures may increase marginally.

2.10 Aggregated Damage and Loss

On the basis of the sector wise damage and losses assessed above, the overall picture of losses incurred due to the earthquake emerges as follows.

Bhutan has suffered a total loss of **Nu. 1,197.63 million or USD 24.46 million.** It is a significant loss as recovery and reconstruction from the 2009 earthquake is still ongoing. The sector wise aggregated loss is compiled in the table below.

S.N.	Sector	Total Cost (Nu. Million)	Total Cost (USD Million)
1	Housing	774.00	15.80
2	Government, Public Buildings and Other infrastructure	16.73	0.34
3	Religious and Cultural Heritage Buildings	340.91	6.96
4	Education	50.18	1.02
5	Health	10.23	0.22
6	Psycho-social impacts	0	0
7	Water and Sanitation	0	0
8	Agriculture	5.58	0.12
	TOTAL LOSS	**1,197.63**	**24.46**

It is likely that due to this significant and widespread damage, there will be financial and human resource requirements to respond, rebuild, and rehabilitate. This may have implications for the achievement of national objectives and implementation of programmes as laid out in 10th five-year plan.

SECTION 3: The Way Forward – Early Recovery

Immediately following the earthquake, the RBA and volunteers delivered relief assistance to the affected families, including assistance in erecting temporary shelter for families whose houses were considered to be unsafe. Assistance has also been provided by various UN agencies. While these might help address the immediate shelter needs of the affected families, in the case of houses/ religious and cultural buildings/ monasteries/ administrative offices/health and educational facilities that have suffered major damages or have collapsed/are beyond repairs, these temporary facilities would not be adequate in the long-term. Considering the time taken to reconstruct/repair the damaged structures, arrangements need to be made in the interim period to ensure that the affected population has access to safe shelter, water, sanitation and basic services. They should also be provided assistance in the process of rebuilding their homes. The following sub-sections describe the various early-recovery needs of the affected population.

3.1 Intermediate Shelters

The 2,005 most affected families whose houses have fully collapsed or have suffered major damages, would require interim shelters till their houses are repaired/reconstructed. These families will need to be supported with more durable interim shelters. As of now, mainly tarpaulin sheets have been provided. The Royal Bhutan Army has provided tents or put up temporary shelters made of tarpaulin, CGI sheets and timber for the most affected people. However, the conditions remain inadequate and a lot of variation in assistance provided was observed by the assessment team. It is essential to ensure that affected households have sufficient space and are protected from extreme climatic conditions. This will also enable them to undertake their normal livelihood-related activities. The assessment team did not have enough information on how many affected families have been provided temporary shelters and therefore was unable to assess the unmet need for temporary shelters. During the field visits, the assessment team observed that immediate shelters provided will soon be inadequate considering the impending winter and the time taken (up to 2 years) for permanent shelter reconstruction.

As the shelter strategy should ensure safety, health, and well being of the affected families and promote recovery and reconstruction, it is essential to ensure more durable shelters. By making a provision of Nu. 20,000 per household for the 2,005 most affected families, CGI-sheets, timber, and human resources (support for labour) can be provided to assist people build a dignified interim shelter. As a principle, it is important to ensure a humanitarian response that supports communities in coping and recovering from the disaster with dignity. The immediate response by the government to provide immediate assistance in form of tarpaulin and help from the Royal Bhutan Army was a first step in this direction. The early recovery phase needs to strengthen the same approach by ensuring adequacy of shelter for the interim period till permanent shelters are constructed. The intermediate shelter programme should be people centric byplacing them in the lead role. Care should be taken not to hamper the community's own initiatives, and efforts should be made to encourage them. To support people's own participation, a sample shelter design with possible material options could be provided. Community members and communities could be encouraged to help each other in the process of making interim shelters. The assessment team estimates **Nu. 40.10 million** for the provision of interim shelters.

3.2 Support to Dismantle Houses and Salvage Materials

Salvaging of material is very important for the affected households, especially those whose houses have either totally collapsed or have suffered major damages, so that they can use it for the reconstruction of a new house. However, these households will need the necessary equipments and tools so that they are able to most efficiently recover usable material. The tools required include crow bars, drills, hammers, saws, etc. At the village level if a set of tools are provided for the community to use, it will help and motivate them to salvage and retrieve building materials. It will also ensure that expensive materials like timber are not wasted. The community could also be mobilized during the process of salvaging as a stepping-stone towards the process of reconstruction.

Tool kits and bulldozers should be made available to communities to help them in salvaging materials and the retrieval process. Simple guidelines on dismantling and salvaging the materials from collapsed or severely damaged houses could be developed and information may be disseminated through billboards at public places like bus stands, *gewog* offices, shops, other public areas etc. This would provide guidance to house owners on the precautions to be taken and the sequence of steps in the salvaging process. Pictorial methods should be adopted to explain the guidelines for dismantling and material retrieval.

Some houses that have not collapsed but are beyond repairs may need support in dismantling so that material can be salvaged and the site be cleared for reconstruction. The total number of fully collapsed houses including beyond repairs is only 345, and in addition, about 10% of houses with major damage may also need this support. Therefore, the total support required is estimated for 511 houses. For this, provision of **Nu. 5.0 million** is recommended. This support will help people in salvaging material worth at least Nu. 150 million.

3.3 Water, Sanitation, and Hygiene Promotion

During the early recovery phase, it is important to ensure hygiene so that no outbreak of disease happens, particularly because families have inadequate shelters and may be lacking basic facilities. Safe excreta disposal is important to reduce the transmission of diseases, and as such, providing access to latrines is crucial to in order to prevent open defecation. The assessment team observed that earthquake affected families were using communal latrines if they were close to villages, which caused inconvenience to children and old people particularly at night, or resorted to open defecation, which posed threat to health of both themselves and their neighbors. Microbiological contamination can lead to outbreak of diarrhea in any emergency situation. Some families during field visits were found to be resorting to open defecation due to toilets being rendered useless by the earthquake.

Based on our field observations, the team estimates about 50% of the 2,005 most affected families (having houses totally collapsed or major damage) will have to be supported with sanitation and water storage facilities in the early recovery phase. A simple single pit toilet is estimated to cost Nu. 2550 and a water storage tank of 200 ltr. Nu. 1000. Thus the total estimated costs for this support will be **Nu. 3.55 million**. The parameters that may be considered for identification of families in interim shelters for support for water storage tanks should include fully collapsed houses, houses at a horizontal distance of more than 100 m. and vertical distance more than 50 m. from the water source.

3.4 Interim Arrangements for Government and Public Offices

As some of the *Gup* offices and some other public buildings have been damaged, it is essential to make intermediate arrangements for totally collapsed and those having suffered

major damage. For early recovery, it is necessary to ensure that *Gup* offices function effectively. Nine *Gup* offices and 3 other public buildings would require interim arrangements. It is suggested to allocate **Nu. 1.20 million** to meet the early recovery needs of government and public buildings.

3.5 Protection of Religious and Cultural Heritage Buildings

Religious and cultural heritage buildings need careful planning, design, and restoration. During the early recovery period, it is essential to ensure protection of already damaged structures so that there is no further damage due to weathering and climatic effects. Special care is also required to be taken to minimize any additional stress on the structures from people visiting these sites for religious festivals and ceremonies. There is also need for provision of interim shelters for monks and nuns in the monastic schools before the onset of winter as the reconstruction process is likely to take 2 to 3 years. The artifacts also need to be moved from the damaged structures to safe locations. Towards this, proper storage areas have to be provided for keeping the *kuten sungtens* (religious artifacts). The *dzongkhags* have supplied tarpaulin sheets, ply boards, and CGI-sheets to the *lhakhangs* for immediate shelter where the monks/nuns had to be evacuated from their living spaces as well as where artifacts had to be removed from the *lhakhangs*. These temporary measures need to be strengthened to serve as interim shelters as part of the early recovery interventions.

In some of the near collapse structures, one of the main difficulties encountered is the removal of the artifacts including very big statues. Most of the *lhakhangs* have centuries old *debri* (mural paintings), which could be conserved although the *lhakhang* itself has suffered major damages. Immediate measures need to be taken by these *lhakhangs* with assistance from the Division of Cultural Properties under the Department for Culture to remove and conserve them for later use after the restoration or reconstruction. There are about 200 major damaged cultural heritage buildings that need such attention. The assessment team suggests **Nu. 6.0 million** to meet the early recovery needs of religious and cultural heritage buildings and its occupants.

3.6 Education

In case of schools where classrooms have developed cracks and therefore are not being used, there is pressure on the remaining rooms. Some schools have adopted shift systems due to lack of availability of usable classrooms. Largely, the normal activities of the schools were not disrupted. Also, there has been no change in the attendance or enrolment.

In case of schools where the boarding facilities/hostels have suffered damages, the students have been relocated temporarily to classrooms or other facilities such as science labs. It is important that these students be relocated back to their hostels. The assessment team observed that the school in Gomtu in Samtse *Dzongkhag* has been using their library as a class room. In Damthang in Haa district, the school is not able to use three damaged blocks and is running in two shifts so that all the students can attend the school. However, as a result teachers are working overtime.

The Royal Government of Bhutan with support from UNICEF has mobilized 200 school-in-a-tent to meet the intermediate need of classrooms, which will serve as the interim facility till the affected school buildings are functional. In places where there the weather is not too harsh and windy, the school-in-a-tent can be used as classrooms. However, the tents might not be the best solution for places such as Damthang (Haa *Dzongkhag*) where the winds are very strong. There is a need to build well insulated and strong semi-permanent structures.

The schools with major damage, particularly in the locations that face extreme weather conditions require semi-permanent structures to last for about two years. 12 schools in Haa, Paro, Gasa, and Chhukha will require these semi-permanent structures. These structures need to be built urgently, for which both materials and manpower has to be mobilized soon. The semi permanent structures could be built of *eckra* walls, waterproof plywood walls, woods, and CGI sheets, and classes be held in these structures. For the teachers currently living in temporary tents that are unsuitable for extreme weather conditions, intermediate structures could also be set up for teachers' living quarters. Provision of water and sanitation facilities for the semi-permanent structures in the schools, especially for girls and female staff, is of utmost urgency and importance, and should be prioritized.

The recovery and reconstruction needs of the monastic schools are mentioned in the earlier section on culture and heritage buildings.

During the early recovery period it is important to undertake detailed assessment of the affected schools to plan repairs and retrofitting of the vulnerable buildings during the reconstruction phase.

The early recovery needs for education sector is estimated at approximately **Nu. 4.0** million. The costs of 200 tents (school-in-a-tent) already provided are not included and are considered additional.

3.7 Health and Nutrition

Existing Health Sector Emergency/Disaster Contingency Plans in place in the health facilities was operationalized during the earthquake. This helped provide normal health services without any disruption and none of the health facilities had to be evacuated.

The *dzongkhag* administration provided counseling services to the affected communities to relieve their sense of loss, grief, and anxiety. There is a need to continue such services including psycho-social counseling to the affected families to minimize the negative effects of trauma and help restore their sense of normalcy. The visits by their Majesties the 4th and 5th King to the four worst affected *Dzongkhags* and their reassurances of assistance for the reconstruction of houses have had a significant influence in relieving their concerns and worries to a large extent.

The level of hygiene and cleanliness in temporary shelters is poor, which could give rise to a number of health issues. There is no report of any outbreak of diarrhea and other diseases. However, there is a possibility of an outbreak in light of the impending winter and poor temporary shelters, which cannot provide safe protection from the strong sun, rain, and extreme cold. As mentioned earlier, an initiative for intermediate shelter that provide better protection from extreme weather conditions will be necessary. It is estimated that 2,005 families who have inadequate shelter conditions due to their houses being totally collapsed or have suffered major damages, may face this risk.

It was also observed that newborn babies staying in temporary shelters are likely to develop respiratory infections (ARI) and diarrhea. In general, ARI and fear were the most common health concerns expressed by the community. An immediate focus on maternal, neonatal, and child health should be a priority for all the affected districts.

The assessment team estimated **Nu. 4.0 million** in the early recovery phase to ensure safe and healthy living environment for the affected families.

3.8 Psycho-Social Care

Psycho-social care needs to be provided in the early recovery phase to strengthen the community to undertake reconstruction with confidence and move ahead. Typically, it is observed that single women, old aged people, physically challenged, and children are most vulnerable to psycho-social trauma. However, in many cases others (including men) also face higher levels of anxiety and stress in post disaster situations due to worries about their ability to perform their roles as care takers and to reestablish normalcy in the lives of dear ones. Such impacts are often not easily discernable and remain hidden unless specific efforts are made by those with the required orientation/training to uncover it. It is necessary to train local officials, health care providers, school teachers, etc. to identify the symptoms and to enable them to reach out to affected community members. Nuns and monks in monastic institutions also would require orientation and training in meeting the psychological counseling needs of the young monks and nuns in the monasteries.

There is need for the education sector to provide guidance and counseling in overcoming fear of earthquake, to remove nervousness from the children, restore normalcy and normal concentration in their studies. During the early recovery phase, counselors in schools and local health facilities should be sensitized, oriented, and mobilized to reach out to the affected community members. Establishing linkages with health professionals at the local BHUs in order to monitor the psychological wellbeing of students and other community members and provide necessary care when school authorities are unable to cater to the needs is also crucial in ensuring wellbeing of the affected population.

For psycho-social recovery in the affected communities, it is equally important to provide the necessary early recovery support in the form of interim arrangements for shelter, water, and other basic services etc. Such measures would help give people confidence that their lives would be normal soon. Population data disaggregated on age and gender will be helpful in identifying the target groups that might need psycho-social support. Efforts should be made to develop a *gewog* level data base on population groups on the basis of age and gender.

