

TERMINAL EVALUATION

***“Reducing Climate Change-Induced Risks and Vulnerabilities from
Glacial Lake Outburst Floods in the Punakha, Wangdue and
Chamkhar Valleys (GLOF)”
(PIMS #3722, GEF ID #59841)***



Final Report

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TABLE OF CONTENTS

LIST OF TABLES.....	II
LIST OF ABBREVIATIONS AND ACRONYMS.....	III
ACKNOWLEDGEMENTS.....	V
1. MAIN CONCLUSIONS AND RECOMMENDATIONS.....	1
1.1. BACKGROUND - INTRODUCTION	1
1.2. CONCLUSIONS.....	2
1.3. RECOMMENDATIONS.....	6
1.4. RATING TABLE.....	8
2. CONTEXT AND OVERVIEW OF THE PROJECT.....	9
3. EVALUATION FRAMEWORK	10
3.1. OBJECTIVES	10
3.2. SCOPE	10
3.3. METHODOLOGY	11
3.3.1. Overall Approach.....	11
3.3.2. Evaluation Instruments	12
3.4. LIMITATIONS AND CONSTRAINTS	13
4. EVALUATION FINDINGS.....	13
4.1. PROJECT DESIGN / FORMULATION	13
4.1.1. Analysis of Logical Framework (LFA) / Results Frameworks.....	13
4.1.2. Assumptions and Risks.....	15
4.1.3. Lessons from other Relevant Projects/Initiatives.....	16
4.1.4. Planned Stakeholder Participation.....	18
4.1.5. Planned Replication Approach	18
4.1.6. UNDP Comparative Advantage.....	19
4.1.7. Linkages Between the Project and Other Interventions within the Sector	20
4.1.8. Management Arrangements.....	21
4.2. PROJECT IMPLEMENTATION	22
4.2.1. Adaptive Management.....	22
4.2.2. Partnership Arrangements.....	24
4.2.3. Project Finance	25
4.2.4. Monitoring and Evaluation (M&E) Approach.....	27
4.2.5. Contribution of Implementing and Executing Agencies	29
4.2.6. Summary of the Mid-Term Review (MTR)	29
4.3. PROJECT RESULTS.....	30
4.3.1. Overall Achievements/Results.....	30
4.3.2. Attainment of Project Objective	36
4.3.3. Relevance.....	39
4.3.4. Efficiency.....	40
4.3.5. Country Ownership.....	40
4.3.6. Mainstreaming.....	41
4.3.7. Sustainability	43
4.3.8. Catalytic Role and Long-Term Impact.....	44
5. LESSONS LEARNED	47
ANNEX 1: TERMS OF REFERENCE	48
ANNEX 2: EVALUATION MATRIX.....	56
ANNEX 3: LIST OF DOCUMENTS REVIEWED	63
ANNEX 4: INTERVIEW GUIDE.....	66
ANNEX 5: EVALUATION MISSION AGENDA AND LIST OF PEOPLE INTERVIEWED	68
ANNEX 6: PROJECT EXPECTED RESULTS AND PLANNED ACTIVITIES	70
ANNEX 7: CO-FINANCING TABLE.....	73
ANNEX 8: LIST OF RECOMMENDATIONS FROM THE MTR.....	74
ANNEX 9: TECHNICAL REVIEW AND SOCIAL IMPACT ASSESSMENT – EXECUTIVE SUMMARY	77
ANNEX 10: VISUAL DOCUMENTATION: TV PRODUCTIONS AND PUBLICATIONS	83
ANNEX 11: SUMMARY OF POTENTIALLY DANGEROUS GLACIERS, GLACIAL LAKES AND LAKES	84

List of Tables

Table 1: Rating Table	8
Table 2: Steps Used to Conduct the Evaluation.....	12
Table 3: Project Logic Model	14
Table 4: List of Risks and Assumptions Identified at the Design Phase	15
Table 5: List of Risks Logged in Atlas	16
Table 6: Summary of Roles in Project for Key Stakeholders	24
Table 7: UNDP/GEF-LCDF Funds Disbursement Status (in USD)	25
Table 8: Co-financing Status	27
Table 9: List of Performance Indicators.....	28
Table 10: List of Delivered Results.....	32
Table 11: Attainment of Project Objective	37

List of Abbreviations and Acronyms

ADA	Austrian Development Agency
ALM	Adaptation Learning Mechanism
APR	Annual Progress Report
AWLS	Automatic Water Level Stations
AWP	Annual Work Plan
AWS	Automatic Weather Station
CBDRM	Community-Based Disaster Risk Management
CO	Country Office
COP	Conference of Parties
DDM	Department of Disaster Management
DGM	Department of Geology and Mines
DHMS	Department of Hydro-Met Services
DM	Disaster Management
DO	Development Objective
DPA	Department of Public Accounts
DRM	Disaster Risk Management
ECP	Environment, Climate Change and Poverty
EIA	Environment Impact Assessment
EWS	Early Warning System
FACE	Funding Authorization and Certification of Expenditures
FSP	Full Size Project
FYP	Five-Year Plan
GECDP	Gender, Environment, Climate change, Disaster risk reduction and Poverty
GEF	Global Environment Facility
GLOF	Glacial Lake Outburst Flood
GNHC	Gross National Happiness Commission
ICIMOD	International Center for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
JDNP	Jigme Dorji Wangchuck National Park
JICA	Japan International Cooperation Agency
JST	Japan Science and Technology Agency
LDCF	Least Developed Countries Fund
LFA	Logical Framework Analysis
LPAC	Local Project Appraisal Committee
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MEA	Multi-lateral Environmental Agreements
MoEA	Ministry of Economic Affairs
MoHCA	Ministry of Home and Cultural Affairs
MoF	Ministry of Finance
MRG	Mainstreaming Reference Group
MTR	Mid-Term Review
NAPA	National Adaptation Programme of Action
NDRM	National Disaster Risk Management
NDRMF	National Disaster Risk Management Framework
NEC	National Environment Commission
NEX	National Execution
PB	Project Board
PDF-B	Project Development Fund
PHPA	Punatsangchhu 1 & 2 Hydroelectric Project Authority
PIR	Project Implementation Report
PM	Project Manager
PPG	Project Preparation Grant
QBS	Qualitative Based Survey
RBA	Royal Bhutan Army
RFP	Request For Proposal
RGoB	Royal Government of Bhutan
SAR	Search and Rescue
SMART	Specific, Measurable, Attainable, Relevant and Time-bound

SOP	Standard Operating Procedures
TE	Terminal Evaluation
TOR	Terms of Reference
TSAT	Technical Support and Advisory Team
UN	United Nations
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UNV	United Nations Volunteer
USD	United States Dollar
WWF	World Wildlife Fund

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DISCLAIMER

This report is the work of independent consultants and does not necessarily represent the views, or policy, or intentions of the United Nations Development Programme (UNDP) or of the Royal Government of Bhutan.

1. Main Conclusions and Recommendations¹

1.1. Background - Introduction

This report presents the findings of the Terminal Evaluation of the UNDP-Supported, GEF- Least Developed Country Fund (LDCF)-Financed Project “*Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys (GLOF)*” and co-financed by the Royal Government of Bhutan (RoGB), the Austrian Development Agency (ADA), the Punatsangchhu Hydropower Project Authority (PHPA I & II) and the World Wildlife Fund (WWF). This terminal evaluation was performed by an Evaluation Team composed of Mr. Jean-Joseph Bellamy and Mr. Yeshey Penjor on behalf of the United Nations Development Programme (UNDP).

The most significant climate change impact in Bhutan is the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures. Inventories of glaciers, glacial lakes, and glacial lake outburst floods (GLOFs) in Bhutan, shows that there are 983 glaciers, 2,794 glacial lakes, including 25 glacial lakes posing potentially high risk for GLOFs. Studies suggest rates of glacial retreat in the Himalayas as high as 30 to 60 meters per decade, and the melting of glaciers leading to alarming volumes of water in downstream glacial lakes. Increased temperature also causes melting of ice-cored moraine dams to the point that the ridges can no longer resist the pressure. Additionally, Bhutan falling on an active seismic zone, the increasing pressure on the fragile moraine dams also increases earthquake triggered GLOF disaster risks. This poses a new dimension to the existing range of threats to lives, livelihoods, and development in Bhutan.

One of the glacier lakes facing a high risk of outburst flooding was Thorthormi Lake in Bhutan’s northern Lunana area. Thorthormi glacier had no supra-glacial ponds on it during the 1950s but now there are numerous supra-glacial ponds, which are enlarging and becoming interconnected. The Thorthormi glacier was therefore considered as one of the most critical growing glacial lakes with GLOF threat in the near future. The area measured 1.28 km² in 2001 from satellite image (Geocover) and it was observed to be steadily growing in size. The assemblage of the supra-glacial lakes on the Thorthormi glacier, whose moraine on one side was weakened by the 1994 Lugge GLOF and the moraine bordering the Rapstreng Lake has been narrowing rapidly made the Thorthormi Lake one of the most dangerous glacial lakes in Bhutan.

Recognizing the need for systematizing the country’s disaster risk management system to account for climate change induced GLOF hazards, the Government of Bhutan partnered with UNDP and GEF-LDCF to integrate climate risk projections into existing disaster risk management practices and implement corresponding capacity development measures. The project has been demonstrating practical mitigation measures to reduce climate change-induced GLOF risks from the potentially dangerous Thorthormi glacier lake, and facilitated the replication of the respective lessons learned in other high-risk GLOF areas. Complementary to this risk reduction effort, the project has also focused on early warning mechanisms for the Punakha-Wangdue Valley, which was not equipped to handle the full extent of potential GLOF risks, to incorporate coverage of this growing threat.

The GLOF project was a UNDP supported, GEF-LDCF financed National Adaptation Programme of Action (NAPA) project with a grant of USD 3.45 million and an expected co-financing of USD 3.9 million from RoGB, ADA and WWF. UNDP was the GEF implementing agency. The Ministry of Economic Affairs (MoEA) was the implementing agency in Bhutan and the project was executed by three executing agencies: the Department of Geology and Mines (DGM) and the Department of Hydro-met Services (DHMS) under MoEA, and the Department of Disaster Management (DDM) under the Ministry of Home and Cultural Affairs. It was a 4-year project that started in June 2008, which was extended to terminate at the end of December 2013.

The goal of the project was to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan. Its objective was to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys, which was to be achieved through four outcomes and a further 15 outputs. The expected outcomes are:

¹ Conclusions and Recommendations are in Chapter 1 with a brief background section. It is structured as an Executive Summary and a stand-alone section presenting the highlights of this final evaluation.

- *Outcome 1:* Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys;
- *Outcome 2:* Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system;
- *Outcome 3:* Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings;
- *Outcome 4:* Enhanced learning, evaluation and adaptive management.