The psycho-social care needs in the early recovery period is estimated at **Nu. 2.0 million.**

3.9 Agriculture and Other Livelihoods

As most of the affected families are engaged in farming, there are concerns about adequacy of storage facilities to store the harvested paddy particularly in the case of families whose houses have fully collapsed. Being a subsistence crop, proper storage of paddy is critical in ensuring food security of the affected families. Therefore, in the early recovery phase, it is proposed to provide these families with a storage unit. In addition, families in need should also be provided with family emergency kits which include items such as pots, pans, blankets, jerry cans, etc. For early recovery of 345 families having fully collapsed houses, and to enable them to pursue their livelihoods, the need is estimated at approx. **Nu. 1.75 million.**

For farmers whose crops might have been affected due to the damages to the irrigation channels, it is suggested that a line of credit be made available to meet any needs arising from reduced productivity. At the time of the assessment, due to the lack of availability of data on the impact of commercial establishments, the team was not able to arrive at any provisions for early recovery or long-term recovery of commercial establishments. Field observations indicated very little disruption. However, it is important to ascertain the impact of the earthquake on commercial establishments by collecting the required data (by the DDM) and if found necessary, the line of credit could also be extended to small businesses to overcome any direct losses due to the earthquake.

3.10 Community Mobilization

While planning an early recovery programme, it is necessary to also take into consideration the capacities of the affected communities and local administrations. The convergence behavior and community spirit that emerges in the immediate aftermath of a disaster often tend to disappear with time when individual concerns take precedence over community needs. Early recovery is the phase that can strengthen community spirit to lay foundations for a community led reconstruction and risk reduction programme. Therefore, early recovery components should emphasize community involvement and ensure their mobilization.

Women headed households and households where men have migrated out for work need particular attention so that women are not burdened with the task of salvaging materials while performing their regular household chores. If adequate attention is not paid, this would lead to increased drudgery and subsequently increased anxiety and mental stress. The field observations of the assessment team indicated that gender specific needs are often sidelined by the overwhelming need for shelter reconstruction. Therefore, in the early recovery stage, specific care needs to be given to ensure availability of counseling services, health and hygiene care, and community support. Efforts should also be made to protect the privacy and security of women and girls including construction of the toilets in the interim shelters or in close proximity.

Currently, gender disaggregated data or information on women headed households in the affected families are not available. This crucial information needs to be gathered before planning early recovery and reconstruction initiatives. This information is critical to articulate appropriate policy and programme to ensure that adequate attention and assistance is provided to the affected families in a gender-sensitive manner. Similarly, information on elderly population and children would also need to be gathered to ensure that their specific needs are taken into account while designing the early recovery and long-term recovery/reconstruction phases.

3.11 Overall Early Recovery Costs

The total costs for early recovery are estimated at **Nu. 67.60 million or USD 1.38 million**. The following table summarizes these early recovery costs sector wise.

S.N.	Expenditure Head	Total Cost (Nu, Million)	Total Cost (USD, Million)
1	Intermediate Shelters	40.10	
2	Dismantling house and Salvaging material	5.00	
2	Interim *gup* and public offices	1.20	
3	Religious and cultural heritage buildings	6.00	
4	Education	4.00	
5	Health and Nutrition	4.00	
6	Water, Sanitation and Hygiene Promotion	3.55	
7	Psycho-Social Care	2.00	
8	Agriculture and Livelihoods	1.75	
	TOTAL	**67.6**	**1.38**

SECTION 4: The Way Forward - Reconstruction

Long-term recovery and reconstruction of assets and restoration of services play a key role in reinstating normalcy in the lives of the affected families. This would require a recovery and reconstruction programme for the various sectors affected by the earthquake. Reconstruction of permanent housing forms the major part of such a programme due to the extensive damage suffered by housing. It is also the top priority for the house owners as well as the *Dzongkhag* and *gewog* officials. Besides housing, the reconstruction efforts will include restoration of government and public buildings, water and sanitation facilities, educational and health infrastructure, agricultural infrastructure, and religious and cultural heritage buildings. The recovery and reconstruction programme would be formulated on the basis of the damage and loss assessment, and build upon the early recovery phase. The recovery and reconstruction needs for each sector and the corresponding monetary implications are discussed in the following sub-sections.

4.1 Housing

The key component of the reconstruction phase, housing has emerged as priority for support from RGoB. The earthquake has adversely affected 7965 houses in 20 *Dzongkhags* with varying degrees of damage. 345 houses have completely collapsed or are beyond repairs, 1660 suffered major damages while 5960 suffered minor damages.

The programme for reconstruction of houses should build the local community capacities. The field visits indicated existence of local skills related to construction in rammed earth, stone masonry, and *eckra* walls. However, the team in its consultations with various stakeholders including community members and local artisans was also made aware of the gradual loss of the traditional knowledge on construction practices and building typologies. Systematic study of traditional building practices and building types, and validation of these practices through modern scientific methods can help in identification of appropriate seismic safety features that have been lost or diluted in current construction practice. It is essential to introduce these features in construction practices. Usually after an earthquake, there is a knee-jerk reaction to discard whatever has failed in its totality. For community to practice sustainable building methods it is essential to build upon and develop on the existing knowledge of building materials and technology rather than introducing something completely new and alien. It is important to rebuild the confidence of the community members and artisans in particular that rammed earth, stone masonry, and other traditional building methods that communities typically use can be practiced while improving them to fulfill their aspirations for better and safe housing conditions.

Some of the key principles and processes that should guide the reconstruction are as follows:

- Reconstruction of houses should ensure disaster safety through incorporation of seismic safety features. This should be the key priority and a non-negotiable aspect of housing reconstruction initiatives. In order to ensure this, it is important to develop practical ways in which such features can be developed for different building typologies prevalent in various parts of Bhutan.
- Simple technical guidelines and rules of thumb need to be developed for different construction technologies. With a clear mandate from the highest level of RGoB, a high level technical committee comprising of senior seismic structural engineering advisor, senior technical representatives from MoWHS, BSB, DDM, Department of Culture, and eminent experts should facilitate and provide technical support in developing these guidelines for rural houses with vernacular technologies.

- Designs and drawings demonstrating technical features for seismic safety in traditional Bhutanese houses as per predominant construction practices should be developed as ready reckoners for community members (as in many cases the construction activities are carried out people themselves with varying degrees of involvement of carpenters/masons) and artisans.
- Artisans and engineers need to be made aware and trained on seismic safe construction and strengthening/retrofitting of existing houses.
- Training and awareness does not always translate to practice. It is necessary to proactively facilitate the process of reconstruction through timely advice and monitoring/quality control at every phase of reconstruction of houses.

Owner Driven Reconstruction

The reconstruction of houses should be owner driven. As there are many regional variations in housing typologies, with habitations widely dispersed, and varying needs and preferences of the families, the process of reconstruction should be led by owners. The past experiences elsewhere have also demonstrated many advantages of this approach as it empowers local communities by granting them greater control over the reconstruction process, and allows them to rebuild their homes based on their needs and aspirations. At the same time socio-technical facilitation of the process ensures that knowledge of seismic safety is internalized and adopted for future extensions/modifications to the house.

In-Situ Reconstruction

Most families are likely to reconstruct houses at the same location as the damaged house. However, some families who have their houses in the total collapse/beyond repairs category may want to abandon these and build at another location due to costs involved in pulling down these structures. However, the assessment team does not estimate significant number of such cases. In-situ reconstruction also helps households to get involved more closely with the construction process, contribute labour, and monitor more effectively. It also ensures that socio-cultural ties and community linkages are unaffected.

Housing Assistance

The assistance for reconstruction for houses should be based on damage categorization. The assistance needs to be provided in such a manner that households are able to complete house construction in timely manner and include all non-negotiable seismic safety norms. The disbursement of financial assistance may be linked with the stages of construction and monitoring to ensure inclusion of seismic safety features. Material assistance in the form of timber or CGI sheets can also be linked to inclusion of seismic safety features. C It should be ensured that incentives in the form of cash bonuses or materials are provided if seismic safety features are incorporated in the newly constructed houses.

As banking is not prevalent in rural areas of Bhutan, it may not be possible to transfer housing assistance through banks, even though it is often a much preferred mode in reconstruction programmes. Therefore, it may be required for *dzongkhags* to have appropriate cash disbursement mechanism for housing assistance that adheres to accountability and transparency norms.

Social and Technical Facilitation for Reconstruction

Facilitation of reconstruction process is extremely critical for vulnerability reduction. Merely training artisans and engineers in earthquake safe construction may not ensure incorporation of these details in the actual house reconstruction and might result in same vulnerabilities being recreated. Some lessons also need to be drawn from the 2009 Mongar earthquake rehabilitation experience where there has been widespread skepticism about the inclusion of seismic features in the reconstructed houses. The experiences of other disaster reconstruction programmes indicate that awareness and training do not always translate to

practice. It is a slow process and requires handholding at the time of actual reconstruction of the houses. It is therefore, suggested that socio-technical facilitation centres for reconstruction should be planned at the *Dzongkhag* level.

The centres may be planned after considering administrative and logistical parameters for such an outreach programme. If masons can be specially appointed to help out house owners with advice and guidance through specific allocation of funds for facilitation purpose, it will be useful. It may be good idea to explore if the trained masons from eastern Bhutan can be deputed in areas where similar construction takes place. In case of different type of construction, new master masons will have to be trained and deputed. These socio-facilitation centres will mostly be required in 4 *dzongkhags* of Haa, Paro, Samtse, and Chhukha as 62% of the total damaged houses are in these *dzongkhags*. A team of 15-20 master masons at Dzongkhag level could be placed with responsibilities of villages and a clear schedule of visits planned for each week. They could be coordinated by Dzongkhag engineer. This team could provide guidance to house owners about possible technical solutions and also help them liaison with gewog and Dzongkhag level administration. The assessment team has estimated Nu. 24 million for this purpose for a period of two years.

The socio-technical facilitation centres with help of master masons and master carpenters should reach out to each house owner during reconstruction of their house to ensure incorporation of appropriate seismic safety features. They can also provide on-site training to masons of house owners and prescribe incorporation of appropriate safety features at particular stage of construction. Information management and support to vulnerable households such as women headed households, old aged people or physically challenged could be provided specific attention through this mechanism making the process of reconstruction more inclusive.

Housing Unit Size

People have houses of varying sizes. The reconstruction will also require the flexibility to allow house owners to build house as per their requirements. However, minimum area for reconstruction should be specified that needs to be essentially constructed with financial assistance provided. The field assessment team found most of the houses to be between 400 sq.ft. to 1600 sq.ft. Taking lifestyle and utility considerations into account, field team recommends minimum area of 400 sq.ft. The house owners should be free to add their own resources if they wish to make their houses bigger. The financial assistance should ensure provision of toilet as essential element by making either a separate provision or including in overall housing assistance.

Sample designs of rural houses for different construction typologies suitable for different geographic regions should be developed considering the costs recommended by reconstruction programme. These should ensure safety features as well. These ready designs could be made available to the community for their use and reference. Proper guidelines for using the plan should also be provided to the carpenters and house owners.

Technical Assistance and Supervision

The scale of damage is large and widespread. Approximately 7965 houses will have to be repaired and reconstructed. It is essential to set up a system of technical assistance and supervision at national and Dzongkhag levels to ensure smooth progress towards the intended objective of safe houses. As the expert structural engineering resources are limited in the country, external expert assistance may be availed. A technical committee mandated by the highest offices of RGoB must be put in place to provide required technical guidelines for appropriate and contextual construction systems that can improve the seismic resilience of their houses and can be easily adapted by local artisans and community.

There should also be systematic monitoring of the progress and extent of incorporation of seismic features in new construction. Any technical issues, bottlenecks, confusions can be resolved by this empowered technical committee. Mid-term and concurrent third party quality audits can also help this process and ensure improvement of the quality of reconstruction. Towards this, provision of Nu. 2.7 million is estimated.

Repairs and Retrofitting

About 7620 houses have suffered minor or major damages and therefore need to be repaired. Different typologies of the houses have suffered different damages. Predominantly there are rammed earth and stone masonry in mud mortar houses. A large number of houses are also of hybrid/composite variety. Earthquake has caused damages like vertical cracks at corners and separation of walls, corner damage and collapse, diagonal opening cracks, partial wall collapse, displacement of *rabsey*, bulging and delamination of stone walls, etc. As most of the people have not much experience of earthquake damages and the solutions, it is likely that there is feeling of need to completely rebuild. This will be huge drain on not only modest national resources but also significant impact on natural and environmental resources. It is, therefore, essential to provide appropriate guidance for possible repairs and methods of retrofitting, so that the damaged structure is not only restored but has better seismic performance in future. There would require accessing technical expertise from outside Bhutan for retrofitting of rammed earth and stone masonry houses (Please refer Annexure-9 for Repairs, Restoration, and Retrofitting of Vernacular Buildings). It is very important for Bhutan to use this as an opportunity to build these capacities and provide people with fewer resources solutions to undertake repairs without blindly advocating for reconstruction of repairable structures. There is need to develop a solutions kit for repairs and retrofitting that provides technical options, estimates of material and costs. This should be widely disseminated to Dzongkhag and gewog officials, engineers, and artisans. Some pilot repairs and retrofitting should also be taken up on priority basis to restore confidence of all involved stakeholders in this process. The assessment team has estimated provision of Nu. 5 million for accessing technical expertise for repairs and retrofitting of vernacular building systems.

Capacity Building of Artisans and Engineers

After the earthquake it is very important to restore the confidence in construction practices by creating awareness on the causes of building failures, wisdom of traditional building practices, modern scientific analysis, and positive steps and actions. Local artisans who are the key service providers in the process of reconstruction should be targeted for awareness and training. The local artisans are the knowledge resource and guides for rural families. The training of artisans should be conducted in manner that their knowledge and wisdom is respected and not disregarded. External inputs should not be seen as rejection of their wisdom and experience. In an owner driven reconstruction process they need to be mobilized in support of the programme and technical options. Any gaps in current practices should be identified and addressed in a participatory manner.