This terminal evaluation report documents the achievements of the project and includes five chapters. Chapter 1 presents the main conclusions and recommendations; chapter 2 presents an overview of the project; chapter 3 briefly describes the objective, scope, methodology, evaluation users and limitations of the evaluation; chapter 4 presents the findings of the evaluation. Lessons learned are presented in Chapters 5 and relevant annexes are found toward the end of the report.

1.2. Conclusions

Project Design / Formulation

a) The project was highly relevant in the context of Bhutan.

The project was highly relevant for Bhutan. Its timing was excellent; it provided RGoB with additional resources to demonstrate the implementation of a series of measures to mitigate risks from potential GLOFs and at the same time to strengthen Bhutan's policy and legislative frameworks.

The project concept emerged from national priorities identified in the NAPA 2006 to address disaster risk management and risk management of GLOFs in Bhutan. It was a set of direct follow-up activities to the NAPA, addressing 3 key national priorities related to the risks of GLOFs. It was an excellent instrument to respond to national priorities; it supported government interventions to pioneer activities to mitigate risks of GLOFs in the Punakha-Wangdue and Chamkhar Valleys. It became *de facto* the DRM programme in Bhutan implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. Additionally, with the good participation of the Gross National Happiness Commission (GNHC) and of the National Environment Commission (NEC), the project had a strong linkage with the national planning process in Bhutan through the Five-Year Planning process led by GNHC and also with the environmental management framework led by NEC.

The project was also highly relevant in the context of the implementation of the LDCF. The LDCF was created in 2001 (UNFCCC COP7) with further guidance on climate change adaptation given to GEF by the UNFCCC subsequent Conferences of Parties (COPs). The goal of the adaptation strategy for the newly created fund was “*to support developing countries to increase resilience to climate change through both immediate and longer-term adaptation measures in development policies, plans, programs, projects and actions*”. The GLOF project was the first step to fund/support the implementation of NAPA in Bhutan and it was said to be among the first projects submitted to GEF for funding under this new financial mechanism (LDCF) and very well in line with most expected outcomes of the LDCF adaptation strategy.

b) The project had a good and logical strategy (Strategic Results Framework) with good management arrangements.

The Strategic Results Framework identified during the design phase of this project presents a set of clear expected results. The review of the objective, outcomes and outputs indicates a good and logical “*chain of results*”. Project resources were used to implement activities to reach a set of expected outputs, which together turned into higher-level results (outcomes) and contributed to achieve the overall objective of the project. This logical framework was used as a “blueprint” on a day-to-day basis by the implementation team. It was used as a guide all along the implementation.

The design started upstream with the identification of the Thorthormi Lake as the most critical risk for a possible GLOF in Bhutan. The project was then designed at three levels: (1) mitigating the risk of flood by lowering the water level of the Thorthormi lake (outcome 2); (2) raising awareness and capacities to prevent

GLOF disasters downstream (outcome 1); and (3) installing an early warning system in vulnerable communities to monitor the water level upstream and warn communities in case of a GLOF (outcome 3). A fourth outcome (outcome 4) was also identified to enhance learning, documenting lessons learned and best practices and furthermore, to contribute to the scaling-up and replication of project achievements.

In addition, the management arrangements – though somewhat complex with the participation of three executing agencies - were adequate and effective for the implementation of the project. They provided the project with clear roles and responsibilities as well as clear reporting lines of authority. The good functioning of the Project Board (PB) – well Chaired - provided an effective way to communicate and keep stakeholders engaged, contributing to an effective use of project resources and a good national ownership of project achievements.

Project Implementation

c) The project used adaptive management extensively to secure project deliverables while maintaining adherence to the overall project design.

The project management team used adaptive management extensively to secure project deliverables while maintaining adherence to the overall project design. Adaptive management was used regularly to adapt to a constantly changing environment; it was particularly used by the PB to make effective decisions regarding the implementation of the project. Such example was the process to mobilize the resources for outcome 2 - lowering the water level of the Thorthormi Lake. As the work progressed, the PB had to regularly made decisions regarding the use of project resources and yet to achieve the plan to lower the water level by 5m. It includes the decision to scope the engineering and safety plan and focus on the spillway instead of the whole area of the lake due to the limited time for the studies in summer 2008; and the request to the Royal Bhutan Army (RBA) to participate in the work in 2012 to be able to reach the target of 5m and due to difficulties to find workers willing to go to Thorthormi Lake for work.

Adaptive management was used as a management approach to allocate effectively and efficiently project financial resources, “stretching” every dollar as much as possible including the use of co-financing.

d) This project was a good application of the UNDP-NEX modality to mobilize project resources.

The UNDP NEX (National Execution) modality was used as the implementation modality of the project to allocate, administer and report on the use of project resources. Project activities were carried out by the three national executing agencies: DGM, DHMS and DDM, each one led by one Project Manager. Each year, they produce a consolidated Annual Work Plan (AWP), including an annual budgeting in consultation with GNHC and UNDP CO. Once the AWP is approved, the UNDP Country Office (CO) in Bhutan released quarterly the necessary funds to the Department of Public Accounts (DPA) at the Ministry of Finance, which then would release the funds onward to the three executing agencies, following RGoB financial procedures. Overall, the process worked well; it reinforced the national ownership of the project and this set up could be the object of a case study to illustrate a good implementation of the NEX modality.

e) Progress reports were produced timely and provided accurate monitoring information.

A comprehensive M&E plan was formulated during the formulation of the project in accordance with UNDP and GEF procedures and with a total M&E budget of USD 60,000 representing about 1.7% of the total GEF-LDCF grant. This plan listed all monitoring and evaluation activities that were to be implemented during the lifetime of the project, including a mid-term evaluation and a terminal evaluation. For each M&E activity, the responsible party(ies) were identified, as well as the budget and the timeframe. The plan was based on the logical framework matrix that included a set of 8 performance monitoring indicators to measure the progress at the outcomes and objective levels.

This M&E plan – including its set of performance indicators - provided the project with a good framework to measure its progress/performance. APR/PIRs were produced timely as well as Quarterly Progress Reports. The annual PIRs were comprehensive – well-written - reports that provided good monitoring information documenting the project’s progress year over year. The review indicates that the M&E function of the

project was highly satisfactory.

Project Results

f) A very effective project that delivered its expected results.

The implementation of the project was highly successful and overall met the expected results planned at the outset of the project. It can definitely be said that these achievements contributed to the attainment of the project objective that was “*to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys*”. The project: a) reduced the risk of GLOF from the Thorthormi Lake by lowering the water level by 5m; b) installed an automated GLOF EWS in the Valley including 6 water level monitoring stations, 2 automatic weather stations, 18 sirens and a control room station located at Gangrithangkha, Wangduephoddrang. The system covers more than 90% of households in the 21 vulnerable communities downstream of the Punatsangchu River in the Punakha-Wangdue valley. This amount to 875 households, 4 schools, 2 Vocational Training Institutes, 1 Basic Health Unit, Department of Roads staff and workers, as well as an estimated 15,000 staff and workers currently employed by the PHPA-I and PHPA-II Hydropower projects; and c) developed the capacity of communities to be able to respond better to natural disasters. Bhutan is now equipped with a demonstrated approach, lessons learned and best practices to reduce risks of GLOFs and increase the awareness of local communities that could potentially be affected by GLOFs.

Three major critical success factors explain partially this success: (i) a project that was highly relevant and that was well designed with an excellent engagement and participation of stakeholders. The project was a direct response to three national priorities: the artificial lowering of the Thorthormi Lake; the piloting of GLOF Hazard Zoning in the Chamkhar Chu Basin; and the installation of an EWS in the Pho Chu Basin; (ii) an excellent collaborative project management team to implement this project. They were able to take the excellent design and implement the project with strong participative and collaborative principles; including excellent guidance from the Project Board; and (iii) an excellent engagement of beneficiaries in project activities. There was a deliberate strategic approach to engage beneficiaries at every steps of the way and as a result, communities in the pilots feel more secure when it comes to the risks of GLOFs.

g) An excellent approach to document project results through TV documentaries and the documentation of project activities and results through a “*Technical Review and Social Impact Assessment*”.

As noted in the technical review report, it is striking to note how much attention the project has been able to generate internationally when considering the number of visual documentaries produced on this project. The following documentaries were filmed:

- “**Himalayan Meltdown**” was produced by Arrowhead Films, at the request of GEF and broadcast on Discovery Network. It was part of the Discovery Asia “Revealed” series, and won the prestigious Platinum Award in April 2012 in the broadcast documentary category at the 45th Annual Worldfest International Film Festival, the oldest independent film festival in the world.
- “**86centimetres**” by Peter Jan van der Burgh, Tshering Gyeltshen for Bhutan and Partners (2012). A documentary about Tashi and his fight against the threat of a glacial lake outburst flooding (GLOF) in Bhutan. This documentary was screened at various international film festivals such as the Washington DC Environmental Film festival in 2012
- “**Tsunami from the Sky**”, a short documentary compiled by United Nations TV in September 2009 and uploaded to the internet in March 2010

In addition a few publications were also produced to document project activities and its achievements; including:

- “**The Cost of Climate Change, the Story of Thorthormi Glacial Lake in Bhutan**”, a communication project by the WWF Living Himalayas Network Initiative conducted in October 2009.
- “**GLOF RISK Reduction through Community-based Approaches, Regional GLOF Risk Reduction Initiative in the Himalayas**” published by UNDP and shared with regional partners (UNDP/BCPR 2010).
- “**A deluge of Consequences – A Riveting Adventure in the High Himalayas**”, an e-book by Jacques

- Leslie – A World Policy Book – that was published in 2013 (available on iTunes and Amazon).
- “*Climate: When the ice melts*”, Article in *nature* by Anjali Nayar, October 2009. (<http://www.nature.com/news/2009/091021/full/4611042a.html>)

Relevant documentation generated through the project has also been shared through the Adaptation Learning Mechanism (ALM) of UNDP. The project also organized an international Conference on GLOF in Bhutan in December 2012. This was an excellent platform to share project experiences with a wider international audience and to discuss how to scale up activities and to link with upcoming GLOF related projects in the regions and in other mountainous areas exposed to GLOF hazard.

Finally, the project financed an excellent “*Technical Review and Social Impact Assessment*” study that was published by UNDP Bhutan in 2012. The purpose of this review was to examine and document technical and social lessons and impact of the project since its inception in order to extract best practices and formulate recommendations for an exit strategy, which would increase the sustainability and enable the scaling-up and replication of project achievements and its approach. The scope of the review focused on capturing knowledge built within the project, documenting best practices and extracting key learning from implementing a complex and challenging project in a difficult environmental setting. Special emphasis of the technical review was on the methods applied for the artificial lowering of Thorthormi Lake (outcome 2) and the installation of a GLOF EWS (outcome 3). It is a recommended report to those who want to read more details about the achievements of this project.

h) The project and its achievements had an excellent country ownership.

The project addressed three key national priorities; it was designed on the basis of an excellent contextual review; and it was implemented by key national partners involved in DRM in Bhutan. During the implementation period, it was *de facto* the DRM programme in Bhutan implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. The timing of the project was also good, corresponding to the development of the “*Disaster Management Act of Bhutan*” that was passed by Parliament at the beginning of 2013. The development of the Act benefited from the experience of the project in demonstrating “live” mitigation measures to reduce the risk of GLOFs and prevent disasters in case of GLOFs through an EWS and the development of local capacities of communities living down the valleys. As a result of this approach, the project enjoyed an excellent country ownership.

i) Project achievements are well mainstreamed in the governance system for mitigating risks of GLOFs in Bhutan.

The project addressed 3 key national priorities related to the risks of GLOFs that were identified in the NAPA 2006. The project was implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. The implementation of the project was very well integrated in the relevant apparatus of government and provided extra resources to demonstrate how to mitigate GLOF risks in Bhutan.

In parallel to the mitigation work at the Thorthormi Lake and in the Punakha-Wangdue and Chamkhar Valleys, the project contributed to the strengthening of disaster risk management and disaster preparedness policy and legal frameworks in Bhutan. Today, these frameworks are much stronger and the RGoB is in a better position to manage GLOF risks. These achievements are now well mainstreamed into the governance system of Bhutan to mitigate natural hazards and to improve disaster preparedness.

j) The project has had a catalytic role and will have long-term impacts in Bhutan as well as for other GLOF prone countries regarding the reduction of GLOF risks.

The implementation of the project focusing on mitigating GLOF risks from the Thorthormi Lake provided Bhutan with a set of lessons learned and best practices on how to mitigate the risk of GLOFs in Bhutan and increase the preparedness of the population living in the downstream valleys.

The “live” demonstration in the Lunana area and in the Punakha-Wangdue and Chamkhar Valleys was

selected as the most critical one in Bhutan on the basis of previous studies of glacial lakes conducted in Bhutan. Now, these valleys have less risk of GLOFs due to the lowering of the water level in the Thorthormi Lake. Moreover, the people living in these valleys have now an EWS to alert them in case of a coming flood and the capacity on what to do in case of a GLOF. The long-term impacts include the fact that the population in these valleys now feel more secure, have zonation maps where development can safely take place and, due to less risks of GLOFs, a better protection of fertile lands along these rivers that is the basis of their livelihoods.

The project ends at the end of December 2013 and the potential for replication and scaling-up of project achievements is also good. The lessons learned and best practices were already used to further develop the legislation framework with the new *Disaster Management Act* passed in early 2013, which will guide further actions in this area over the coming months and years. The Act provides the necessary legislation for the country to implement a disaster management strategy nationwide and the mandated departments have the capacity to scale-up similar initiatives to other valleys in Bhutan.

In the medium term, the replication to mitigate risks of GLOFs includes two RGoB initiatives supported by international donors to expand the capacity to manage risks due to climate-induced natural disasters. It includes the DHMS-JICA project “*Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning in the Kingdom of Bhutan*”, that started mid-2013 for 3 years; and the RGoB-UNDP project “*Addressing the Risks of Climate-induced Disasters through Enhanced National and Local Capacity for Effective Actions*”, that was recently submitted to the GEF-LDCF for funding. It is a four-year project with a total budget of USD 66M including a requested GEF-LDCF grant of USD 11.5M (pending final approval) and a co-financing of USD 54.5M.

1.3. Recommendations

Based on the findings of this terminal evaluation, the following recommendations are suggested.

Recommendation 1: It is recommended that UNDP Bhutan and the RGoB continue their regional participation on GLOF risks and disaster risk management to exchange experiences and learn from other countries’ experiences.

Issue to Address

The project organized an international Conference on GLOF in Paro, Bhutan in December 2012 titled “*Glacial Lake Outburst Flood (GLOF): Reducing Risks and Ensuring Preparedness*”. This was an excellent platform to share project experiences with a wider international audience with participants from Nepal, India, Japan, Austria, Norway, and United States to discuss how to scale up activities and to link with upcoming GLOF related projects in the regions and in other mountainous areas exposed to GLOF hazards.

Bhutan has a lot of experience and knowledge to share with other GLOF-prone countries and would also benefit from other countries’ experiences. Additionally, considering the two newest related initiatives (JICA project and NAPA2 project), Bhutan should continue to have lot more experiences and knowledge to share.

Recommendation 2: It is recommended to pursue the review/update of GLOF risks in Bhutan; particularly pursuing the monitoring of GLOF risks of the 25 identified glacial lakes.

Issue to Address

The GLOF project was to support the development of a national database on GLOF risks and vulnerabilities. However, this activity did not take place due to the ongoing “*Study on GLOFs in Bhutan Himalayas*” supported by the Japan International Cooperation Agency (JICA) and the Japan Science and Technology (JST) Agency, which also aims at establishing a similar database at a more detailed and comprehensive scale than planned under this project. The review of this study indicates that the focus was mostly on assessing the GLOF risk in the Mangdechhu river basin in central Bhutan. The study concluded that there were no urgent risks of potential GLOFs in this basin, which needed to be mitigated by counter measures such as lowering the water level of lakes. However, the study recommended the continuous monitoring of glacier lakes as well as the development of an early warning system in this particular basin.

It is recommended that the monitoring of GLOF risks of glacial lakes in Bhutan be reviewed and complete the geoscience database maintained by DGM. This activity could possibly be done in the context of the soon-to-start RGoB-UNDP-GEF/LCDF “*Addressing the Risks of Climate-induced Disasters through Enhanced National and Local Capacity for Effective Actions*”. This is a critical area when managing GLOF risks in a country like Bhutan and these lakes should be clearly identified, assessed – including field observations - and monitored regularly over time.

Recommendation 3: It is recommended to remove the misconception of “No GLOF Risk in Winter” when conducting public awareness campaign.

Issue to Address

Currently, there is a perception – and sometimes discussions with the public - that the risk of GLOFs in winter is inexistent due to cold weather up in altitude. The perception is that there will be no glacier melts to increase water and the water in the lakes will be frozen. This is a misconception and any strong earthquake in winter could breach glacial lake moraines and trigger a GLOF. It is recommended that public education and awareness campaigns specifically mention that GLOF is possible in winter too. There could be earthquake induced GLOF risks in winter considering the country’s vulnerability to earthquakes.

Recommendation 4: The Evaluation Team supports all follow up activities that are under way: Implementation of the Disaster Management Act; strengthening of the institutional set-up at the District level (resources, mandates, responsibilities, etc.); and strengthening DHMS capacity to monitor water level.

Issue to Address

It is not a recommendation as such but based on the review conducted by the Evaluation Team, it supports all follow up activities that are under way. Following this highly satisfactory project, the RGoB is already replicating some of these achievements through 2 key initiatives: a DHMS-JICA project and a soon-to-start RGoB-GEF-LCDF project. The Parliament also passed the Disaster Management Act early in 2013, which provides the necessary legislation for the country to implement a disaster management strategy nationwide. Additionally, mainstreaming disaster management into economic sectors in Bhutan and expanding disaster risk management schemes to other parts of Bhutan are part of the current 11th Five-Year Plan 2013-2018. Bhutan is now equipped with the foundation for developing a nationwide disaster management strategy and the mandated departments have the capacity to implement this strategy. The Evaluation Team reviewed all follow-up activities that are under way and support their implementation.

Recommendation 5: It is recommended to conduct research on lake water level variability and explore possible measures to regulate water flow for hydro-electricity production.

Issue to Address

Bhutan’s economy depends a lot on the production of hydro-electricity and a large portion of this production during the summer months is exported to India. Currently, a few projects are under way to expand its production capacity with the building of additional power plants. Most of this production of electricity is generated by run-of-the-river hydroelectric power plants². The production of electricity, therefore, depends a lot on the water flow available at any time during the year. Discussions with the MoEA revealed an interest in conducting more research on the water level at these glacial lakes and explore the possible measures to regulate the water flows down the valleys for extending hydro-electricity production.

It is a relevant interest for Bhutan. Exploring/researching technologies to drain out glacial lakes in winter would increase electricity generation downstream in lean season (winter) and the empty lakes would become natural reservoirs in summer while reducing GLOF risks.

² Run-of-the-river hydroelectricity is a type of hydroelectric generation whereby little or no water storage is provided. Run-of-the-river power plants may either have no storage at all, or a limited amount of storage, in which case the storage reservoir is referred to as pondage. A plant without pondage has no storage and is, therefore, subject to seasonal river flows and serves as a peaking power plant while a plant with pondage can regulate water flow and serve either as a peaking or base load power plant (*Wikipedia*)

1.4. Rating Table

Below is the rating table as requested in the TORs. It includes all the required performance criteria rated as per the rating scales presented in the TORs.

Table 1: Rating Table

Evaluation Ratings:			
1. Monitoring and Evaluation	Rating	2. IA & EA Execution	Rating
M&E design at entry	HS	Quality of UNDP Implementation	S
M&E Plan Implementation	HS	Quality of Execution - Executing Agency	S
Overall quality of M&E	HS	Overall quality of Implementation / Execution	S
3. Assessment of Outcomes	Rating	4. Sustainability	Rating
Relevance	R	Financial resources:	L
Effectiveness	HS	Socio-political:	L
Efficiency	S	Institutional framework and governance:	L
Overall Project Outcome Rating	HS	Environmental:	L
		Overall likelihood of sustainability:	L

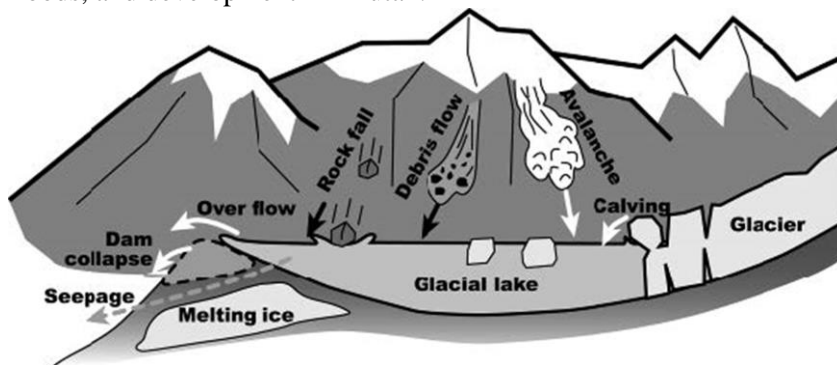
Rating Scales

<p>Outcomes, Effectiveness, Efficiency, M&E, I&E Execution ratings:</p> <p>Highly Satisfactory (HS): no shortcomings Satisfactory (S): minor shortcomings Moderately Satisfactory (MS) Moderately Unsatisfactory (MU): significant shortcomings Unsatisfactory (U): major problems Highly Unsatisfactory (HU): severe problems</p>	<p>Sustainability ratings:</p> <p>Likely (L): negligible risks to sustainability Moderately Likely (ML): moderate risks Moderately Unlikely (MU): significant risks Unlikely (U): severe risks</p>
<p>Relevance ratings:</p> <p>Relevant (R) Not relevant (NR)</p>	<p>Impact Ratings:</p> <p>Significant (S) Minimal (M) Negligible (N)</p>

2. CONTEXT AND OVERVIEW OF THE PROJECT

1. One of the most significant climate change impact in Bhutan is the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures. The risk of potential costly economic damages on key development sectors such as agriculture, hydropower, and forestry by Glacial Lake Outburst Floods (GLOFs) is mounting as well as on human settlements. Climate change is attributed as the primary reason that water levels in glacial lakes approach dangerous thresholds. This poses a new dimension to the existing range of threats to lives, livelihoods, and development in Bhutan.