Also the Dzongkhag and gewog engineers should be oriented and trained on aspects of seismic safety in vernacular building systems. They should be oriented also about the strengths of traditional artisans.

As the artisans in the eastern parts of Bhutan have already gone through the process of training and reconstruction after 2009 earthquake, the process of knowledge sharing between community from the east and west would strengthen the local artisans who will be involved in reconstruction. Interaction between community members who have suffered and rebuilt their houses and the affected families in the western part of Bhutan would bring about learning useful for the reconstruction programme. Such interactions should be encouraged through well-planned events. Assessment team has estimated about Nu. 5.0 million for these capacity building activities.

Financing of the Housing Reconstruction

Total loss for the shelter sector has been estimated at Nu. 774.00 million. The actual cost of repair and reconstruction of houses actually will vary because house sizes, materials, and technologies will differ with people's preferences. Financing of the house reconstruction will also include insurance payouts, use of salvaged materials, and self-contribution of the families. This will have to be augmented with additional financial support from the Government to enable reconstruction of houses. The insurance payout is linked with the extent of damage where only fully collapsed houses will get 100% of insured coverage of Nu.100,000. Major and minor damage payouts have been assumed to be Nu. 20,000 and Nu. 5000 respectively on an average. This may result in about Nu. 97.5 million from insurance payouts. Salvaged material is estimated at Nu. 152 million. Nu. 152.2 may be contribution from the community in form of their own labour for the reconstruction of their houses and *Kidu* grants. The following table summarizes these details.

Damage Category	Houses affected	Finance Source (Amount in Nu., million)			
		Through Insurance	Material Salvaged	Kidu Grants and Self Contribution	Additional Support
Totally collapsed/ beyond repairs	345	34.5	69.0	34.5	69.0
Major damage	1660	33.2	83.0	58.1	124.5
Minor damage	5960	29.8	0	59.6	178.8
Total	**7965**	**97.5**	**152.0**	**152.2**	**372.3**
		774.0			

This means **Nu. 372.3 or USD 7.60 million** will be additional requirement for reconstruction of houses. This translates into Nu. 200,000 support to totally collapsed houses, Nu. 75000 support to houses with major damages and Nu. 30000 support to houses with minor damages. Support that the Government may provide to RCIB for insurance payment settlement is not accounted. To ensure reconstruction worth Nu. 774.0 million, 38.7 million (5% of 774 million) should be provisioned in the following manner to ensure effective implementation. Thus the total outlay for reconstruction support to houses through owner driven process should be Nu 411 million (USD 8.39 million) as follows.

	Costs for Reconstruction of Houses	Estimated amount (Nu. million)
1	Housing reconstruction assistance through programme	372.3
2	Damage categorization related programme expenses	2.0
3	Socio-technical facilitation	24.0
4	Technical assistance and supervision	2.7
5	Accessing technical expertise	5.0
6	Capacity building of engineers and artisans	5.0
	Total Housing Reconstruction Support	**411.0**

4.2 Government and Other Public Buildings

Gup offices and other public buildings such as telecom office, district court, Bank of Bhutan buildings, etc. will also need to be repaired. The details of damage to these structures have been discussed in section on damage and loss assessment. Respective institutions can undertake repairs and reconstruction. In some cases, they may have to review the existing

details to ensure seismic safety. For example, the field assessment found damage of Jumthogs at the district court of Samtse due to faulty design. Heavy RCC canopy structure designed to stand on four corner columns were unable to take axial loads during earthquake. Such structural details will need rectification. Prior to repairs, proper structural assessment and design need to be undertaken. As most of these government and public buildings are RCC frame or load bearing cement mortar structures, compliance to building codes should be ensured.

The loss due to damages to government and public buildings has been estimated at Nu. 16.73 million (USD 0.34 million). The assessment team estimates that with the incorporation of disaster safe construction features the financial figures will go up by 10% and therefore **Nu 18.40 million (USD 0.38 million)** will be required.

4.3 Religious and Cultural Heritage Buildings

Restoration and reconstruction of religious and cultural heritage structures would require involvement of local skilled artisans. Although it is seen that some of the traditional construction have withstood the 2011 earthquake and even those that have been severely damaged have withstood a number of earthquakes in the earlier days, it is observed that good practices of construction techniques have deteriorated over time and this would be huge loss in the long run. Therefore, it is of very high importance to strategize on how to revive these skills. However, in the aftermath of the earthquake, this would pose a real challenge.

A strong and effective coordination mechanism should be developed between the Dzongkhag, which is the implementing agency and the local community which contributes from labour for the reconstruction of the *lhakhangs*. Based on experiences of the 2009 earthquake reconstruction, it is advisable to have a standard method (adopted by the government) in all the affected areas on how to go about with the reconstruction / restoration work, especially in the method of awarding the work, involvement of the local community, assistance by the government, etc. This would help to have uniformity in the execution of the recovery works but also prevent auditing problems to the implementers at a later stage.

Every *lhakhang* has its own unique architecture, which makes it different from the other. Therefore, in the reconstruction and recovery phase it is important to retain the unique architectural features of the *lhakhangs* as much as possible rather than adopting a uniform architecture for all such structures across the region. The new structures should retain the original architecture as far as possible with traditional local materials but be restored / reconstructed using improved construction techniques and inclusion of structural safety features to make them more resilient to earthquakes.

The Department of Culture could provide the necessary technical assistance during the restoration works, including recommendations for repair and restoration measures, based on discussions among the Department of Culture and the District Engineers on the restoration and reconstruction of heritage sites. These discussions should focus on issues related to conservation guidelines, revival of traditional construction techniques and materials, etc. and also be used as a platform to share the findings in the field by the District Engineers and formulate strategies for the recovery phase. Since the local construction materials and techniques for rural houses and heritage sites are same, the same platform of discussion could also be applied for providing technical backstopping to the public for reconstruction of rural houses.

In the case of *lhakhangs* in remote locations (far from the road head), in addition to ensuring the availability of suitable building materials and labour, efforts should be made by the local administration to improve the living conditions of the monks for eg., by providing access to

water as part of the reconstruction project where there is a shortage of water. This would not only make the reconstruction process faster and of better quality but also solve water shortage faced by the monks.

In order to ensure the quality of work, it is extremely important to provide proper monitoring. In order to account for the shortage in technical staff, a pool of engineers should be created at the Dzongkhag level to oversee the reconstruction work. Special regulatory measures need to be taken at the Dzongkhag level to monitor the reconstruction/restoration of religious and cultural heritage properties such as the *Ihakhangs* to minimize chances of incorporation of new features which did not exist before the disaster or expansion of the structure. However, essential ancillary buildings such as toilets, common kitchen and dining areas, storage spaces etc., should be incorporated in the reconstruction or restoration plan.

The method of awarding the work can also influence the quality of construction as parts of the same structure constructed through different modalities such as Woola (Compulsory Community Labour or Contractors exhibited varying degrees of damage (also quality of construction). One of the important factors that need to be considered while adopting the method of execution is the difference in wage rate set by the government and the prevailing wage rate in the private market. The table below indicates the difference in wage rates:

Category of labour	**Government Rates (Nu.)**			**Private sector Wage Rates (Nu.)**	**Remarks**
	Previous Rate	**Revised Rate**	**Revised rate with 50% Zorig Chusum**		
Unskilled	100	165	165 Zorig Chusum N.A.	250	Minimum without food
Mason Gr.3 Carpenter Gr.4	110	180	270	300 - 350	
MasonGr.2 Carpenter Gr.3 Lharib Gr.3	120	195	292.5	350 - 400	
MasonGr.1 Carpenter Gr.2 Lharib Gr.2	135	220	330	450 - 500	
Carpenter Gr.1 Lharib Gr.1	150	240	360	450 - 500	

Note: The *Zorig Chusum* allowance is not uniformly applied and varies from project to project.

After the 2009 earthquake, the government provided financial assistance for the reconstruction / restoration of all damaged *Ihakhangs* irrespective of its ownership. The loss due to this earthquake has been estimated to be Nu.340.91 million (USD 6.96 million). Now with incorporation of seismic safety features the assessment team estimates 10% more requirement. Therefore, this assessment estimated need of outlay of **Nu.375.0 million (USD 7.65 million)** for repairs and restoration of religious and cultural heritage buildings. Conservation and landscape planning can enhance the value of cultural heritage sites but these costs have not been included. Similarly conservation costs if any for relics, murals, artifacts, etc. have not been estimated. Present assessment has focused only on the buildings.

4.4 Educational Buildings

Repairs and reconstruction of schools falls under Ministry of Education. School Planning and Building Division (SPBD) is a special body under the ministry to provide technical support. SPBD should take proactive role in repairs and reconstruction of the schools and develop design and drawings for the repairs and reconstruction. SPBD should also develop guidelines for retrofitting of the schools to ensure seismic safety of these buildings.

The field assessment found that the standard school building designs developed by the SPBD, are not strictly adhered to. Even when the designs are followed, poor quality construction practices render these structures vulnerable to earthquakes. These are attributed to adjustments made to the original design due to lack of funding to meet the design specifications or lack of timely and adequate supervision due to human resource constraints as reported by the *dzongkhags*. Therefore it is important to set up a system of monitoring during the recovery and reconstruction phase to ensure the adherence to structural safety. SPBD should also review its standard designs to comply with the seismic building codes. During field visit to school at Kamji, Chhukha Dzongkhag, the assessment team felt that columns of new blocks that were under construction had slender tall columns, lacked continuous lintel band and had very large openings in the load bearing walls.

The costs for repairs and reconstruction have been taken 10% more than the loss estimated as there will be additional costs for incorporating seismic safety features. The cost of repairs for primary schools (including Community Primary Schools) that have been damaged in varying degrees (details in Section 1 on damage and loss) has been estimated at Nu 34.16 million (USD 0.7 million). The cost of repairs for the LSS/MSS/HSS has similarly been estimated at Nu 21.04 million (USD 0.43 million). Thus, the total cost of repairs for damaged educational institutions is approximately **Nu 55.20 million (USD 1.13 million).**

4.5 Health Facilities

Health facilities have not suffered very serious damage. Total 9 hospitals, 40 Basic Health Units (BHUs) and 11 Out Reach Clinics (ORCs) have been damaged but the major damage has been only in 2 ORCs. All other facilities have suffered only minor damage. Ministry of Health (MoH) has a technical division that supports and guides construction of health facilities through, design, drawings, specifications and estimates. Dzongkhag health division monitors and implements the construction. For repairs and reconstruction also the technical division of MoH and Dzongkhag health divisions will have to coordinate. There will be need to undertake detailed assessment of affected health facilities and prepare repair and retrofitting plans. The costs for repairs and reconstruction have been taken 10% more than the loss estimated as there will be additional costs for incorporating seismic safety features. For the repairs of health facilities there is need of outlay of **Nu.11.25 million (USD 0.24)**. As repairs and retrofitting are special measures and are not normally implemented, extra care will be required in ensuring specifications and details through more intensive monitoring.

4.6 Water and Sanitation Infrastructure

Field assessment team observed that from some of the locations, the horizontal distance to procure water was more than 100 m or vertical distance more than 50m. The coverage of Rural Water Supply Schemes varies. The field team based on its observations and discussions with Dzongkhag officials estimated that approx. 30% of the affected households may be required to be covered through extension of water supply schemes or linking them with new water sources. Considering a rough estimate of Nu. 60000 for 20 households, the team suggests Nu. 4.5 million to reach to 1500 households. This work may also include repairs of intake reservoir tanks and broken pipes. It may be necessary to confirm whether

10th five-year plan aims to cover these households through RWS scheme. 10th five-year plan has aimed to provide safe drinking water in rural areas. The assessment team as of now has included this cost in proposed reconstruction measures.

Reconstruction approach needs to be based on the principle of 'build back better'. It is essential to ensure appropriate sanitation in all repaired and reconstructed homes. As in the early recovery needs for water and sanitation, it was estimated that 750 households may not have adequate access to toilets. It is, therefore, essential that all these households build toilets along with the houses. It is estimated a pour flush latrine costs about Nu. 10000. On contribution basis, toilet construction should be promoted by providing Nu. 5000 per toilet towards substructure and toilet pan. Remaining Nu. 5000 may be contributed by the home owners. This would require Nu. 3.75 million. Past experiences have shown that construction of toilets should be accompanied by WASH training to raise awareness on hygiene and promote use of toilet facilities. Total recommended outlay for repairs and reconstruction of water supply and sanitation is **Nu. 9.0 million or USD 0.18 million**.

4.7 Agricultural Infrastructure

Repairs and reconstruction of RNR centres may be assumed at 10% higher cost than the total loss so as to ensure inclusion of seismic safety features by making extra provisions. Total loss of RNR centres is estimated at Nu. 4.80 million and therefore, cost of reconstruction may be estimated as **Nu. 5.28 million (USD 0.11 million)** counting 10% extra provision for seismic safety. Cost of repairing and reconstructing irrigation canals is estimated to be **Nu. 0.85 (USD 0.02 million)**. Total cost to repair and reconstruct agriculture infrastructure would be **Nu. 6.13 million (USD 0.13 million).**

4.8 Aggregated Costs of Reconstruction

Aggregated reconstruction costs with sector wise has been estimated at Nu. 885.98 million or USD 18.1 million. The details of reconstruction costs are summarized in the table below.