2. An inventory of glaciers, glacial lakes, and glacial lake outburst floods (GLOFs) in Bhutan, prepared by a team of Bhutanese and foreign experts in 2001, identified 677 glaciers and 2,674 glacial lakes. The study also revealed a total of 24 glacial lakes posing potentially high risk for GLOFs³ (see also Annex 11). An update of the UNEP/ICIMOD GLOF inventory in 2007 shows that the number of high-risk glacial



Possible triggers of glacial lake outburst flood

Source: Final Report of SATREPSE Project, June 2012,
Graduate School of Environmental Studies, Nagoya University

lakes has increased to 25, and the team identified 983 glaciers and 2,794 glacial lakes. This inventory is in line with findings in the Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) that climate change is contributing to the melting of glaciers and the formation of glacial lakes in Bhutan. Studies suggest rates of glacial retreat in the Himalayas as high as 30 to 60 meters per decade, and the melting of glaciers leading to alarming volumes of water in downstream glacial lakes. Increased temperature also causes melting of ice-cored moraine dams to the point that the ridges can no longer resist the pressure. The concern is that when the current holding capacity of the lakes reaches a critical threshold, loose glacial debris that act as dams or barriers could fail and lead to flash floods that result in severe adverse impacts on downstream communities. Additionally, Bhutan falling on an active seismic zone, the increasing pressure on the fragile moraine dams also increases earthquake triggered GLOF disaster risks.

3. One of the glacier lakes facing a high risk of outburst flooding was the Thorthormi Lake in Bhutan's northern Lunana area. Thorthormi glacier had no supraglacial ponds on it during the 1950s but now there are numerous supra-glacial ponds, which are enlarging and becoming interconnected. The Thorthormi glacier was therefore considered as one of the most critical growing glacial lakes with GLOF threat in the near future. The area measured 1.28 km² in 2001 from satellite image (Geocover) and it was observed to be steadily growing in size. Thus the assemblage of supraglacial lakes, which lie on the Thorthormi glacier, has made it one of the most dangerous lakes in Bhutan.

4. Further, the risks of GLOF from the Thorthormi Lake are its moraine on one side that has been damaged at the foundation by the 1994 Lugge GLOF and the moraine between Thorthormi and Rapstreng lakes that has been observed to narrow rapidly. Observation of active collapse structures on the surface of the Thorthormi-Rapstreng moraine has become a serious concern. Should the moraine collapse and let Thorthormi flow into Rapstreng the risk is a breach of the Rapstreng moraine letting out around 53 million cubic meters of water.

5. Recognizing the need for systematizing the country's disaster risk management system to account for climate change induced GLOF hazards, the Government of Bhutan seeks to integrate long-term climate change-induced risks into the existing disaster risk management framework and enhance its longer term planning capabilities. Within this context, the Government of Bhutan partnered with UNDP and GEF-LDCF to integrate climate risk projections into existing disaster risk management practices and implement corresponding capacity development measures. The project has been demonstrating practical measures to

³ ICIMOD, Jack D. Ives, Rajendra B. Shrestha, Pradeep K. Mool, May 2010, *Formation of Glacial Lakes in the Hindu Kush-Himalayas and GLOF Risk Assessment*

TE of the UNDP-Supported, GEF-Financed Project "Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys"

reduce climate change-induced GLOF risks from the potentially dangerous Thorthormi glacier lake, and facilitated the replication of the respective lessons learned in other high-risk GLOF areas. Complementary to this risk reduction effort, the project has also focused on early warning mechanisms for the Punakha-Wangdue Valley, which was not equipped to handle the full extent of potential GLOF risks, to incorporate coverage of this growing threat.

6. The GLOF project was a UNDP supported, GEF-Least Developed Country Fund (LDCF) financed National Adaptation Programme of Action (NAPA) project with a grant of USD 3.45 million and an expected co-financing of USD 3.9 million (refer Table 8). UNDP was the GEF implementing agency. The Ministry of Economic Affairs (MoEA) was the implementing agency in Bhutan and the project was executed by three executing agencies: the Department of Geology and Mines (DGM), the Department of Hydro-Meteorological Services (DHMS), and the Department of Disaster Management (DDM). It was implemented under the National Execution (NEX) modality of UNDP. It was a 4-year project that started in June 2008, which was extended to terminate at the end of December 2013.

7. The goal of the project was to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan. Its objective was to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys. This goal and objective were to be achieved through four outcomes and a further 15 outputs. The expected outcomes were:

- **Outcome 1:** Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys;
- **Outcome 2:** Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system;
- **Outcome 3:** Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings;
- **Outcome 4:** Enhanced learning, evaluation and adaptive management.

3. EVALUATION FRAMEWORK

8. This terminal evaluation (a requirement of UNDP & GEF procedures) has been initiated by UNDP Bhutan as the GEF Implementing Agency. This evaluation will provide an in-depth assessment of project achievements and recommendations for other similar UNDP-supported, GEF-financed projects in the region and worldwide.

3.1. Objectives

9. The objectives of the evaluation was to assess the achievement of project results, and to draw lessons that can both improve the sustainability of benefits from this project, and aid in the overall enhancement of UNDP programming. More specifically, the evaluation:

- Assessed the overall performance against the project objective and outcomes as set out in the project document, project's logical framework and other related documents;
- Assessed the effectiveness and efficiency of the project;
- Analyzed critically the implementation and management arrangements of the project;
- Assessed the progress to date towards achievement of the outcomes;
- Reviewed planned strategies and plans for achieving the overall objective of the project within the timeframe;
- Assessed the sustainability of project's interventions;
- Listed and documented lessons concerning project design, implementation and management;
- Assessed project relevance to national priorities (including achieving gender equality goals);
- Provided guidance for closing project activities.

3.2. Scope

10. Below is a summary of the elements that were covered by this evaluation. Each element was assessed and those marked with an “*” were rated as per the TOR. These elements are:

- **Project Formulation**
 - Analysis of LFA/Results Framework (Project logic /strategy; Indicators)
 - Assumptions and Risks
 - Planned stakeholder participation
 - Replication approach
 - UNDP comparative advantage
 - Linkages between project and other interventions within the sector
 - Management arrangements
- **Project implementation**
 - Adaptive management (changes to the project design and project outputs during implementation)
 - Partnership arrangements (with relevant stakeholders involved in the country/region)
 - Feedback from M&E activities used for adaptive management
 - Project Finance and co-financing (*)
 - Monitoring and evaluation: design at entry and implementation (*)
 - Contribution of Implementing and Executing Agencies (*)
- **Project results (outputs, outcomes and objectives)**
 - Overall results (attainment of objectives) (*)
 - Relevance (*)
 - Effectiveness and Efficiency (*)
 - Country ownership
 - Mainstreaming
 - Sustainability: financial resources, socio-political, institutional framework and governance and environmental (*)
 - Impact

3.3. Methodology

11. The methodology used to conduct this terminal evaluation complied with international criteria and professional norms and standards; including the norms and standards adopted by the UN Evaluation Group.

3.3.1. Overall Approach

12. The evaluation was conducted in accordance with the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects⁴. It was undertaken in-line with GEF principles, which are: *independence, impartiality, transparency, disclosure, ethical, partnership, competencies/capacities, credibility and utility*. It considered the two GEF evaluation objectives at the project level: (i) promote accountability for the achievement of GEF objectives; including the global environmental benefits; and (ii) promote learning, feedback and knowledge sharing on results and lessons learned among the GEF and its partners.

13. The Evaluation Team developed tools in accordance with the UNDP and GEF policies to ensure an effective project evaluation. The evaluation was conducted and the findings were structured around the GEF five major evaluation criteria; which are also the five internationally accepted evaluation criteria set out by the Development Assistance Committee of the Organization for Economic Co-operation and Development. There are:

- *Relevance* relates to an overall assessment of whether the project was in keeping with donors and partner policies, with national and local needs and priorities as well as with its design.
- *Effectiveness* is a measure of the extent to which formally agreed expected project results (outcomes) have been achieved, or can be expected to be achieved.
- *Efficiency* is a measure of the productivity of the project intervention process, i.e. to what degree the outcomes achieved derive from efficient use of financial, human and material resources. In principle, it means comparing outcomes and outputs against inputs.

⁴ UNDP Evaluation Office, 2012, *Project-Level Evaluation – Guidance for Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects*.

TE of the UNDP-Supported, GEF-Financed Project “Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys”

- *Impacts* are the long-term results of the project and include both positive and negative consequences, whether these are foreseen and expected, or not.
- *Sustainability* is an indication of whether the outcomes (end of project results) and the positive impacts (long term results) are likely to continue after the project ends.

14. In addition to the UNDP and GEF guidance for project evaluation, the Evaluation Team applied to this mandate its knowledge of evaluation methodologies and approaches and its expertise in global environmental issues. It also applied several methodological principles such as (i) *Validity of information*: multiple measures and sources were sought out to ensure that the results are accurate and valid; (ii) *Integrity*: Any issue with respect to conflict of interest, lack of professional conduct or misrepresentation was immediately referred to the client if needed; and (iii) *Respect and anonymity*: All participants had the right to provide information in confidence.

15. The evaluation was conducted following a set of steps presented in the table below:

Table 2: Steps Used to Conduct the Evaluation

<u>I. Review Documents and Prepare Mission</u> <ul style="list-style-type: none"> ▪ Start-up teleconference/finalize assignment work plan ▪ Collect and review project documents ▪ Elaborate and submit <u>Inception Report</u> ▪ Prepare mission: agenda and logistic 	<u>III. Analyze Information</u> <ul style="list-style-type: none"> ▪ In-depth analysis and interpretation of data collected ▪ Follow-up interviews (if necessary) ▪ Elaborate and submit <u>draft evaluation report</u>
<u>II. Mission / Collect Information</u> <ul style="list-style-type: none"> ▪ Mission to Bhutan for the Team Leader ▪ Interview key Stakeholders and conduct field visits ▪ Further collect project related documents ▪ Mission debriefings 	<u>IV. Finalize Evaluation Report</u> <ul style="list-style-type: none"> ▪ Circulate draft report to UNDP/relevant stakeholders ▪ Integrate comments and submit <u>final report</u>

16. Finally, the Evaluation Team signed and applied the “*Code of Conduct*” for Evaluation Consultant. The Evaluation Team conducted evaluation activities, which were independent, impartial and rigorous. This terminal evaluation contributed to learning and accountability and the Evaluation Team has personal and professional integrity and was guided by propriety in the conduct of his business.