S.N.	Expenditure Head	Total Cost (Nu, Million)	Total Cost (USD, Million)
1	Housing	411.00	8.39
2	Government and Public Buildings	18.40	0.38
3	Religious and Cultural Heritage Buildings	375.00	7.65
4	Education	55.20	1.13
5	Health	11.25	0.24
6	Water Sanitation	9.00	0.18
7.	Agriculture Infrastructure	6.13	0.13
		885.98	**18.1**

SECTION 5: The Way Forward - Disaster Preparedness and Risk Reduction

The assessment team has identified eight thematic areas to enhance disaster preparedness and risk reduction in Bhutan.

5.1 Emergency Preparedness

Early Warning System and Operations Centre

Standard Operating Procedures (SOP) for the line departments is one of the key tools, which defines the roles and responsibilities of different departments in the event of a disaster. During the September 2009 earthquake that affected Bhutan, the need for such a tool was strongly felt by the DDM. Under the Regional Climate Risk Reduction Project (2009-2010), a UNDP-ECHO pilot initiative, in order to strengthen emergency communication and response capacities of the institutions at the national and district level in Bhutan, a series of consultation meetings pertaining to setting up Emergency Operations Centres (EOC) were held in Punakha, Wangdue Phodrang, and Bumthang. On the basis of discussions in these meetings, Departmental SOPs for EOCs and guidelines for emergencies in the form of an EOC Operational Manual were developed to strengthen disaster response capability in the country. About sixty districts officials were oriented in the operation of EOCs with a hands-on training on radio communications/VHF sets. Towards setting up an EOC at the district headquarters of Punakha district, basic communication hardware such as radios and VHF sets were also provided. In the aftermath of the 2011 earthquake, the emergency equipments could not be used as the system was not set up. In the case of *gewogs* in remote locations, it is important to provide VHF equipments to the Gups and the other *gewog* officials and test the efficacy of such systems.

Strengthening Telecommunication Networks

The telecommunication network was jammed after September 18, 2011 earthquake. This hampered connectivity, quick flow of information and response. DDM is in process of finalizing a telecommunications master plan. Upon finalization of this plan, the equipments will be procured and provided to key officials central to disaster response. This is an important initiative and would strengthen emergency response and coordination among various levels of the government.

Prepositioning of Emergency Stockpiles

The mountainous terrain of Bhutan poses additional challenges in terms of responding to the needs of the dispersed population in the event of an emergency. Not all the *gewogs* are connected with a motorable road. Also, there are villages which can be reached only in 2-3 days from the dzongkhag headquarters. Emergency stockpiles at gewog and dzongkhag levels need to be planned, instituted and implemented. Currently, at dzongkhag level, there is provision for stockpiles that can be used at times of emergency. This includes emergency kits, tarpaulins, CGI sheets, dignity kits. In addition to such materials, WASH materials should also be included in the stockpile to meet the water, sanitation and hygiene needs of affected population. To make the disaster response quick, it is being proposed if the emergency stockpiles could be pre-positioned at gewog level. The field discussions during the assessment visit strengthened the idea. However, standard operating procedures for gewog officials to use and distribute items from the stockpiles will have to be defined and also there will have to be a system by which the stockpiles could be replenished. In the long

term, it will be a good step towards disaster preparedness to institute emergency stockpiles at gewog level as well as the dzongkhag level.

During field visits, the assessment team observed variations in the distribution of relief items such as UNICEF emergency family kits. While some *dzongkhags* distributed kits to the most affected families, in other cases distribution of stockpiles was not undertaken. The observations during field visits indicated the lack of clarity among the officials regarding when and whom these kits should be given. These guidelines should be accepted and agreed by all *dzongkhags*. Now when prepositioning of stockpiles is being considered, it is likely that it will be more effectively utilized as community is much closer at gewog level. However, there will still be a need of commonly accepted and agreed guidelines for the distribution.

5.2 Risk Assessment

Preparedness for risk assessment is an area that needs to be strengthened for DDM in Bhutan. The capacity for disaster risk assessment need to be strengthened technically by preparation of seismic zonation maps at macro and micro level, hazard vulnerability and risk maps, etc. This need was also identified in the assessment report after the 2009 earthquake.

The DDM should undertake institutionalization of the process of disaster damage assessment. The process of damage categorization needs to be refined with details of housing typologies. The BDA tools aim to systemize the process and are designed as a step in this direction. Institutional as well as technical challenges should be identified and solutions should be deliberated and implemented. The process of risk assessment is of a lot of concern for the affected community and can be a cause of dissatisfaction if not trusted by the community. A participatory framework will, therefore, be more appropriate. The BDA tools can be enhanced further by use of participatory methods. Such development and institutionalization should be a priority activity. DDM should consider training a cadre of volunteers that can be deployed immediately in the aftermath of a major disaster event, following which all government staff, if not directly affected themselves, will be overwhelmed with too many tasks.

5.3 Promotion of Disaster Safe Housing

As most of the rural housing stock is non-engineered and built over a long period of time by people with many constraints of increasing costs, lack of quality material, access to good skills, dilution of traditional wisdom and practices, it is highly vulnerable to natural disasters particularly earthquakes. It is essential to study the extent of this vulnerability, its causes and develop a mainstream housing improvement programme that aims to improve seismic behavior of buildings over a period of time.

Such a process also requires guidance in terms of rules of thumb and technical manuals to advise on vernacular building practices and make the houses safer. Such technical guidelines and manuals need to be developed and disseminated by making people aware and artisans trained. The provisions here may support a first set of trainings for the master masons and engineers. However, there should be a process of having refresher trainings once in six months during the period of reconstruction.

To strengthen the use of disaster safe construction, a pro-active demonstration of safe construction and seismic strengthening of existing traditional houses should be taken up. Actual constructions can also be the pilot training and learning sites for local artisans and community.

5.4 Improving Resilience of Critical Public Infrastructure

There are certain public functions that are extremely critical for *dzongkhag* and *gewog* level responses. Also, there are some critical services that communities should be able to continue to access without disruption. These include key administrative offices (including those functioning as EOC), police and fire stations, hospitals, etc. It is important to undertake a systematic process of identification of such critical infrastructure, map its vulnerabilities and make them resilient. Systematic assessment of structural safety of such facilities should be undertaken and typical designs be improved upon to incorporate disaster safe features. This will go a long way in strengthening capacities of Bhutan to cope, manage and mitigate disasters.

5.5 Taking Building Traditions and Heritage Forward

Cultural heritage has a key role in the socio-cultural community and national life in Bhutan. It is extremely important to protect it. The cultural heritage in Bhutan is not confined to monuments but is alive in form of actual practices. It is important to revive and revitalize the traditional building practices as part of cultural heritage where some dilution and deterioration is visible. Learning from traditional wisdom of the past and validating it with modern scientific analysis, the traditional building systems can be further enhanced.

There is also a need to train all the stakeholders who participate in disaster response such as the Royal Bhutan Army and volunteers on shoring of the cultural heritage properties that may have been impacted. This will contain further damage and hence reduce cost implications for repairs and restoration.

5.6 School Safety Programme

The response to the earthquake highlights the importance of trainings and mock drills in schools as children who had attended these trainings found themselves adept to respond to the earthquake by adopting suitable measures. They were also able to direct their parents. Therefore, it is important to regularly conduct such Safety Trainings and mock drills for the students as well as teaching and non-teaching staff in schools.

In addition to these non-structural measures, structural assessments of all the existing school buildings should be carried out and retrofitting measures undertaken, as deemed necessary.

5.7 Water, Sanitation and Hygiene Promotion

Water, sanitation and hygiene promotion is a critical area for response preparedness. Inadequacy of shelter conditions could lead to outbreak of diseases or epidemics, further worsening the situation. However, such conditions can be mitigated by preparedness planning. Awareness of communities and surveillance practices by local health facilities can be effectively enhanced during normal times. Therefore, focus on WASH awareness by all stakeholders is an important area of intervention. Towards this objective, a national level awareness campaign may be launched with the active involvement of key government ministries such as Ministry of Health, Education, and other development partners such as UNICEF and WHO. The DRR component of the Recovery and Reconstruction programme would provide technical and financial assistance in launching such an initiative. The WASH awareness building initiatives would need to be supplemented with sustained efforts from various government departments/ministries in providing adequate water supply and sanitation facilities to all the *dzongkhags* through long-term investments.

5.8 Psycho-Social Care

After a disaster it is difficult to identify psycho-social impacts as these do not come to surface easily. It is largely assumed that there have been no or little impacts. However, experiences from previous disasters suggest that where psycho-social interventions and care have been provided, such interventions helped communities to cope. To strengthen psycho-social need assessments and subsequently the care for the affected people, it is necessary to develop required tools and skills. As part of DRR programme, these components should be included to ensure timely response in future disasters. Developing assessment tools and strengthening counselors through training programmes need to be undertaken. Training of counselors can be focused at care givers in schools and local health facilities in all the *dzongkhags*.

5.9 Protection of Natural Resources

Efforts should be made to maintain the forest cover as it plays a vital role in preventing the occurrence of landslides. After the earthquake, numerous landslides triggered by the earthquake hampered the relief and rescue operations in Sikkim, India. Bhutan faced relatively fewer landslides as forest cover played an important role by holding the top soil. The roads like Phuentsholing that faced road blocks were in the area where forest cover has been affected due to developmental activities. It would be important to restore the forest cover at the earliest in these areas.

5.10 Institutional Capacity Building

There is need to strengthen and augment capacities of the DDM with trained human resources and good quality facilities. The assessment team would like to reiterate the recommendations made by the Joint Rapid Assessment Report after the 2009 earthquake with regards to institutional capacity building of DDM: “The capacity of national nodal department viz. the Department of Disaster Management (DDM) needs to be enhanced to disseminate the agenda of disaster risk management across the Ministries and sector-specific agencies. DDM should have enough human and technical resources to formulate and implement comprehensive risk management initiatives involving different agencies and stakeholders. It is also important to support capacity-building of other sector agencies like DGM, DOE, BSB (formerly SQCA) with respect to risk reduction, preparedness and response.” Formulating a programme after a capacity needs assessment of the DDM should be the next step.

There is also a need to build capacities for information management and coordination. Information at the time of disasters is not easily available. The systems and coordination arrangements that are in place during normal times play a critical role in information collection and management. The DDM needs to strengthen its capacities to facilitate collection and sharing of information as there are demands from different stakeholders and ministries for making appropriate response. The DDM is in process of institutionalizing the BDA tools. To be effective, the DDM should ensure the finalization of Standard Operation Procedures for the BDA tool and enlarge the scope to include coordination with various ministries and departments for information collection and management. Data collection, compilation, rationalization, verification, coordination and dissemination are the areas that need to be strengthened.

Strengthening capacities of local administration should be taken up through trainings for disaster response and recovery, management and mitigation. *Dzongkhag* administrations also need to be strengthened with human resources and facilities. Institutional systems such

as disaster response funds should be looked into as they can enable quick response from *dzongkhag* and *gewog* administrations.

5.11 Risk Financing

The assessment team would like to reiterate the recommendations made by the joint rapid assessment following the 2009 earthquake as they are still relevant. Bhutan has a unique and very important insurance programme by Royal Insurance Corporation of Bhutan (RICB) that covers rural houses. The assessment team observed in the field visit that it is one of the main instruments for rural households to plan their coping strategy for rebuilding their house. It is necessary to improve the payout process and avoid conflicting and repetitive assessments. It may be important to look into enhancing this insurance programme by increasing its coverage to include more households. The insurance may also look into aspect of linking it with financial incentives for incorporation of seismic features in the reconstructed houses.

In addition to the rural homes, efforts could be made to extend the insurance coverage to critical public infrastructure such as hospitals, key administrative buildings, police and fire stations, etc. which play a vital role in emergency response and coordination.

5.12 Aggregated Resource Requirement for DRR

The assessment team has generally observed similar directions for disaster preparedness and risk reductions as were indicated by the assessment after the 2009 earthquake. The assessment team suggests carrying forward the process more rigorously. **Nu. 80 million (USD 1.63 million)** are estimated to strengthen the DRR process through technical and handholding support to the DDM for implementing DRR programme components as outlined below. The RGoB should make long-term investment on DRR components to reduce vulnerabilities to future disasters. The following plan of activities proposes investments of Nu. 840 million over a period of time. The DDM should prioritize the DRR components and mainstream these activities as part of regular plan outlays.

The following table summarizes the above ideas and proposes a set of activities with estimated budget. The DDM can plan and take further steps as per resource mobilization and prioritization.

S.N.	DRR Programme Components	Project contribution (Nu. million)	Long-term Govt. Investments (Nu. million)
1	**Emergency Preparedness**		
	Early Warning Systems		50
	Emergency Operations Centre	5	50
	Telecommunication network		50
	Emergency Stockpiles at Gewog and Dzongkhag level	5	20
2	**Risk Assessment**		
	Seismic Zonation Maps	5	10
	Hazard Vulnerability Maps and Risk Analysis	5	10
	Development of Risk Assessment Tools and Methodologies	5	
3	**Promotion of Disaster Safe Housing**		
	Developing Mandatory Rules of Thumb for Rural House Construction	5	

	Guidelines, Manuals and Training of Artisans and Engineers	5	5
	Demonstration of Seismic Strengthening and Safe Construction		10
	Community Awareness through Popular Media		5
	Developing methodologies and assessing Vulnerability of Existing Housing Stock	5	
4	**Improving Resilience of Critical Public Infrastructure**		
	Identification and Assessment of Critical Public Infrastructure	5	
	Strengthening of Critical Public Infrastructure		45
5	**Taking Building Traditions and Heritage Forward**		
	Seismic Strengthening of Key Heritage Buildings	10	500
	Guidelines, Manuals and Training of Artisans and Engineers	5	5
6	**School Safety Programme**		
	Assessment of All Existing School Buildings and Improvement of Typical Designs		10
	Non-structural mitigation, Trainings and Mock Drills		10
	Seismic Strengthening of Schools - Pilots	5	20
7	**WASH Promotion**		
	Awareness programme	2	5
8	**Psycho-Social Care**		
	Development of Assessment tools for Psycho-social impacts	5	
	Training of counselors in schools and health facilities	5	10
9	**Institutional Capacity Building**		
	Strengthening of levels of administration (DDM, *Dzongkhags*, *Gewogs*)	5	10
	Creation of Disaster Response Fund		20
		82	**845**

SECTION 6:

Overall Costs and Recommendations

6.1 Overall Costs

The overall recovery and reconstruction cost is estimated at **Nu. 1108.07 million (USD 22.63 million).** This includes implementation support of Nu. 72.49 million (USD 1.48 million) for early recovery, reconstruction and DRR components at 7% of the total programme components. While the DRR component covers the entire country, the early recovery and reconstruction components would directly benefit approximately 7,965 families affected by the 2011 earthquake. Financial planning and a well-designed implementation strategy will be essential to ensure successful and effective recovery and reconstruction. The resources for implementation support may be planned in a phased manner over two years of programme implementation.

S.N.	Programme components	Total Cost (Nu. Million)	Total Cost (USD Million)
1	Early Recovery	67.60	1.38
2	Reconstruction	885.98	18.10
3	DRR	82.00	1.67
	Subtotal	**1035.58**	**21.15**
4	Implementation Support @7%	72.49	1.48
	TOTAL	**1108.07**	**22.63**

6.2 Summary of Recommendations for Implementation

Early Recovery (3-5 months)

1. The early recovery process should include support for interim shelters, dismantling of severely damaged houses, and salvaging of materials. Moreover, support should also be provided for water storage, sanitation, hygiene promotion, and storage of harvested crop as discussed earlier in the document. This phase should mobilize the community with the agenda of rebuilding their lives and would serve as the stepping stone for long-term reconstruction and rehabilitation.
2. The re-verification of damage categorization is important. Currently there are several discrepancies including the extent of damage being over-rated. This may be due to the absence of a standard methodology and the limited capacity at the local level. During the early recovery phase, it is important to clarify damage categorization as discussed in Annexure-8. Trainings should be provided to the assessors on the damage assessment process and methodologies used. They should also be imparted with the necessary understanding on the use of indicators for different housing typologies, and equipped with tools such as uniform formats, and if possible a visual guide for damage categorization.
3. As discussed in the early recovery section, it is important to make interim arrangements for the protection of damaged religious and cultural heritage buildings to ensure that physical condition of these damaged structures do not deteriorate further until the reconstruction process is initiated. Similarly, interim arrangements for essential educational institutions, public buildings and services like *gup's* offices should be made where the damages have been extensive.
4. Health surveillance should be a priority as the impending winters would expose those living in inadequate shelters to the greater at risk of respiratory disorders, diarrhea,

etc. In particular, pregnant women, mothers, infants and the elderly may need special care.

5. Provision of psycho-social care is important. Even though more than a month has passed after the earthquake, people are still trying to piece together their lives. Counselors in the schools and health facilities should be sensitized, oriented and trained to respond to provide psycho-social care in the affected communities. At the same time it is important for the administrations to ensure confidence and assure that their lives will return to normalcy soon. Therefore, early recovery and reconstruction support are essential.
6. Early recovery is also the phase to embark on planning, policy making, setting up institutional arrangements and coordination mechanisms for the reconstruction phase. The next 3-4 months will be critical and these processes must be taken in parallel to early recovery activities as outlined before.
7. Early recovery efforts should be built on the basis of community mobilization. This is a very important aspect and care should be taken to ensure a participatory process so that communities are not simply passive receivers of relief items. A community-based process, which identifies their role and responsibilities along with the support they receive from the Government, encourages them to undertake their own rehabilitation. Early recovery should be taken up in a campaign mode, one that can infuse energy in the whole community bringing positive outlook towards the future.

Recovery and Reconstruction (2-3 years)

1. There should be a clear articulation of the reconstruction policy, programme and overall package. This should include objectives, eligibility criteria, extent and details of financial assistance, systems of socio-technical facilitation, institutional arrangements, non-negotiable features, and roles and responsibilities of households and different levels of the government.
2. A community-led reconstruction programme should be taken up for a duration of 2-3 years.
3. Community-led reconstruction should not mean merely financial assistance to the affected households. It should ensure support in terms of knowledge, skills, and guidance through administrative and technical facilitation to incorporate seismic safety features in repairs and reconstruction.
4. Vulnerability reduction should be a national agenda and therefore, inclusion of seismic safety must be a non-negotiable feature. Assistance should be made conditional to achieving this objective at every stage of repair/reconstruction.
5. At the national level there should be two institutional arrangements specially for reconstruction – i) inter-ministerial committee for overall oversight, directions, monitoring, and decision making; and ii) high level technical committee of technocrats and experts to provide technical standards and guidelines, clarify confusions, and develop solutions during implementation.
6. DDM should coordinate and facilitate the reconstruction process through a special programme. If required, a special purpose vehicle may be established under DDM to perform this specific function. *Dzongkhags* should have primary implementation responsibility as well as to provide outreach services to communities for socio-technical facilitation. The systems at national and local levels should be instituted with clear mandate, and definition of roles and responsibilities.
7. Financial mechanisms for provision of assistance should be clearly worked out. The government should decide whether a special purpose vehicle will be an efficient and effective way forward. It is anticipated that the respective ministries will take the responsibility to coordinate with DDM and *dzongkhag* administrations for reconstruction. For eg., MoWHS for housing and public infrastructure, Department of Culture for cultural heritage buildings, MoE for schools, MoH for health facilities, etc.

8. An appropriate implementation framework as indicated in the document should be put in place with specific features described therein.
9. As there are concerns about expertise for repairs and retrofitting of vernacular housing of rammed earth and stone masonry load bearing housing, it is necessary to access this knowledge. Such expertise can be availed from outside Bhutan at a fraction of the cost of pulling down repairable houses. There are enough examples of repairs and retrofitting of non-engineered earth-based and stone constructions elsewhere in the world. If expertise is seen as a hurdle, efforts should be made to overcome it. This should also be seen as a process to strengthen the national capacities in Bhutan in dealing with similar situations in future.

IMPLEMENTATION FRAMEWORK for RECOVERY & RECONSTRUCTION

a) Governance and Programme Management

The Department of Disaster Management should be strengthened to steer the recovery and reconstruction programme. Therefore, it is necessary to have the required human resources and essential facilities at DDM to ensure coordination with *dzongkhag* administrations. The DDM also needs to build its capacities for managing different parameters of recovery and reconstruction outlined in this framework in a time bound manner. As Bhutan has a high risk profile, the DDM will need to deal with many complex situations particularly when existing rural housing stock continues to remain highly vulnerable. Capacities need to be developed for undertaking a technically rigorous, administratively efficient, comprehensive recovery and reconstruction programme.

b) Institutional Arrangements

The recovery and reconstruction programme needs to be taken on a priority basis so that the objectives are effectively achieved. It is therefore essential to set up an inter-ministerial body to coordinate with all departments and administrative levels and to provide oversight with the required financial and technical capacities.

As *dzongkhag* administrations will be the primary implementing authorities, they will need to be facilitated through steady finances, technical guidance and advice, monitoring and review mechanism support. A coordination system at the DDM level should essentially ensure this. The DDM's role will also be critical to ensure inter-departmental coordination at national level and ensure smooth flow of information and guidance/directions on reconstructions to *dzongkhags*.

For ensuring effective implementation of the recovery and reconstruction programme, it is essential to set up a system for developing technical guidelines for various types of materials and construction systems. The entity mandated to do this should among others, ensure continuous feedback and review of reconstruction to develop technical solutions and clarify contentious issues.

c) Appropriate Recovery and Reconstruction Policy Framework and Package

It is critical that a clear recovery and reconstruction policy framework is articulated with financial provisions for various sectors. The reconstruction of housing will require articulation of an assistance package for the affected families and this will have to be linked with damage categorization. Although the need for financial assistance has been assessed in this report (details in section 3, a.9), this will essentially depend upon finances made available for reconstruction.

d) Duration for Recovery and Reconstruction

The impact of this earthquake, though of low intensity, has been widespread. As compared to the 2009 eastern Bhutan earthquake, it has affected almost double the households. While most of the houses are in the minor damage category and can easily be repaired, accurate damage categorization, articulation of assistance packages, expediting insurance claims, making building materials and skills available, informing about seismic safety norms to be followed in construction and timely disbursement will pose challenges for reconstruction. Therefore, a timeline of 2-3 years is recommended for recovery and reconstruction. Recovery components should be implemented in the first 6-8 months and the 2 years recommended is for the reconstruction programme.

e) Eligibility Criteria

Clear and transparent eligibility criteria need to be articulated on the basis of damage categorization. Damage categorization at the moment is conflicting and confusing as the indicators have not been well-defined for different typologies. The perceptions of *dzongkhag* and *gewog* officials regarding the extent of damage and possible solutions tend to be subjective at the moment. The Joint Rapid Assessment team feels that there is a need for re-verification of the extent of damage and its categorization in the field. However, frequent assessments may not be the preferred option at this point in time, considering the time and resources involved. The process needs to be undertaken only after a mature level of preparation has been made with clear indicators and a good level of training and familiarity of the national assessment team. The human resources at *dzongkhag* and *gewog* levels should be augmented with more expertise and with the objective of setting up a well-trained pool of experts. This process must be undertaken with highest priority.

f) Disbursement of Financial Assistance

As per the assistance package articulated, disbursement of financial assistance will have to be planned and implemented. The disbursement may be in installments. The financial assistance needs to be timely and linked with incorporation of seismic safety features as defined by the technical guidelines.

g) Building Materials

Field observations of the assessment team indicate that many of the damaged houses have actually used poor quality materials. This is more of an issue for stone houses where rounded and small stones have been used. Also the quality of soil in rammed earth houses has been an issue as at many locations the appropriate soil type is not available. It is, therefore, important to promote an option of good quality materials at the community level. The communities should be guided on the quality of stones and soil to be used for reconstruction purpose. In addition alternative materials can also be added to the available options. The option of using stabilized soil cement blocks, which have been demonstrated well in Bhutan offer good walling options and such technologies, should be promoted.

h) Seismic Safe Construction

Ensuring a seismic safe reconstruction is a non-negotiable aspect to ensure reduction in vulnerability towards future disasters. The programme needs to be implemented in a way that repairs and reconstruction of houses has norms defined by technical guidelines. Technical guidelines should be drafted to promote simple rules of thumb that people can follow in the reconstruction and repairs of their houses. It will also be necessary to promote retrofitting of houses with minor and major damage.

i) Capacity Building

In order to ensure successful and effective implementation of recovery and reconstruction programme, there is a need to build capacities at various levels. *Dzongkhags* need to be strengthened with more technical and managerial human resources. *Dzongkhags* will have to undertake damage categorization, ensure house owner linkage and coordination, financial disbursement, management and monitoring, and linkage with various departments. Existing human resources may not be sufficient to provide the required attention to all these processes.

j) Facilitative and Monitoring Mechanisms

Mechanisms for facilitation and monitoring of reconstruction need to be set up. The communities will require socio-technical facilitation for administrative processes and technical advice for seismic safety. As the community has the most effective interface at *gewog* level, such facilitation mechanism can be best set up at that level. The facilitation set up should include administrative facilitator and master artisans who can visit repair and reconstruction sites. The role of master masons will be to advise house owners and their masons and carpenters during the different stages of repair or reconstruction, about seismic safety features and handholding them throughout the process. This is essential to ensure reconstruction is seismically safe and that the houses are not subject to the same vulnerabilities in the future.

There will also be a need for monitoring of progress and database management for such a large programme. A system of information management should be set up linking *gewogs*, *dzongkhags* and the DDM for accurate and timely information flow. It will also be useful to institute a third party technical audit for quality assurance for houses under repair and reconstruction.

Disaster Preparedness and Risk Reduction

The national priority for institutionalization of Disaster Preparedness and Risk Reduction is already being accorded through the proposed Disaster Management (DM) bill to be presented to the Parliament in the next winter session. The DM bill rightly envisages institutional arrangements at various levels of governance and appropriate provisions have been included to strengthen preparedness and risk reduction capacities. Many of the recommendations by the Joint Rapid Assessment team present a programmatic framework and are in line with the provisions of the DM bill. The Assessment team would like to make the following recommendations with regard to the implementation of disaster preparedness and risk reduction initiatives:

1. Section V on Disaster Preparedness and Risk Reduction presents a long list of programmatic actions. These actions need to be prioritized through a national consultative process. This is necessary because commitments should be made to include long-term investments for such programmes through the five year plans.
2. Disaster Risk Reduction needs to be mainstreamed by each ministry in its respective programmes. The DDM as a coordinating body should encourage and promote this. The inter-ministerial body - National Committee on Disaster Management (NCDM), as envisaged in the DM bill, should provide oversight and review regularly the inclusion of DRR in all national development programmes.
3. DRR programmes aim at long-term vulnerability reduction, preparedness for quick and efficient response and mitigation activities. It is important to build capacities of institutions at various administrative levels. A comprehensive assessment of existing capacities and gaps should be made on a priority basis and following that a strategy should be articulated for the capacity building.
4. The DDM as the coordinating body for DRR should develop a knowledge base on various subjects such as hazard and vulnerability mapping, standards for relief, response and reconstruction, implementation of the DM bill provisions, as well as derive learning from experiences and disseminate the same, build capacities of various institutions and coordinate implementation of DRR programmes.
5. The DM plan as envisaged by the proposed DM bill has already identified hazard, vulnerability, and risk assessment and mapping as key priorities and has identified nodal ministries and departments. The process must be taken up in an expedited manner as they form the basis for the formulation and implementation of future preparedness and risk reduction initiatives.
6. The Assessment team has proposed provision of technical hand-holding on certain priority areas under DRR. This would help in developing a comprehensive DRR

action plan. As part of this earthquake rehabilitation programme, DRR processes should be further strengthened.