3.3.2. Evaluation Instruments

17. The evaluation provided evidence-based information that is credible, reliable and useful. The findings were triangulated through the concept of “*multiple lines of evidence*” using several evaluation tools and gathering information from different types of stakeholders and different levels of management. To conduct this evaluation the following evaluation instruments were used:

Evaluation Matrix: An evaluation matrix was developed based on the evaluation scope presented in the TOR, the project log-frame and the review of key project documents (*see Annex 2*). This matrix is structured along the five GEF evaluation criteria and includes all evaluation questions; including the scope presented in the guidance. The matrix provided overall directions for the evaluation and was used as a basis for interviewing people and reviewing project documents.

Documentation Review: The Evaluation Team conducted a documentation review in Bhutan and in Canada (*see Annex 3*). In addition to being a main source of information, documents were also used as preparation for the mission of the Team Leader in Bhutan. A list of documents was identified during the start-up phase and further searches were done through the web and contacts. The list of documents was completed during the mission.

Interview Guide: Based on the evaluation matrix, an interview guide was developed (*see Annex 4*) to solicit information from stakeholders. As part of the participatory approach, the Evaluation Team ensured that all parties view this tool as balanced, unbiased, and structured.

Mission Agenda: An agenda for the mission of the Team Leader to Bhutan was developed during the preparatory phase (*see Annex 5*). The list of Stakeholders to be interviewed was reviewed, ensuring it

represents all project Stakeholders. Then, interviews were planned in advance of the mission with the objective to have a well-organized and planned mission to ensure a broad scan of Stakeholders' views during the limited time allocated to the mission.

Interviews: Stakeholders were interviewed (*see Annex 5*). The semi-structured interviews were conducted using the interview guide adapted for each interview. All interviews were conducted in person with some follow up using emails when needed. Confidentiality was guaranteed to the interviewees and the findings were incorporated in the final report. A stakeholder workshop/debriefing on initial findings was held in Thimphu on Friday December 13, 2013.

Achievement Rating: The Evaluation Team rated project achievements according to the guidance provided in the TORs and consisting of four specific rating scales for rating (1) Outcomes, Effectiveness, Efficiency, M&E and Execution; (2) Sustainability; (3) Relevance; and (4) Impact.

3.4. Limitations and Constraints

18. The approach for this terminal evaluation is based on a planned level of effort of 16 days. It comprises a nine-day mission to Bhutan for the international consultant to interview key stakeholders, collect evaluative evidence; including a two-day visit to the Punakha and Wangduephodrang districts. Within the context of these limited resources, the independent Evaluation Team was able to conduct a detailed assessment of actual results against expected results and successfully ascertained whether the project met its main objective - as laid down in the project document - and whether the project initiatives are, or are likely to be, sustainable after completion of the project. The Evaluation Team also made a few recommendations that may be useful to reinforce the long-term sustainability of project achievements. Finally, the evaluation report contains lessons learned and best practices, which could be further taken into consideration during the development and implementation of other similar GEF projects in the region and elsewhere in the world.

19. It is also noted that the Evaluation Team could not visit the Thorthormi lake site during the evaluation mission that was the focus of outcome 2 with the artificial water lowering of the Thorthormi Lake and representing almost 2/3 of the GEF grant budget. This was due to the time required and harsh conditions, inaccessible project site due to snow cover during the visit, which would have required an extensive preparation for a demanding hiking trek of 10 days to go to the site (Lunana area) that is at 4,500m altitude with passes over 5,000m altitude and almost the same time to come down to Thimphu. Instead, the Evaluation Team relied on an excellent independent review "*Technical Review and Social Impact Assessment*" that was published in 2012 with the objective to examine and document technical and social lessons and impact of the project, as well as extracting the best practices and formulate recommendations for an exit strategy.

4. EVALUATION FINDINGS

20. This section presents the findings of this terminal evaluation adhering to the basic structure proposed in the TOR and as reflected in the UNDP Evaluation Guidance for GEF Financed Projects.

4.1. Project Design / Formulation

21. This section discusses the assessment of the formulation of the project – including its relevance - and its overall design.

4.1.1. Analysis of Logical Framework (LFA) / Results Frameworks

22. The logical framework matrix identified during the design phase of this project presents a set of clear expected results. No changes were made during the inception phase. The review of the objective, outcomes and outputs indicates a good and logical "*chain of results*" – outputs → outcomes → objective. Project resources were used to implement activities to reach a set of expected outputs, which together turned into higher level results (outcomes) and contributed to achieve the overall objective of the project. This logical framework was used as a "blueprint" on a day-to-day basis by the implementation team. It was used as a guide all along the implementation.

23. The design started upstream with the identification of the Thorthormi Lake as the most critical risk for a possible GLOF in Bhutan. The project was designed at three levels: (1) mitigate the risk of flood by lowering the water level of the Thorthormi lake (outcome 2); (2) raise awareness and capacities of vulnerable communities to prevent and respond to GLOF disasters downstream (outcome 1); and (3) install an early warning system in vulnerable communities to monitor the water level upstream and warn communities in case of a GLOF (outcome 3). A fourth outcome (outcome 4) was also identified to enhance learning, identified lessons learned and best practices and furthermore, to contribute to the scaling-up and replication of project achievements. It was found that this approach was excellent. It allowed the national partners to pioneer/test a GLOF mitigation approach in a real – most critical risk – environment. Then, using the lessons learned from this project, the government continued to develop its own strategy to address the need for disaster preparedness and disaster risk management; including the adoption of the “*Disaster Management Act of Bhutan*” in 2013 by the Parliament to provide the necessary legal framework for disaster risk management and preparedness.

24. The logic model of the project presented in the LFA is summarized in table 3 below. It includes one objective, four outcomes and a set of 15 outputs. For each expected outcome and objective, performance indicators were identified with their respective baseline value, target at the end of the project and the source of verification. It is a coherent model that was developed to “*reduce climate change-induced risks and vulnerabilities from glacial lake outburst floods in the Punakha, Wangdue and Chamkhar valleys*”. A more detailed list of outputs and their respective indicative activities is presented in Annex 6.

Table 3: Project Logic Model

PROJECT OBJECTIVE To reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.
Outcome 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys. <ul style="list-style-type: none"> • Output 1.1: Climate-resilient DRM legislation, policy frameworks, and sectoral plans; • Output 1.2: Capacities for climate risk planning strengthened at the district (Dzongkhag) Administrative level; • Output 1.3: Information on climate hazards and vulnerabilities (with a focus on GLOFs) in Bhutan systematically captured, updated, and synthesized; • Output 1.4: Vulnerable communities are aware of, and prepared for, climate-related disasters.
Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system. <ul style="list-style-type: none"> • Output 2.1: Engineering and safety plans for climate change risk reduction measures on Thorthormi Lake are in place; • Output 2.2: Artificial lowering system of Thorthormi Lake waters implemented; • Output 2.3: Water levels of Thorthormi Lake and status of artificial lowering system are regularly monitored and maintained; • Output 2.4: Technical knowledge and lessons in the artificial lowering of glacier lake levels captured and documented for use in future projects.
Outcome 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings. <ul style="list-style-type: none"> • Output 3.1: Technical components for a GLOF early warning system in the Punakha-Wangdue valley installed and operational; • Output 3.2: Institutional arrangements in place to operate, test, and maintain the GLOF EWS; • Output 3.3: Awareness of communities in the Punakha-Wangdue Valley on operation of the EWS; • Output 3.4: Safe GLOF evacuation areas identified and publicized in each vulnerable community in the Punakha-Wangdue Valley; • Output 3.5: Technical knowledge and lessons in the installation and operation of GLOF EWS captured and documented for use in future projects.
Outcome 4: Enhanced learning, evaluation and adaptive management. <ul style="list-style-type: none"> • Output 4.1: Project lessons captured in, and disseminated through, the Adaptation Learning Mechanism; • Output 4.2: Project knowledge shared with other GLOF-prone countries.

4.1.2. Assumptions and Risks

25. Risks and assumptions were identified for each expected result and presented in the logical framework matrix in the project document. These risks and assumptions were not changed during the inception phase. The review of these risks and assumptions indicates that they can be categorized into four main categories: (a) the project assumes that a GLOF event will not occur during the project implementation period; (b) the government will continue to support climate-resilient DRM; (c) staff turnover will not negate training benefits; and (d) weather conditions permit at least five months of mitigation work in the Thorthormi Lake each year. This is a valid list of risks and assumptions for this project but it was noted that no mitigation measures (management responses) were proposed in the project document. However, the strong ownership of the project by national partners was a strong mitigating measure to manage these risks and assumptions.