7. For rural housing, enforcement of building codes is not easy as most of the houses are owner built and non-engineered. Therefore, it is important for Bhutan to develop mandatory rules of thumb that can be understood and used easily by artisans and house owners, thereby improving seismic safety of the built environment. Experiences from Nepal and India can be particularly useful in this regard.
8. Academic institutions should internalize disaster management as an area of education and research. Schools should, in particular, include DRR not merely as an additional activity but as part of their overall curriculum. The engineering colleges should focus on learning from disasters and strive to include relevant academic information in their curriculum and research programmes. The academic institutions should also play an active role in the training/capacity building programmes.
9. Relevant Government Departments/Ministries must focus on making all schools, critical public infrastructure and health facilities safe by assessing the safety of existing structures and adopting appropriate structural measures to strengthen the existing buildings. The monitoring mechanisms for overseeing construction of new buildings should also be strengthened. Non-structural interventions should be scaled up.
10. Emergency preparedness activities such as preparation of Contingency Plan, setting up of Emergency Operations Centers (EOC) and communication systems, prepositioning of stock piles, etc. should be implemented on a priority basis. It is important to clearly articulate roles and responsibilities in the form of standard operating procedures for effective response.
11. Development of appropriate indicators of damage for each typology, reference materials, visual guides and toolkit should be taken up for future use in damage assessment processes. Training should be provided to *dzongkhag* and *gewog* level officials on this subject.
12. The focus on assessment by *dzongkhag* administrations has been mainly on structural damage and the collection of demographic data, population figures and gender disaggregated date, including psycho-social impacts have been largely ignored. It is important to collect such data and information to identify the need and nature of humanitarian assistance required in the aftermath of such disaster.

Based on this assessment report, the Royal Government of Bhutan is expected to be able to formulate a programme to help affected families recover effectively from the impact of the disaster and strengthen their resilience.

Annexure-1

Terms of Reference

Joint Rapid Assessment for Recovery, Reconstruction and Risk Reduction

II. Position Information

TITLE: Joint Rapid Assessment Team
LOCATION: Bhutan
DURATION: 3 weeks
SUPERVISOR: UNRC
LANGUAGE: English

III. Background & Organizational Context

An earthquake of magnitude 6.9 on the Richter Scale struck Bhutan on 18 September 2011 at 6:41 pm, the epicenter of which was in Sikkim (42 miles northwest of Gangtok), India, close to Bhutan's western border with India.

As of 27 September 2011, the Government of Bhutan has reported 1 fatality and 14 injuries. All of Bhutan's 20 districts have reported damages to homes and social infrastructure including schools, basic health units/outreach clinics, hospitals, offices, *Dzongs*, monasteries and *choetens*. Overall, it is reported that over 8,000 houses have been affected by the earthquake. Reports of damages are still being submitted by Dzongkhag administrations and the full extent of damages is yet to be ascertained.

The Royal Government of Bhutan (RGoB) has made an official request for assistance to the UN System in Bhutan, including a request for fielding a mission to the affected areas to conduct a joint rapid assessment of damage and losses in order to determine the extent and cost of the damages and recovery and reconstruction needs. The mission will also assess the need for further relief and early recovery assistance to the affected population. The disaster is expected to have affected a larger number of households in more *dzongkhags* (districts) than the earthquake of September 2009 which touched 12 districts in eastern Bhutan, as compared to all 20 *dzongkhags* in this case. While no estimate is yet available, the cost of reconstruction is anticipated to be extremely high and will further divert resources from the ongoing 10th Five Year Plan. Assessment of damages caused by the earthquake is being undertaken by the Government in consultation with the district authorities, with a preliminary attempt at classification. However, efforts to carry out a comprehensive assessment are hindered by the large size of the affected area, the large number of affected buildings, difficult road access, and remoteness of some of the affected communities.

The UN Country Team (i.e. the UN Agencies, Funds and Programs and the World Bank) have offered support in terms of meeting the immediate and long-term recovery needs of the affected population and in mobilizing additional resources, if required. The request for assistance from the Government has come as a response to this offer.

IV. Objectives of the Joint Rapid Assessment

The objectives of the Joint Rapid Assessment mission are the following:

a. To assess the damage and loss, in the aftermath of the earthquake, with particular attention to classification of the level of damage so as to enable provision of further relief and early recovery assistance to the affected population and to assess the recovery and long-term reconstruction requirements.

b. Prepare damages and needs assessment report for use by the Government and Development partners to help prioritize assistance and serve as a basis for the mobilization of resources for recovery and reconstruction planning.

V. Methodology/Organization of the Team

Given the context of Bhutan, as in the past, the assessment will combine post disaster damages and needs assessments to generate information that will allow the RGoB to plan and budget for further recovery and reconstruction efforts.

The damage assessment will be based on the methodology deployed in the aftermath of the 2009 earthquake, with a standardized classification of the levels of repairs required in four categories. This will be complemented with data on the post-disaster needs assessment to be generated using the Bhutan Disaster Assessment (BDA) tools launched in March 2011, thereby providing an opportunity to further test the tools before their final roll out by the RGoB. For practical reasons and to reduce the burden on the *dzongkhags*, the needs and damages assessment teams will be combined into one team.

The damage and loss assessment will be carried out by international and national experts that will assess the extent of the damages and costs associated with the damages. The team will comprise of members from UNDP/BCPR, UNOCHA, World Bank, and RGoB. The BCPR will provide the team leader.

The field work will consists of physical visits to selected earthquake-affected areas followed by focused discussions with the affected population. The team will rely on primary data collected by the Department of Disaster Management (DDM) from the *dzongkhags* beforehand.

The post disaster needs assessment component will be carried out by RGoB and UN personnel based on the on the BDA tools. The BDA questionnaire for Local Authorities (LA) as a priority will be completed in selected earthquake-affected communities. The team will gather information with the assistance of the Dzongkhag and local authorities. Simultaneous on-site data entry during the field assessment will be carried out by the team if feasible.

Based on discussions with DDM, both teams will proceed together to the *dzongkhags* to conduct a field assessment during the period from 3-12 October, followed by a period of consultation with concerned stakeholders in Thimphu and preparation of the assessment report.

The RGoB will extend support in terms of data collections and sharing, provision of necessary information and assistance, as well as logistical support to the assessment team.

VI. Functions/Key Results Expected

1. Under the auspices of the UNRC's Office, provide technical expertise to the Government and the UN Country Team for a well articulated and coordinated assessment of damages and the needs for early recovery and reconstruction. More specifically, the team will:

a) Conduct a joint rapid assessment mission to the most affected areas in close coordination and collaboration with concerned Government administrations/teams, the UNDEMT and the UNCT.
b) Identify the needs of the affected population with regard to relief, early recovery, recovery and long-term reconstruction, as applicable.
c) Prepare a post disaster needs assessment cum damage and loss assessment report for use by the Government and Development partners to help prioritize assistance and serve as a basis for the mobilization of resources.

2. Provide technical support to the government for the institutionalization at all levels (central, Dzongkhag and Gewog) of systematic and standardized post disaster data collection, with particular attention to damage classification and needs assessment through the application of Bhutan Disaster Assessment tools, including for the incorporation of cross-cutting issues into the assessment processes (gender, child, environment, etc.).

3. Facilitate the translation of the assessment findings into instruments for early recovery and long-term advocacy and intervention

a) Provide assessment input into the formulation of the interagency early and long-term recovery strategic framework
b) Provide support to the preparation of a strategy for resource mobilization and planning for early and long-term recovery implementation.

VII. Deliverables

a) Draft the damage loss assessment and needs assessment report, (requirements, resources and processes for implementation)
b) Debriefings with UNCT and Government leading to final report and priorities
c) Debriefings with Development Partners
d) On-the-job technical support to Department of Disaster Management
e) Documentation on the conduct of the needs assessment
f) Resource mobilization and implementation plan

VIII. Competencies and Critical Success Factors for International Team Members

Corporate Competencies:

- ❑ Demonstrates integrity by modelling the UN's values and ethical standards.
- ❑ Promotes the vision, mission and strategic goals against the context of UN and WB operation in Bhutan.
- ❑ Displays cultural, gender, religion, race, nationality and age sensitivity and adaptability.

Functional (UN) Competencies:

Knowledge Management and Learning

- ❑ In-depth technical knowledge of interagency needs assessment on relief, early recovery and reconstruction
- ❑ Seeks and applies knowledge, information, and best practices from within and outside of the early recovery cluster

Coordination Effectiveness

- ❑ Ability to lead the design and implementation of interagency needs assessment
- ❑ Ability to build and sustain effective partnerships with the Government, UN Agencies, the WB and other main constituents, advocate effectively, communicate sensitively across different constituencies

Management and Leadership

- ❑ Focuses on impact and result for the disaster-affected people.
- ❑ Capacity to gather comprehensive information on complex problems or situations; evaluates information accurately and identifies key issues required to resolve problems
- ❑ Consistently approaches work with energy and a positive, constructive attitude
- ❑ Demonstrates excellent oral and written communication skills.
- ❑ Builds strong relationships with clients and external actors.
- ❑ Manages conflict and stress, remaining composed and working as a mediator in crisis or antagonistic situations.
- ❑ Demonstrates openness to change and ability to manage complexities.
- ❑ Responds positively to critical feedback and differing points of view, and solicits feedback when needed.

IX. Team Qualifications	
Education:	Advanced university degree in political science, sociology, law, international relations, public administration, or other relevant field; or the equivalent combination of education and the extensive relevant professional experience in a related area.
Experience:	At least 10 years of progressively responsible professional experience in humanitarian affairs and/or development, including at least 8 years of experience at the international level. Part of that experience must be in the field involved with needs assessment and early recovery. Professional experience in Asia/Pacific would be a strong asset.
Language Requirements:	Fluency in written and spoken English
Other Skills:	❑ Familiarity with early recovery issues particularly with regard to contemporary assessment tools and methodologies. ❑ Demonstrated experience in humanitarian and/or development coordination. ❑ Excellent proven skills in analysis, negotiations and leadership and overall diplomatic skills.

	❑ Proven ability to carry out representation at the interagency forums. ❑ Familiarity with the Humanitarian Reform, IASC systems, and UNRC / HCT tools and procedures. ❑ Experience in preparation of written reports prepared in an accurate and concise manner, and public presentation skills. ❑ Experience in project design and planning ❑ Computer literacy, including familiarity with spreadsheets, and power point presentations.

X. Management arrangements
a) The mission is for 3 weeks from 2nd to 22rd October 2011 b) The team will report to the UNRC while maintaining a multiple reporting structure to: a. the UNCT b. RGoB c. the sponsoring agency/office

Annexure-2

Joint Assessment Team Members

Royal Government of Bhutan

Tenzin Choden	(Department of Disaster Management, MoHCA)
Chencho Tshering	(Department of Disaster Management, MoHCA)
Thinley Pelden	(Department of Disaster Management, MoHCA)
Keshup Moktan	(Department of Disaster Management, MoHCA)
Dechen Tshering	(Department of Culture, MoHCA)
Kaka Tshering	(Ministry of Education)
Neten Wangchuk	(School Planning and Building Division, Ministry of Education)
Khina Maya	(Ministry of Health)
Rinchen Namgyal	(Ministry of Health)

United Nations

Reshmi Theckethil	(UNDP BCPR, New Delhi)
Vivek Rawal	People in Centre Consulting (Consultant, UNDP BCPR)
Rajan Gengaje	(UNOCHA, Bangkok)
Karma Rapten	(UNDP, Bhutan)
Anne Erica Larsen	(UNDP, Bhutan)
Kencho Namgyal	(UNICEF, Bhutan)
Dorji Wangdi	(UNICEF, Bhutan)
Sonam Tobgay	(Consultant, UNICEF, Bhutan)
Karma Wangchuk	(Consultant, UNICEF, Bhutan)
Phub Delma	(WFP, Bhutan)
Dorji Phub	(WHO, Bhutan)

The World Bank

Augustin Maria	(World Bank, New Delhi)
Rosanna Chan	(World Bank, New Delhi)

Annexure-3

Mission Programme

Date	Time	Programme
Sunday 2 October		Arrival and check-in at Thimphu of international team members
Monday 3 October	09:30-10:00 10:00-10:45 11:00-12:30 15:00-16:00	Meeting with UNDP Meeting with UN Resident Coordinator Meeting with UN Country Team, DDM Director, and DDM staff Meeting with MoHCA Minister or Secretary, including DDM and Department of Culture
Tuesday 4 October	9.30-10.30 10.40-11.40 12.00-13.00 13.15-14.45 15.00-16.00 16:15-17:00 17:05-18:00	Internal meeting of the Assessment Team Ministry of Agriculture & Forests Ministry of Education Informal lunch with Development partners MoWHS including DUDES and BSB Ministry of Health Department of Culture
Wednesday 5 October	10:00-12:30 13:30	Briefing of field assessment team and preparatory meeting for field visits with RGoB and concerned UN staff Departure for the field of two teams
Thursday 6 October - Wednesday 12 October		Field assessment to most affected *dzongkhags* **Team A: Paro and Haa** **Paro District** 1. Sharpa Gewog (Eta Goenpa under Zhingkarna village, Hafu Goenpa under Hafu village) 2. Ta-Dzong, Paro 3. Dotey Gewog (Patsha Village) 4. Lango Gewog (Jagkarthang Village) 5. Tsento Gewog (Jutsa Village, Drugyal Higher Secondary School) 6. Dogar Gewog (Dobji Dzong, Dawakha Lower Secondary School) 7. Naja Gewog (Jabab Chholing Goenpa) **Haa District** 1. Bjee Gewog (Tsenkha, Genesa and Tokey Villages) 2. Damthang Lower Secondar School 3. Katsho Gewog (Ingo Village, Katsho Goenpa) 4. Essue Gewog (Tachu Goenpa and Jow Gempa Village) **Team B: Chukha and Samtse** **Chukha District** 1. Chapcha Gewog (Paga and Lobnekha communities)

		2. Bongo Gewog (Gedu Trashigang Goenpa) 3. Darla Gewog (Darla Rinchentse Lhakhang) 4. Geling (Kamji L.S.S and Kamji Lhakhang) **Samtse District** 1. Ugyentse Gewog (Kado Village) 2. Namgaycholing Gewog- 3. Yoeseltse Gewog (Yoeseltse H.S.S and Dungkhhar community) 4. Sangnagcholing Gewog (Sangnagcholing community and Sangnagcholing Lhakhang) 5. Sipsoo Gewog (Sipoo Hospital)
Thursday 13 October		Team internal meetings and drafting of report
Friday 14 October	10:00-12:00	Meeting of Team A and B
Saturday 15 October		
Sunday 16 October	9:30-12:30	Discussion of key findings with UNRC, World Bank Representative and DDM Director
Monday 17 October	9.30-13.00	Stakeholder consultation meeting
Tuesday 18 October	16.00-18.00	High-level presentation of zero draft report to RGoB and UNCT
Wednesday 19 October		Incorporation of comments in draft report
Thursday 20 October	12.30-14.00	Briefing for Development Partners
Friday 21 October		Departure of international team members from Paro airport

Annexure-4

Field Visit Check-list

Situation Assessment

1. Location, accessibility constraints	Observation, Gewog officials, Dzongkhag officials (for overview)	
2. Infra services to village – electricity, communication, water supply, others	Gewog officials, Dzongkhag officials (for overview)	
3. Numbers of persons/ homes affected, infrastructure damaged, Other losses/impacts	Gewog officials, Dzongkhag officials (for overview)	
4. Immediate demands after Eq. & emerging needs	Gewog officials, Dzongkhag officials (for overview)	
5. Response, nature of relief assistance (identify voluntary efforts if any)	Gewog officials, Dzongkhag officials (for overview)	
6. Available human resources at Gewog/ GUP office	Gewog officials, Dzongkhag officials (for overview)	

For Housing Assessment

1. Identify typologies, variations in typologies, mixed typologies (Typologies are defined by Materials (walling, roofing), structural system, house design	Visual Observation, local engineers or artisans in village, Gewog officials, community reps	In each field village
2. Identify tradition and changes, safe and unsafe elements	Visual Observation, local engineers or artisans in village	In each field village
3. Damage categorization – understanding local authorities' definition and assessment, numbers	Local authorities, Dzongkhag engineer, Gewog officials	In each field village/ *Dzongkhags*
4. House size – family sizes, variations, joint family set up, property divisions	Gewog officials, community representatives	Understand predominant pattern, not necessary to repeat in all villages
5. Material availability – quantity, sources, supply chain	Artisans and home owners With inputs from Dzongkhag engineer Gewog officials	In each field village
6. Skills – availability locally, from outside (masons, carpenters, bamboo workers, mud wall builders)	Artisans and home owners with inputs from Dzongkhag engineer Gewog officials	In each field village
7. Knowledge sources – who	Home owners, community	In each field

advises, decides? any mason or artisan guilds?	representatives Inputs from Dzongkhag engineer and Gewog officials	village
8. Cost Estimate – quantity & cost of main materials, wage rates, time taken for construction	Any master artisan	For each typology of house, in any accessible as well as any remote location
9. Any land related, layout related issues – particularly any vulnerable sites	Gewog officials, community representatives	In each field village
10. How do they build toilets, how much does it cost? Perception about use of toilets.	Home owners, community representatives, Gewog officials	In each field village
11. Other services for housing –water, electricity, etc. (availability, impact)	Home owners, community representatives, Gewog officials	In each field village
12. Vulnerable groups – Old aged, single women or women headed - How will they manage own construction?	Community representatives, Gewog officials	In each field village
13. Interim shelters – numbers, types, reach, insitu/ other locations, longevity, adequacy for the upcoming winters, seismic safety/risks,	Community representatives, Gewog officials with Dzongkhag engineer	In villages where people are in interim shelters
14. Immediate response – adequacy, effectiveness, issues and challenges	Local officials, community representatives, owner-users	
15. Photo documentation of each type of damage category by Gewog officials	Minor Major Severely damaged/ fully collapse (choose severely damaged, if there)	In each village

For Damage to Public Infrastructure (Schools, Hospitals, Other Govt. buildings- Gewog office, R&R Centres)

1. Type of unit (school –primary-secondary?)(Hospital, BHU, or ORC?), Number of users, Facilities (school boarding?)	School/ hospital administration, other relevant authorities, Gewog officials	In each field village
2. Understanding damage categorization, Type of building, Numbers and extent of damage, Present status of usage.	Local authorities, visual observations	In each field village
3. Siting issues –vulnerability, public accessibility, etc.	Local authorities, building users Visual observations	In each field village
4. Management set up for	Local authorities	In each field

maintenance of the public buildings (responsibilities at other various levels)		village
5. Available technical guidelines for construction, monitoring and supervision system	Local authorities	In each field village
6. Impact on quality of service provisions	Local authorities	In each field village
7. Impact on number of users – up or down (e.g. school enrollment, patients in hospital)	Local authorities	In each field village
8. Immediate/ short term response	Local authorities	In each field village
9. Interim options for providing these services – stresses and difficulties, longevity of these options	Local authorities, field observations	In each field village
10. Risks due to onset of winters – (e.g. possible diseases) and extent of preparedness to deal	Local authorities	In each field village
11. Impact on other infrastructure – water tanks, irrigation channel, roads, bridges (extent and type of damage)	Local authorities, field observations	In each field village, In Dzongkhag (compiled)

For Damage to Cultural Buildings

1. Type of construction, extent of damage, damage categorization	visual observations, inputs from Dzongkhag engineer local Gewog officials	Each building visited
2. Present status of usage –stress and difficulties	Field observations, inputs from users	Each building visited
3. Ownership and management	Users and authorities	Each building visited
4. Discussion on repair methods, skills and material availability	Owner/users, local officials	Each building visited
5. Available technical guidelines for construction, monitoring and supervision system	Owner/users, local officials	Each building visited

Livelihoods/ Agriculture

• Seeds or grain – extent of loss, likely impact, coping strategy	Farming families, community reps, Local officials	In each field village
• Farm inputs, tools and implements – extent of loss, likely impact, coping strategy	Farming families, community reps, Local officials	In each field village
• Any issues related to crops due to earthquake or landslides?	Farming families, community reps, Local officials	In each field village
• Livestock affected	Farming families, community reps, Local officials	In each field village
• Approximate number of	Farming families, community	In each field

people/household affected	reps, Local officials	village

Other Occupations

• Identifying important occupations that are impacted – forms of likely impact	Community reps, Local officials	In each field village
• Back ward and forward occupational linkages – extent and type of impacts	Family with such occupation	Case study of different occupations (not necessary in each village)
• Approximate number of people/household affected	Community reps, local officials	In each field village

Psycho-Social Impacts

• Information about well being of women, children, physically challenged and elderly
• Any symptoms – sleeplessness, loss of appetite, lack of concentration, etc.
• Extent of engagement with daily chores (whether normal?)

Annexure-5

Bhutan Disaster Assessment Tool

Following the 2009 21st September earthquake that hit Eastern Bhutan, the need for a standard Post Disaster Needs Assessment format for collecting and compiling data for providing humanitarian assistance became clear. This lesson was based on the challenges faced by multiple reporting formats used, the strain on Dzongkhag and Gewog officials facing multiple reporting requests, and the challenge of adequately and quickly meeting the needs on the ground.

The development of the Bhutan Disaster Assessment (BDA) tools and mechanisms customized to Bhutan started in June 2010 as a multi-stakeholder process involving the Royal Government of Bhutan, the UN System in Bhutan, Insurance companies, the Royal Bhutan Army, the Royal Bhutan Police, and NGOs. Following in-depth stakeholder consultations, field testing and high-level sensitization in November 2010, the tools were finalized in March 2011. National sector focal points and district officials from all of Bhutan's 20 districts were trained in the use of the tool and draft Standard Operating Procedures (SOPs) were formulated. The electronic data platform, Emergency Info, was finalized in September 2011, with expected finalization of SOPs in the autumn 2011.

The BDA-tool is a multi-sectoral disaster needs assessment tool comprising of the following tools:

- **Initial Assessment form:** Establishes an overview of the disaster scenario within the first 72 hours based on information submitted by *dzongkhag*, *gewog* or *chiwog* authorities
- **Local Authority form:** Provides a detailed overview of Humanitarian needs and priorities based on information submitted by *dzongkhag*, *gewog* or *chiwog* authorities
- **Household survey form:** Provides a sample overview of impacts at the household level based on an interview-based sampling tool

In the aftermaths of the 2011 18th September earthquake, the BDA Initial Assessment form for information collecting within the first 72 hours following a disaster was shared with four *dzongkhags* by the Department of Disaster Management. However, only one *Dzongkhag* was able to complete the form as relevant officials in other *dzongkhags* were already engaged in response activities in the field. While the BDA was finalized and *Dzongkhag* officials of all of Bhutan's *dzongkhags* trained as trainers in March 2011, the Standard Operating Procedures are not yet finalized and the tool was therefore not institutionalized for effective use.

The BDA Local Authority form which was used by the 2011 Joint Rapid Assessment team aim to provide a more in-depth multi-sectoral overview of key needs and priorities based on information provided at the *Gewog*-level. In total 11 forms were completed in discussion with *Gewog* officials in the visited *Gewogs* in Paro, Haa, Chhuka and Samtse *Dzongkhags*. It was, however, a challenge to obtain the desired information as this was not readily available or known to the *Gewog* officials. Due to the nature of impact of the earthquake causing mainly structural damages, the focus and immediate priority for *Dzongkhag* and *Gewog* authorities was the structural damage assessment and categorization. The impact on other sectors such as transport and communication was minimal, whereas the impact on longer term needs on for example food and livelihoods was less pressing and information therefore not yet available. From the use of the BDA Local Authority forms, qualitative information has been used in the report; however, quantitative data was insufficient for analytic purposes.

Lessons and Recommendations:

- The challenge of multiple reporting formats and competing reporting requests as experienced in Eastern Bhutan in 2009 was again highlighted by *Dzongkhag* officials in Western Bhutan as a burden in the aftermaths of the 2011 earthquake. Institutionalization of the BDA tool as well as a strong mechanism for its implementation, along with building of related capacities down to the *Gewog* level, should therefore be emphasized.

- Formal policy-level endorsement of the BDA-tools and mechanism is needed. For the mechanism, the Standard Operating Procedures should be finalized and institutionalized to clearly define roles and responsibilities related to BDA implementation, so that BDA is automatically implemented in the event of a disaster.

- Disaster Management Officer/focal point at the *Dzongkhag* level should be appointed and empowered to take leadership to coordinate rapid assessment and develop response plan. *Dzongkhags* can conduct a BDA simulation exercise and field tests the tools and mechanism.

- Further facilitation for sensitization at *Dzongkhag* and *Gewog* levels is needed to institutionalize the BDA-tool. All District and *Gewog* Officials should be oriented and made conversant with the BDA tool and mechanism and disaster preparedness and response. In this regard, there is a need to revisit the ToT approach.

- Stakeholders have to be oriented about the BDA tool's focus to provide a rapid overview of humanitarian needs and priorities (sensitization on the importance of humanitarian data) versus damage and loss estimates and detailed sectoral assessments that may be used to complement the BDA.

- Pre-crisis data or baseline data has to be updated for each *Gewog, Dzongkhag* and sector.

- Operational *Dzongkhag* Disaster Management plan covering different sectors (such as Shelter, Food and Livelihood, Culture, WASH, Health, Education, Psycho-social and Transport and Communication, Staff Safety and Security, etc.) integrated together covering different elements such as coordination and participation of different sectors, needs assessment, information management, resource mobilization (human resources, funds and supplies) and monitoring and reporting are needed.