26. The list of risks and assumptions identified at the outset of the project is presented in the table below.

Table 4: List of Risks and Assumptions Identified at the Design Phase

Project Strategy	Assumptions
Objective: To reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys	<ul style="list-style-type: none"> Stakeholders are able to perceive reductions in vulnerability over the time-scale determined by project duration No flooding disasters in target communities occur throughout the project lifetime
Outcome 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys	<ul style="list-style-type: none"> Government remains supportive to link longer-term climate risk planning with current disaster risk management initiatives Government continues to support climate-resilient DRM. Turnover of staff does not counteract benefits of capacity building efforts Data is provided in an accessible format for use by different government departments Communities' training needs are correctly assessed and delivered in an accessible and culturally sensitive manner
Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system	<ul style="list-style-type: none"> No natural disasters in project area Workforce availability Climatic conditions permit at least five months of excavation work each year No natural disasters in project area Climatic conditions permit the geotechnical assessment to take place Availability of work force Regular seasonal variations of glacier melt do not greatly exceed average No natural disasters in project area Staff turnover does not negate training benefits Government continues to allocate resources to maintain artificial lowering system Continued assessment of GLOF risks in Bhutan National ownership of glacier lake management technology National political agreement for follow-up plan on GLOF risk management National agreement on other project sites with GLOF risk as priority hazard Artificial lowering system in the target area contains elements that can be replicated elsewhere
Outcome 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings	<ul style="list-style-type: none"> No tampering with early warning system installations Functioning backup systems in place Procurement proceeds on schedule Transport of building materials not delayed by seasonal climate extremes Staff turnover does not negate training benefits Government continues to allocate resources for maintenance and continuous testing of early warning system Messages are delivered in an appropriate way to enhance awareness, receptiveness and understanding Messages are delivered in a concerted, coordinated and consistent manner At least two sufficiently safe evacuation points exist in and around target communities All DRM stakeholders cooperate in simulation exercises Government ownership of GLOF early warning technology National political agreement for follow-up plan on GLOF early warning
Outcome 4: Enhanced	<ul style="list-style-type: none"> The ALM is operational and circumstances in Bhutan apply to future GLOF mitigation

Project Strategy	Assumptions
learning, evaluation and adaptive management	and preparedness initiatives <ul style="list-style-type: none"> • The ALM is operational to facilitate learning • Other regions and countries believe experiences from the project will be valuable for future GLOF mitigation and preparedness initiatives

Source: *prodoc*

27. The review conducted for this terminal evaluation reveals that during the implementation of the project the project management team did not focus much on this list of risks. A shorter list of risks was entered in the Atlas system and none were reported as critical. The log of risks as of November 2013 is presented in the table below:

Table 5: List of Risks Logged in Atlas

Risks	Type	Date Identified	Critical
1. Implementing partner unable to meet delivery target	Financial	Oct. 2008	N
2. Delay in project implementation due to parliamentary elections and formation of the new government	Political	Aug. 2008	N
3. Political changes causing delay in fund transaction to the implementing agency	Political	Oct. 2008	N
4. Mitigation works carried out at high altitude and in difficult environmental conditions thereby poisoning health and safety risks to workers and multi-disciplinary team	Environmental	Sept. 2010	N
5. Adoption of Disaster Management Bill delayed	Political	Jan. 2011	N
6. Delay in project implementation under outcome 2 due to difficult environmental conditions	Environmental	Jan. 2011	N
7. Lack of project workers for Thorthormi Lake mitigation work	Operational	Jun. 2012	N
8. Fire of Wangduephodrang Dzong (district administration of one of the three pilot districts)	Operational	Jun. 2012	N

Source: *Atlas print out as of November 2013*

28. The review indicates that the risks related to the implementation of the project were monitored and addressed mostly at the PB level. As discussed later in Section 4.1.8, the PB was very active and provided an excellent channel of communication and guidance among the various project's partners. The PB also regularly reviewed project progress and implementation issues and made the corresponding decisions to address these issues; often acting quickly to anticipate that any issue may slow down the implementation of the project.

4.1.3. Lessons from other Relevant Projects/Initiatives

29. This project was conceptualized on the basis of an excellent contextual analysis and from a series of key events that took place prior to this project and which provided the necessary background studies for the preparation of this project. In September 2000, the government of Bhutan published its initial national communication under the UNFCCC declaring that GLOF was one of the priority areas likely to be affected by climate change. It stated "*in the northern region of the country there are numerous snow-clad mountains and glacial lakes. Increases in temperature caused by global warming will result in the retreat of glaciers, increasing the volume of such lakes and ultimately provoking glacial lake outburst floods (GLOFs) with potential catastrophes*". It is also important to note that this communication took place after the October 1994 flash flood on the Pho Chhu River due to a glacial lake outburst in the Lunana area⁵. Furthermore, it

⁵ Previous GLOFs occurred in Bhutan in 1957, 1960, 1968 with varying intensity and damage to life and property in the lower valleys. The 1994 GLOF was the most devastating GLOF in living memory. On 7th October 1994 the Luge Tsho in eastern Lunana burst and caused massive flooding, loss of life and extensive damage to property along the Punakha-Wangdue valley. The Dzongchu or small Dzong in Punakha was partly destroyed when the Pho Chu and Mochu rivers joined course above the Dzong. The flood in the Lunana Region affected a total of 91 households. The GLOF washed away 5 water mills, damaged 816 acres of dry land and 965 acres of pastureland, and carried away 16 yaks and about 16 tons of food grains (NAPA - 2006).

was stated that “possible significant impacts of glacial lake outbursts in the context of Bhutan include perturbation in the quantity of river water used for hydropower generation; destruction of settlements, infrastructure, and agricultural lands; and loss of biodiversity, and even human lives downstream”. This communication identified the information gaps and the priority needs.

30. In 2001, a team of Bhutanese and foreign experts conducted an “*Inventory of Glaciers, Glacial Lakes, and Glacial Lake Outburst Floods, Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region*” under the aegis of the International Center for Integrated Mountain Development (ICIMOD) and in cooperation with the regional resource center for Asia and the Pacific of UNEP. This inventory identified 677 glaciers covering an area of about 1,317 km² with an approximate amount of 127 km³ of ice reserves; it also identified 2,674 glacial lakes, all in Bhutan. It also revealed a total of 24 glacial lakes posing potentially high risk of GLOFs, including 8 of these 24 lakes located in the Pho Chhu Sub-basin and 3 lakes in the Chamkhar Chhu Sub-basin. Further to this inventory, a team of experts from the Department of Geology and Mines (DGM) and the Institute of Geology of the University of Vienna carried out detailed field assessments in the headwaters of the Pho Chhu Sub-basin in 2002. They found a serious and immediate threat of GLOF from the Thorthormi and Raphstreng lakes whereby the worst-case scenario could be the collapse of the wall separating the Thorthormi and the Raphstreng lakes as early as 2010. It was estimated that this case scenario would result in a massive GLOF with over 53 million cubic meters of water – twice the volume of the 1994 flood – flowing downstream the valley.

31. Following the initial national communication, Bhutan completed its National Adaptation Programmes of Action (NAPA) in 2006. The process was highly consultative and it reviewed all existing information on potential climate change impacts including the risk of GLOFs in Bhutan. The process concluded with the identification of 9 priorities:

- Disaster Management Strategy (Pilot Implementation of Food Security and Emergency Medicine)
- Artificial Lowering of Thorthormi Glacier Lake (*)
- Weather Forecasting System to Serve Farmers and Agriculture
- Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)
- Flood Protection of Downstream Industrial and Agricultural Area
- Rainwater Harvesting
- GLOF Hazard Zoning (Pilot Scheme – Chamkhar Chu Basin) (*)
- Installation of Early Warning System on Pho Chu Basin (*)
- Promote Community-based Forest Fire Management and Prevention

32. The project was conceptualized following this NAPA process. From the outset it aimed at addressing 3 priority areas – those marked with an * - among the 9 priorities that were identified by NAPA 2006. The timing also corresponded to the setting up of the LDCF in 2001 (UNFCCC COP7) with further guidance on climate change adaptation given to GEF by the UNFCCC subsequent Conferences of Parties (COP). It was the first step to fund/support the implementation of NAPA priorities and this follow-up project for Bhutan was among the first projects submitted to GEF for funding under this new financial mechanism (LCDF).

33. The design of this project was then done through an extensive preparatory phase funded jointly by GEF, the Government of Bhutan and the Netherlands Climate Assistance Programme. It started at the end of 2006 with a total budget of USD 430,000 of which USD 180,000 was funded by a GEF grant. The objective of this phase was the “*Hazard Zonation and Early Warning System Assessment for GLOF vulnerable areas of Punakha-Wangdue and Chamkhar Valley areas*”. It focused on the compilation of baselines studies analyzing the threats of climate change and variability on glacial lakes in Bhutan; the hazard zonation and vulnerability mapping for the Chamkhar valley and lower Punakha-Wangdue valley; the assessment of most suitable early warning system for GLOF threats in Punakha-Wangdue valley, the preparation of an implementation plan for the Full Size Project (FSP); and finally, the preparation of the FSP brief to be submitted to GEF.

34. In conclusion, the project is the logical follow up initiative to address key national priorities related to the risk of GLOF in Bhutan. It is part of the overall national approach to address GLOF risks and it provided the first attempt at mitigating GLOF risks in Bhutan.

4.1.4. Planned Stakeholder Participation

35. A complete stakeholder analysis was conducted during the PPG phase to identify key stakeholders who would be involved in the implementation of the project but also to consult and gather feedback during the design phase of the project. Several stakeholder consultation meetings took place during the PPG phase; they were involved throughout the project design process.

36. The analysis identified the following list of key stakeholders with a role in disaster risk management, climate change and GLOFs:

- Department of Geology and Mines (DGM) at the Ministry of Economic Affairs (MoEA)
- Disaster Management Division (DMD) at the Ministry of Home and Cultural Affairs (MoHCA)
- National Environment Commission (NEC)
- Planning Commission renamed today as the Gross National Happiness Commission (GNHC)
- The Dzongkhag Administrations
- Local communities: Punakha, Wangdue, Gasa, and Chamkhar
- National Committee for Disaster Management
- Ministry of Finance
- Department of Roads, Ministry of Works and Human Settlement
- Department of Energy, Ministry of Economic Affairs (MoEA)
- Jigme Dorji Wangchuck National Park (JDNP) Management
- Department of Agriculture
- World Wildlife Fund (WWF Bhutan)
- International Centre for Integrated Mountain Development (ICIMOD)
- UNDP Country Office
- Austrian Development Agency (ADA)
- UN Volunteers (UNV)

37. Following the identification of this list during the PPG phase, almost all these stakeholders participated in the implementation of the project at one point or the other and their participation was critical for the success of the project. However, two stakeholders listed above did not participate: the UNV and ICIMOD. In the meantime, two more key stakeholders, the Department of Hydro-met Services (DHMS), then a Division of Hydro-met Services under the Department of Energy, Ministry of Economic Affairs (MoEA) as well as PHPA became key stakeholders. Finally, another stakeholder that provided very valuable help during the last summer in lowering of the Thorthormi Lake was the Royal Bhutan Army (RBA) (*see Section 4.3.1*).

4.1.5. Planned Replication Approach

38. The review of documents produced during the PPG phase and interviews conducted for this evaluation indicate that the replication and scaling-up of results were “embedded” in the design of the project itself. Each outcome had one output focusing in capturing the lessons learned. Then, it was planned to disseminate this information in Bhutan and also in other GLOF-prone countries. These outputs include:

- *Output 1.3:* Information on climate hazards and vulnerabilities (with a focus on GLOFs) in Bhutan systematically captured, updated, and synthesized
- *Output 2.4:* Technical knowledge and lessons in the artificial lowering of glacier lake levels captured and documented for use in future projects
- *Output 3.5:* Technical knowledge and lessons in the installation and operation of GLOF EWS captured and documented for use in future projects
- *Output 4.1:* Project lessons captured in, and disseminated through, the Adaptation Learning Mechanism;
- *Output 4.2:* Project knowledge shared with other GLOF-prone countries

39. Furthermore, the strategy to scale-up project results were through the incorporation of a DRM programme into the initial 10th Five-Year Plan 2007-2012, which was later shifted to 2008-2013. This

approach allowed the government to allocate additional human and financial resources to sustain the activities initiated by the project related to DRM in Bhutan.