Annexure-6

List of Stakeholder Consultations

Stakeholder Consultation Meeting, 17 October 2011, Tarayana Conference hall, 9.30 – 1:00 pm

List of Participants

1. Ms. Claire Van Der Vaeren, RC, UN Bhutan (co-chair)
2. Mr. Namgay Wangchuk, Director, DDM, MoHCA (co-chair)
3. Mr. Dhilip Thapa, Dy. EE, Dept. of Roads, MoWHS
4. Ms. Nagtsho Dorji, Head, DCHS, Dept. of Culture, MoHCA
5. Ms. Junko Mukai, Dy. Chief Conservation Architect, DCHS, Dept. of Culture, MoHCA
6. Mr. Phuntsho Namgyal, Dy. Chief Engineer, Dept. of Energy, MoEA
7. Mr. Karma Jamtsho, Dy. EE, DUDES, MoWHS
8. Mr. Phuntsho Wangdi, Director, BSB, MoWHS
9. Mr. Rinzin Namgay Chief Engineer, BSB, MoWHS
10. Mr. Sangay Chophel, PPD, MoA&F
11. Mr. Kinley Tshering, Dept. of Forest & park Services, MoA&F
12. Kinley Pelden, Dept. of Livestock, MoA&F
13. Mr. Tshering Tashi, NEC
14. Mr. Chencho Dorji, Chief Liaison Officer, Dept. of School Education, MoE
15. Mr. Thinley Rinzin, PPD, MoE
16. Captain Tshering Tobgay, RBA
17. Col. Chewang Tandin, Construction Officer, RBG
18. Maj. Karma Tshering, SP, Fire Services Division, RBP
19. Mr. Wangchuk Namgay, General Manager, RICBL
20. Ms. Sonam Pyade, Engineer, RICBL
21. Mr. Damdi Dorji, General Manager, Bhutan Insurance Ltd
22. Captain Sangay, DGPC
23. Mr. Gem Tshering, General Manager, BPC
24. Mr. Tashi Tenzin, Dratshang Lhentshog
25. Mr. Tandin Dorji, CPO, DoPH, MoH
26. Mr. Sonam Tobgay, Consultant, UNICEF
27. Mr. Kencho Namgyal, Wash Officer, UNICEF
28. Mr. Dorji Phub, WHO
29. Ms. Dechen Tshering, Engineer, DCHS, Dept. of Culture, MoHCA
30. Mr. Kaka Tshering, Dy. Chief Liaison Officer, DoSE, MoE
31. Mr. Thinley Pelden, DDM, MoHCA
32. Mr. Keshap Moktan, DDM, MoHCA
33. Ms. Juliet Attenborough, UNICEF-Bhutan
34. Ms. Khina Maya, MoH
35. Mr. Chencho Tshering, DDM, MoHCA
36. Ms. Lhachey Dema, DDM, MoHCA
37. Mr. Karma Rapten, UNDP-Bhutan
38. Ms.Reshmi Theckethil, UNDP-BCPR

39. Mr. Jo Scheuer, UNDP-Bhutan
40. Ms. Rosanna Chan, World Bank
41. Ms. Anne Erica Larsen, UNDP-Bhutan
42. Mr. Vivek Rawal, UNDP
43. Ms. Kesang C. Phuntsho, UNRC
44. Ms. Tshering Dolkar, UNRC

Regrets:

45. Mr. Tashi Duba, DMS, MoH
46. Mr.Norbu Gyeltshen, NCWC
47. Mr. Ugyen Wangda, Dept. of Geology & Mines
48. Director, DoIM, MoIC
49. Mr. Tshering Chophel, DLG
50. Mr. Kinley Dorji, Training Officer, Dept. of Youth & Sports, MoE

Meeting of Senior Level RGOB and UNCT Members, 18th October 2011, Tarayana Conference Hall, 4.00 - 6.00 pm

Participant lists

1. Dasho Penden Wangchuk, Hon'ble Secretary, MoHCA (Chairperson)
2. Dasho Dr. Sonam Tenzin, Hon'ble Secretary, MoWHS
3. Dr. Dorjl Wangchuk, Offtg. Secretary, MoH
4. Mr. Pema Wangda, Hon'ble Secretary, MoLHR
5. Aum Sangay Zam, Hon'ble Secretary, MoE
6. Mr. Karma Penjor, Hon'ble Secretary, Dratshang Lhentshog
7. Mr. Sherub Gyaltshen, Hon'ble Secretary, MoA&F
8. Mr. Phuntsho Namgyal, Director, Cabinet Secretariat
9. Ms. Doma Tshering, CPO, PPD, MoFA
10. Mr. Tshering Tashi, Environment Specialist, NEC
11. Ms. Kuenzang Lham Sangay, Sr. Program Officer, GNHC
12. Mr. Ugyen Wangda, DGM, MoEA
13. Mr. Choiten Wangchuk, Director, DPA, MoF
14. Mr. Kinzang, Chief, Multilateral Division, MoFA
15. Mr. Rinchen Wangdi, Chief Program Officer, DCD, GHNC
16. Mr. Tshewang Tandin, Director General, DoSE, MoE
17. Mr. Namgay Wangchuk, Director, DDM, MoHCA
18. Mr. Tshewang Norbu, DDM, MoHCA
19. Mr. Thinley Rinzin, PO, MoE
20. Ms. Claire Van der Vaeren, RC, UN Bhutan
21. Mr. Mark LaPrairie, Representative, World Bank
22. Dr. Gepke Hingst, Representative, UNICEF
23. Dr. Nani Nair, Representative, WHO
24. Mr. Jo Scheuer, Oftg DRR, UNDP
25. Mr. Dungkar Drukpa, OIC, WFP
26. Mr. Yeshey Dorji, ARR, UNFPA
27. Ms. Reshmi Theckethil, UNDP-BCPR (mission member)

28. Mr. Vivek Rawal, UNDP-BCPR (mission member)
29. Ms. Rosanna Chan, World Bank (mission member)
30. Mr. Chencho Tshering, DDM, MoHCA (mission member)
31. Mr. Thinley Pelden, DDM, MoHCA (mission member)
32. Ms. Dechen Tshering, Dy. EE, DCHS, DoC, MoHCA (mission member)
33. Mr. Kaka Tshering, MoE (mission member)
34. Mr. Kencho Namgyal, Wash Officer, UNICEF (mission member)
35. Mr. Sonam Tobgay, Consultant, UNICEF (mission member)
36. Mr. Dorji Phub, WHO (mission member)
37. Mr. Karma L. Rapten, UNDP (mission member)
38. Ms.Phub Delma, WFP (mission member)
39. Ms. Anne E. Larsen, UNDP (mission member)
40. Ms. Tshering Dolkar, UNRCO

Regrets:

1. Dasho Zimpoen, OGZ
2. Hon'ble Secretary, HM Secretariat
3. Chadho Tenzin, ARR, FAO
4. Om Bhandari, CC, IFC

Development partners briefing on 20 October 2011, Hotel Kisa, Thimphu.

Participant lists

1. Claire van der Vaeren, UNRC
2. Mark LaPrairie, WB
3. Nancy Strickland, Bhutan-Canada Foundation
4. Henrik A. Nielsen, Representation Offiice of Denmark
5. Walter Roder, Helvetas
6. Jo Sheuer, UNDP
7. Gepke Hingst, UNICEF
8. Phuntshok Choden Tshering, Consultate of Netherlands
9. Tomoki Nitta, JICA Om Bhandari, IFC
10. Kesang Phuntsho, UNRCO
11. Karma Rapten, UNDP
12. Anne Erica Larsen, UNDP
13. Reshmi Theckethil, UNDP-BCPR
14. Kencho Namgyal, UNICEF
15. Sonam Tobgay, UNICEF consultant
16. Phub Delma, WFP

Annexure-7

Glossary of Dzongkha Terms

Choeten	*Stupa*
Debri	Mural painting in a Lhakhang
Doesung	Civilian Volunteers of His Majesty's Volunteer Group
Dzondag	Administrative head of the Dzongkhag
Dzong	Fortress or Monastery
Dzongkhag	District
Eckra	Timber frame with wattle and daub panel
Goenpa	Monastery
Gewog	Administrative Block consisting of a number of villages under a District
Gup	Elected representative of the Gewog
Kuten Sungtens	Religious Artefacts
Lam	Title given to reincarnate Lams of senior monks of the monastic boday appointed as teacher/head of monastery/Buddhist institutions
Latruel	Ownership of a religious institution based on reincarnate *Rinpoche*s or *Lam*s
Lhakhang	Temple
Rabsey	Typical full height window in traditional houses and religious buildings
Reja	Canvas
Rinpoche	Honorific title meaning 'precious one', referring to Buddhist masters and reincarnate lamas

Annexure-8

Note on Damage Categorization

Damage categorization forms the basis for assessment and planning for response, recovery and rehabilitation. The extent of damage is dependent not only on the severity of the earthquake but also on the building typology and quality of construction. Therefore, damage categorization has to take housing typologies into consideration. It is also important to clarify the purpose of damage categorization.

To understand the behaviour of buildings during the earthquake, impact of earthquake forces on various building elements and then evolve technical solution to improve building resilience, engineers typically use G1 to G5 classification.

Damage grade	**Broad indicators**
G1	No structural damage, slight nonstructural damage
G2	Slight structural damage, moderate nonstructural damage
G3	Moderate structural damage, heavy nonstructural damage
G4	Heavy structural damage, very heavy nonstructural damage
G5	Destruction - very heavy structural damage

Detailed indicators are required based on the building typology and following framework may be used for such a technical exercise.

Damage grade	Detailed indicators for non-structural damage	Detailed indicators for structural damage	Post earthquake action
For Rammed earth construction			
G1			
G2			
G3			
G4			
G5			
For random rubble stone masonry in mud mortar			
G1			
G2			
G3			
G4			
G5			

The above framework is only for purpose of engineers to develop technical solutions for improving resilience of buildings.

However, there is need for governance response after the earthquake to assist affected households. The reconstruction policy response is usually linked with the extent of damage. Financial assistance is provided based on the extent of damage. Therefore, ensuring a reliable damage categorization is critical for any reconstruction programme. The damage categorization should also ensure transparency so that chances of community dissatisfaction can be minimized without raising unreasonable and undeserving expectations. For this purpose, a simplified framework that can be easily understood by the community and thereby reduce community grievances needs to be adopted. The framework adopted by DDM is based on this idea. However, there is need to refine the categorization to ensure that that it is

technically correct and not based on individual perceptions. Therefore, following categories are to be used.

Minor damage	Slight damage, poses no structural threat and easily repairable
Major damage	Significant damage, can pose structural threat if not attended and possible to be repaired under guidance.
Total Collapse/ Beyond repairs	Such damage that cannot be repaired and needs complete replacement or reconstruction.

These categories need to be well understood for each building typology. Particular care is required to differentiate between major damage category with beyond repair/ total collapse category. Indiscriminate categorization not based on knowledge of repairs and reconstruction coming from earlier framework of G1 to G5 can result in incorrect and often subjective assessment. As a result repairable houses may be categorized as beyond repairs and subsequently recommended for reconstruction causing unnecessary waste of national and community/household resources. It is therefore, necessary to develop clear indicators for each category. Past experiences from other parts of the world indicate that visual guides of the damage and format for visual screening are very effective tools to assist people who conduct assessments. These two tools need to be developed carefully with great rigour and field assessment teams need to be trained and equipped with. The format for the visual tool may be as follows.

	Detailed indicators for each typology	Visual picture guide
Minor Damage	1.	
	2.	
	3.	
Major Damage	1.	
	2.	
	3.	
Total Collapse/ beyond repairs	1.	
	2.	
	3.	

Such a reference tool will reduce individual judgments and bring about standardization based on expert knowledge.

For future preparedness, DDM should coordinate with technical institutions and if required, seek expertise from outside Bhutan, to develop a more rigorous, clear and easily implementable framework for damage assessment and appropriate reference tools.

Annexure-9

Repairs, Restoration, and Retrofitting of Vernacular Buildings

Repairs, restoration and retrofitting of rammed earth buildings and stone masonry buildings is a viable technological solution and needs to be included in the reconstruction approach. As most of the houses have either minor or major damage that are repairable, developing solutions and building capacities of local engineers and artisans is critical. It is a natural response after the disaster to see the buildings as completely lost and think of replacement. However, it is not practical, sustainable and advisable. Replacement is not only expensive option but also colossal waste of environmental resources. As lot of confusion during the damage assessment and categorization arises due to lack of knowledge of possible solution, the assessment team felt it important to include some preliminary ideas for repairs and retrofitting of rammed earth and stone masonry buildings. The following table indicates some ideas that can be easily adapted to the context of Bhutan for developing technical solutions to repair and retrofit. Majority of families in Bhutan live in traditional, vernacular houses made of rammed earth and stone masonry. It is not appropriate to say that the only path to safety is to replacement of these houses. Instead it is important to show that these houses can not only be repaired but their seismic strength can be enhanced. That will be more affordable path to reconstruction and to seismic safety.

The following table presents typical problems observed in the damaged houses and provides indicative solutions. The solutions only indicate possible direction and further work would be required to refine them in context of Bhutan.

Problems	**Repairs and Restoration**	**Retrofitting**
Rammed Earth Houses		
Cracks in Earthen walls including corner cracks	Grouting using low pressure, hand operated pump	Stitching across cracks using geogrids or timber Adding geogrid or timber belts on all the walls horizontally at lintel & sill levels, vertically at wall junctions, and around the openings.
High slenderness ratio of wall due to excessive length and low thickness		Adding vertical timber stiffeners or geogrid belt at selected locations.
Corner failures	Rebuilding of the corners using rammed earth technique	Ensuring good connections with existing walls by inserting timber connectors in old and new walls.
Degraded timber elements in roof and its support structure	Removal and replacement of the particular timber element, if easily feasible	Repairing the small cracks with fevicol and sawdust, adding additional member or supporting sagging member.
Shifting and tilting of Rabsey	Re-fixing of Rabsey in proper location	Adding anchorage to the vertical sides of Rabsey with the walls.
Houses with stone masonry in mud mortar		
Cracks in stone walls including corner cracks and separation	Grouting using low pressure hand operated pump	Stitching across cracks using ferro-cement or geogrid bandage

		Adding geogrid or ferro-cement belts on all the walls horizontally at lintel & sill levels, vertically at wall junctions, and around the openings.
Very thick stone masonry walls		Installing through stones spread throughout the wall surface to bond both the faces together.
Long walls		Adding cross shear walls or buttresses
Diagonal cracks around the openings	Filling the cracks with mortar	Adding geogrid or ferro-cement belts around the openings.
Corner failures	Rebuilding of the corners using stone masonry and proper corner stones.	Ensuring good masonry connections with existing walls.
Bulging or delamination of stone walls	Removing the affected part and reconstructing the part of the wall.	
Degraded timber elements in roof and its support structure	Removal and replacement of the particular timber element, if easily feasible	Repairing the small cracks with fevicol and sawdust, adding additional member or supporting sagging member.
Shifting and tilting of Rabsey	Re-fixing of Rabsey in proper location	Adding anchorage to the vertical sides of Rabsey with the walls.

Based on discussions with Rajendra Desai, National Centre for People's action for Disaster Preparedness (NCPDP), Ahmedabad, India