40. The review conducted for this evaluation reveals that this project was the logical continuation of a series of events that included the development of the first NAPA for Bhutan (*see Section 4.1.3*). Having an excellent national ownership, the project has been the first implementation step to address 3 main national priorities identified through the NAPA. Moreover, the project became part of the national strategy to address GLOF and DRM issues in the country. As a result, a DRM programme emerged nationally and became part of the Five-Year Plans. The project was mentioned in the Tenth Five-Year Plan 2008-2013 and GLOF risks are cited in the Eleventh Five-Year Plan 2013-2018 among the challenges that Bhutan is facing for its development.

41. It was then anticipated that lessons learned and best practices would become very valuable for the related departments in the government to expand the results achieved in the Punakha-Wangdue and Chamkhar Valleys to other parts of Bhutan, including the development of adequate policy, legal and institutional frameworks. These lessons include the lowering of the water level in the Thorthormi Lake, the installation of an early warning system (EWS) and the development of community-based capacities required when operationalizing an EWS.

4.1.6. UNDP Comparative Advantage

42. As part of the UN System in Bhutan, which espouses the principle of “*Delivering as One (DaO)*”, UNDP functions as a knowledge-based organization, providing technical assistance and support to the Royal Government in achieving its development goals. Its programs in Bhutan is part of the UN Development Assistance Framework (UNDAF) that provides an overarching framework to guide and facilitate the development of partnerships among UN agencies and between the UN, the RGoB, other stakeholders as well as donor agencies. The second UNDAF for Bhutan (2008-2012) was critical to keep Bhutan on track to meet the MDGs and also coincided with the implementation of the Tenth Five-Year Plan (2008-2013). When planning this second UNDAF, environment and Disaster Risk Management (DRM) was identified as a priority area among four other priority areas for UN assistance. It was recognized that disaster management capacity must be strengthened, as Bhutan is vulnerable to numerous natural hazards such as glacial lake outbursts, floods, earthquakes, landslides, and forest fires.

43. The *UNDP Country Programme for Bhutan (2008-2012)* recognized that despite that Bhutan has been balancing development with environmental conservation, the increasing urbanization and economic activity, infrastructure development and natural disasters place increasing pressure on environmental sustainability. It was, therefore, stated that reconciling development with environmental sustainability was a major challenge for Bhutan. Furthermore, since 2004, UNDP has supported disaster-risk management in Bhutan through institutional capacity development at all levels and with a range of stakeholders from different government departments; including the support for the development of a national disaster risk reduction strategy framework.

44. According to an assessment of results conducted by the UNDP evaluation office in 2006, it was found that UNDP established a partnership with the Government of Bhutan and that, as a knowledge centre, UNDP takes advantage of its linkages with regional and global networks. It is the case with the UNDP’s Bureau for Crisis Prevention and Recovery programme that supports national counterparts to develop both a disaster risk perspective and the human, financial, technical, and legislative capacity; civil society preparedness; and coordination systems required to effectively manage and reduce risk. In an effort to promote integrated development approaches, UNDP brings together partners working on both climate change and disaster risk reduction.

45. It was also found that in addition to its focus on disaster management, the implementation of development programmes through the national execution modality has worked well in Bhutan, as it enhances national ownership and capacity to manage development plans and programmes. Finally, the assessment revealed that the use of limited resources available to UNDP as catalysts to mobilize additional technical, human and financial resources, allowed the government of Bhutan to augment its development efforts.

46. In the context of implementing the UNDAF 2008-2012, (later on changed to 2008-2013 to align it with the RGoB's Five Year Planning cycle), the *UNDP Country Programme for Bhutan (2008-2012)* focuses on three priority areas (out of a total of 5 for the UNDAF): promoting good governance, reducing poverty, and environment and disaster management. It was recognized that UNDP has a comparative advantage in these areas due to past experience, particularly in multi-sectoral approaches, and because of its access to policy and technical support through its global and regional networks. It was stated that UNDP - as the main UN organization for the UNDAF planned outcomes in these 3 priority areas - will play a leading role in conducting joint reviews and evaluations in those areas, in collaboration with the Government and other development partners.

4.1.7. Linkages Between the Project and Other Interventions within the Sector

47. As discussed in Section 4.1.3, the project was formulated on the basis of an excellent contextual review, which provided necessary background studies for the preparation of the project. The emergence of the project concept was also a logical continuation of the strategy in Bhutan to address disaster risk management and risk management of GLOFs. The project was a set of direct follow-up activities to the NAPA 2006, addressing 3 key national priorities related to the risks of GLOFs and seeking to mitigate those risks in Bhutan.

48. In Section 4.1.5, the review discussed how the project was mainstreamed into the policy, legislation and institutional frameworks in Bhutan; including the emergence of a DRM programme in the Five-year (Development) Plans of Bhutan. Due to its excellent responsiveness to national priorities, its implementation through the NEX modality (*see Section 4.2.3*) and the strong engagement of national partners, the project has benefited from a strong national ownership. As a result, the project supported government interventions to pioneer activities to mitigate risks of GLOFs in the Punakha-Wangdue and Chamkhar Valleys. It became a supportive instrument to the government to address key national priorities in the DRM area.

49. Since June 2008, the project has been *de facto* the DRM programme in Bhutan. Interventions have been implemented by key government departments; including the Department of Geology and Mines (DGM), the Department of Hydro-Met Services (DHMS), the Department of Disaster Management (DDM) and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. Additionally, through a well functioning Project Board (PB), the planning of project interventions was well planned with the interventions of the Gross National Happiness Commission (GNHC) and of the National Environment Commission (NEC). From an international partners point of view, the Austrian Development Agency (ADA) and the World Wide Fund (WWF) were also part of this initiative through the co-funding of project activities (*see Section 4.2.2*).

50. The review also noted the excellent linkage between the GLOF project and PHPA, which decided to participate in the development of an early warning system in the Punakha-Wangdue Valley with a cash contribution of Nu. 20,000,000 (USD 325k). The RGoB - in a joint venture with the Government of India - is building 2 hydroelectric projects in this valley (PHPA I & II) and the risk of GLOF cannot be under estimated. They estimate that the flood from a burst of the Thorthormi Lake would affect the 2 sites between 4 to 6 hours after the burst. The construction of the 2 sites involves between 12,000 and 15,000 people working at the riverbank level in the valley; and lots of equipment (assets). In order to mitigate the risk of GLOFs, PHPA I & II jointly developed a DRM plan for each site including evacuation plans, installed a water level monitoring station at the Thorthormi Lake and posted 2 staff in Lunana to monitor the Lake. They are also linked with the EWS developed with the support of the project in the Punakha-Wangdue Valley, which includes 4 siren towers installed near the 2 hydroelectric sites.

51. The project outputs also clearly indicate Bhutan's commitment to climate change and other multilateral environmental agreements (MEA). The project has also been a clear indication of cooperative approaches of the UN agencies and other development partners in garnering sustainable development achievements.

52. In conclusion, this project was the main instrument to support the government of Bhutan during these years of implementation (2008-2013), strengthening a DRM programme for the country. It was fully implemented by national partners, which facilitated a strong national coordination. In parallel to this project,

another initiative is worth mentioning here. The Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA) – the latter a long-term partner of Bhutan on GLOF research - conducted a 3-year study to evaluate GLOFs' hazard level in Bhutan for mitigation. It started in 2009 and was implemented through the DGM, hence ensuring coordination and complementarity among projects at national level. The main focus of this study was on the Mangde-Chhu basin, for which the GLOF hazard level has been believed to be high but information for mitigation has been lacking. This study supported the development of a JICA funded project that recently started in Bhutan to mitigate GLOF risks in the Mangde-Chhu basin (*see Section 4.3.8*).

4.1.8. Management Arrangements

53. The management arrangements planned at the onset of the project included:

- *GEF Implementing Agency*: UNDP served as the GEF implementing agency for the project.
- *Implementing Agency in Bhutan*: Ministry of Economic Affairs
- *Executing Agencies*: Three executing agencies were designated to implement the project:
 - *Department of Geology and Mines (DGM)*, from the Ministry of Economic Affairs, which has the mandate and expertise to address GLOF risks;
 - *Department of Hydro-Met Services (DHMS)*, from the Ministry of Economic Affairs, which has the mandate for flood warning and forecasting;
 - *Department of Disaster Management (DDM)* from the Ministry of Home and Cultural Affairs, which is the focal agency for disaster management in Bhutan, including climate change-induced risks.

All three government agencies have been responsible for the timely delivery of inputs and outputs and for coordination with all other relevant agencies, including the NEC and the GNHC.

- *Project Board (PB)*: A PB was formed with 18 members, representing all key organizations related to the implementation of the project. The *Secretary* of the Ministry of Economic Affairs - under which two lead executing agencies DGM & DHMS are situated - has been the Chairman of this PB. The PB was the group responsible for making management decisions on a consensus basis when guidance was required by Project Managers; including approval of project revisions. Project assurance reviews by this group were made at designated decision points during the running of the project, or as necessary when raised by Project Managers.
- *Technical Support and Advisory Team (TSAT)*: A TSAT was formed at the inception of the project with 11 members. It was decided at the inception workshop (June 2008) that the Director General of DGM would chair this advisory body. TSAT provided technical support to the project during the implementation of activities related to the artificial water lowering of the Thorthormi Lake (Outcome 2). It provided technical advice and backup support to the Project Manager during the implementation of this outcome.
- *Project Managers (PM)*: A PM was designated by each executing agency (DGM, DHMS, DDM) to execute their respective part of the project, applying government of Bhutan administrative and financial procedures in compliance with UNDP rules and regulations. It was noted that these three PMs were Officers in Charge in their respective departments. They have been responsible to deliver the expected outputs under their respective agencies but they also kept their respective office duties during the implementation of the project. The project responsibilities were in addition to their regular workload and it was noted by this review that no GEF-LDCF funds were used for these management functions. The responsibilities rendered by these officials and use of their office space for the project purpose was accounted as co-financing from the RGoB.
- Part time *Consultants/Experts* have been hired to provide technical expertise to the project.

54. From the outset of the project, decisions were made to determine clear roles and responsibilities for each executing agency. During the design phase and subsequently during the inception phase of the project, the allocation of implementation responsibilities were as follow:

- DHMS has been responsible for delivering outputs: 3.1 and 3.5;

- DGM has been responsible for delivering outputs: 1.3, 2.1, 2.2, 2.3, 2.4;
- DMD has been responsible for delivering outputs: 1.1, 1.2, 1.4, 3.2, 3.3, and 3.4;
- All 3 Agencies have contributed to outputs 4.1 (lessons learned) and 4.2 (knowledge sharing) from their respective component. Additionally, UNDP also produced some advocacy materials, fact sheets, etc. and provided a quality assurance function for some publications,

55. The project was implemented using the National Execution (NEX) modality of UNDP that is – in the case of Bhutan - the transfer of the funds to the national budget system and, once available, these financial resources were released to the respective three executing agencies by the Ministry of Finance (MoF), following RGoB administrative and financial procedures and UNDP rules and regulations (*see Section 4.2.3*).

56. The review indicates that the management arrangements – though somewhat complex with the participation of three executing agencies - were adequate and effective for the implementation of the project. They provided the project with clear roles and responsibilities as well as clear reporting lines of authority. The good functioning of the PB – well Chaired - provided an effective way to communicate and keep stakeholders engaged, contributing to an effective use of project resources and a good national ownership of project achievements. This oversight body met 14 times during the implementation of the project starting with the first meeting in July 2008 focusing mostly on the mobilization of resources to start work at the Thorthormi Lake. The last meeting was in January 2014 to review the major achievements of the project and also to discuss on the appropriate exit strategy for the project.

57. The TSAT met four times during the implementation of outcome 2. The first time was in July 2008 to review the contextual studies/assessments for the artificial lowering of the Thorthormi Lake (outcome 2) and outline the way forward to produce the engineering and safety plan. The fourth meeting was in January 2011 to review the progress made during the first 2 working seasons (2009 and 2010), the challenges faced by the project, and the work plan for the summer of 2011.

4.2. Project Implementation

58. This section discusses the assessment of how the project has been implemented. It assessed how efficient the management of the project was and how conducive it was to contribute to a successful project.

4.2.1. Adaptive Management

59. The project has been well managed. The Project Managers followed RGoB and UNDP procedures for the implementation of the project and used adaptive management extensively to secure project deliverables while maintaining adherence to the overall project design. The review indicates that project achievements are well aligned with the project document that was endorsed by stakeholders. The log-frame – also called Strategic Results Framework - included in the project document had been used as a “blueprint” to guide the implementation of the project (*see Section 4.1.1*). An efficient implementation team was in place, detailed work plans were guiding the implementation, assignments were conducted with the required participation of relevant stakeholders and the project progress was well monitored.

60. Adaptive management was used regularly to adapt to a constantly changing environment; it was particularly used by the PB to make effective decisions regarding the implementation of the project. It was used as a mechanism to respond to stakeholders’ needs and priorities. As a result, activities supported by the project benefited from a strong participation of stakeholders. Each assignment was conducted following well-defined terms of reference.

61. One example of adaptive management was the decisions taken to mobilize the resources for outcome 2. Due to the very harsh working conditions at the Thorthormi Lake, the implementation of the project needed to constantly be adapted to the local environmental conditions. It started with the decision of the scope of the Engineering and Safety Plan. Due to a limited time in 2008, the TSAT decided that instead of covering the whole area of the Thorthormi Lake, the plan study would focus on the spillway channel area and if time permits, further geotechnical assessment and topographic survey of wider area would be carried

out⁶. Then, the PB regularly reviewed a series of issues related to the work to be done to lower the water level of the Thorthormi Lake and made the appropriate decisions to move the work forward. It included questions regarding the transport of equipment, tools and food to the site at 4,500m altitude but also communication arrangements for the crew to be in contact with Thimphu, method to recruit labor for the mitigation work and labor payment, emergency arrangements, etc. The process to adapt the management of project resources was also well documented through minutes and reports such as the “*PB Meeting Review, Proposals and Recommendations: Thorthormi Lake Mitigation Work*” report that was submitted to the PB meeting of February 2009 to support the discussion and decision making process.

62. Another example of adaptive management was during the tragic event during the start of the 2010 mitigation work at the Lake. Two workers died while proceeding to Lunana - the site for the mitigation work at the Thorthormi Lake – despite the safety arrangements put in place before the start of the 2010 working season. Medical and police reports reported that the loss of these two workers was due to high altitude sickness. As a result, the PB reviewed the conditions of these tragic events and made decisions to compensate the two families; imposed mandatory acclimatization of one day each at 2 points on the way up to Lunana (Taksemakhang at 3,500m and Todophu at 4,200m altitude); and position medical staff and Gamow bags⁷ (Portable Altitude Chamber) at these two locations. Additionally, in October-November 2010, the project conducted a health and safety assessment to examine the health and safety measures in place, which concluded with a set of 27 recommendations to improve the health and safety aspects of the GLOF mitigation work in Lunana⁸. Based on this assessment, the PB made additional decisions to strengthen the health and safety measures; particularly during the travel time to go up to Lunana. In addition to the acclimatization days, it included the establishment of medical camps at both points on the way up to Lunana, added one additional health representative to the medical team accompanying the workers during their journey to Lunana and strengthened the medical screening of workers during the selection process.

63. A third example was the request for the involvement of the Royal Bhutan Army (RBA) to provide soldiers to augment the number of workers during the 2012 working season in Lunana. Each year since 2009, the project hired over 300 workers to lower the water level in the Thorthormi Lake (outcome 2). However, despite attractive wages, it became more and more difficult to find enough workers for the 2011 and 2012 seasons. Faced with a serious shortage of workers at the outset of the 2012 season and understanding the risk, the issue was brought to the PB and a decision was made at the 12th PB meeting on June 2012 to contact the RBA and request the help of 130 soldiers to participate in the work at the Lake during the 2012 season. A request letter from the Minister for Economic Affairs was sent to RBA. A few weeks later, 123 soldiers were sent to Lunana – including 6 Army Officers - to augment the crew of 112 workers and, together, complete the mitigation work at the Thorthormi Lake by the end of the 2012 season with a lowering of the water level by a total of 5m over 4 seasons.

64. Finally, a complete review of project expenditures and remaining budget amounts was conducted prior to the 13th PB meeting held on January 18, 2013. Proposals to use the remaining budget amounts by the three executing agencies – estimated at about USD 560,000 total as of January 2013 - were submitted to the PB. Based on these proposals, the PB decided to allocate the remaining amounts to new activities and approved a no-cost time extension of the project to the end of December 2013. It included the expansion of GLOF EWS on Mochhu and Tarina sub-basins and the procurement of Search and Rescue (SAR) equipment for the three pilot Dzongkhags.

65. The review of activities that were supported by the project reveals that adaptive management was used as a management approach to particularly allocate effectively and efficiently project financial resources. On one hand, the log-frame gave the project team an overall plan on how to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys; and on the other hand the project management team used adaptive management to properly allocate the financial resources available, “stretching” every dollar as much as possible including the use of co-financing. Considering the

6 TSAT Meeting Minutes, July 2008.

7 A Gamow bag is an inflatable pressure bag large enough to accommodate a person inside. By inflating the bag with a foot pump, the effective altitude can be decreased by 1,000 to as much as 3,000 meters. It is primarily used for treating severe cases of altitude sickness (Wikipedia).

8 GLOF Project, *Health and Safety Assessment – UNDP*.

TE of the UNDP-Supported, GEF-Financed Project “Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys”

nature of the project, adapting the day-to-day management of the project was a necessity for succeeding and this approach, certainly, contributed to the long-term sustainability of project achievements.

4.2.2. Partnership Arrangements

66. As discussed in Section 4.1.8, the management arrangements of the project were adequate for the implementation of the project; they provided the project with clear roles and responsibilities for each party engaged in the implementation of the project. With the addition of project resources, the project has been *de facto* the DRM programme in Bhutan implemented by the relevant government partners. Overall, the partnership arrangements were excellent and provided excellent synergies among the key departments involved in the implementation of the project. A review of the role of each agency was conducted during the design of this project; a summary is provided in the table below:

Table 6: Summary of Roles in Project for Key Stakeholders

Key Stakeholders	Role in Project
Department of Geology and Mines (DGM)	<ul style="list-style-type: none"> DGM executed all technical aspects regarding the design of the project, in close collaboration with the Disaster Management Division and other stakeholders. The agency was involved in contributing to the PPG process, and has been the Lead Agency for the implementation of the project.
Disaster Management Division (DMD)	<ul style="list-style-type: none"> DMD participated in the Project Steering Committee meetings of the PPG phase. It has provided coordination and guidance during the implementation of the project, particularly to facilitate logistics and labor mobilization for outcome 2 and to collaborate closely with DGM to incorporate climate change issues into the DRM framework and training materials for Outcome 1.
National Environment Commission (NEC)	<ul style="list-style-type: none"> NEC took the lead in designing and implementing the NAPA process in Bhutan and provided information on climate change vulnerabilities. NEC participated in the Project Steering Committee meetings of the PPG Phase and has ensured policy coordination during the implementation of the project. As the agency responsible to prepare the Second National Communication to the UNFCCC, it continued to provide input on vulnerabilities related to climate change and disasters, particularly in designing awareness and training for local staff and communities.
Gross National Happiness Commission (GNHC)	<ul style="list-style-type: none"> For the long-term sustainable development following the project, the GNHC has been crucial to integrate the hazard zonation maps into development plans for the Punakha-Wangdue Valley and Chamkhar Valleys. It has helped ensure that successful approaches developed by the project would contribute to Bhutan's adaptation to climate change. It also provided guidance for ensuring that development activities be more climate change resilient.
The Dzongkhag Administrations	<ul style="list-style-type: none"> All relevant district-level administration offices have worked closely with DGM, DHMS and DMD in all districts where project activities were implemented.
Local communities	<ul style="list-style-type: none"> Local communities in the Punakha-Wangdue Valley and Chamkhar Valley, as well as in the upstream region near the Thorthormi Lake, were important stakeholders/beneficiaries during the implementation of the project.
National Committee on Disaster Management	<ul style="list-style-type: none"> Through the DMD, the NCDM provided policy directions for mainstreaming climate-resilient DRM in the development framework in Bhutan.
UNDP Country Office	<ul style="list-style-type: none"> The UNDP Bhutan office has acted as the overall coordinator and monitor of project funds. It has helped the mobilization and coordination with other partners through its global network.

Source: adapted from *prodod* and *mission notes*

67. From the outset of the project and by design, three main government departments were involved in the implementation of project activities: DGM, DHMS and DDM. The project work plan was closely aligned with the existing work plans of these three agencies, providing additional resources for the strengthening of disaster risk management – including mitigation - and preparedness in Bhutan.

68. As a result, the review found that beyond partnership arrangements the project was very well integrated in the relevant apparatus of government in Bhutan. It provided extra resources to demonstrate how to mitigate a GLOF risk and along the way to strengthen disaster risk management and preparedness in

Bhutan, including the policy and legal frameworks to support the development of a national disaster risk management strategy in Bhutan (*see Section 4.3.3*).

4.2.3. Project Finance

69. As indicated in Section 4.1.7, the implementation modality of the project to allocate, administer and report on the project resources was the UNDP NEX⁹ (National Execution) modality; that is project activities were carried out by three eligible national entities to execute the project: DGM, DHMS and DDM, each one led by one Project Manager. Each year, they produce a consolidated Annual Work Plan (AWP), including an annual budget in collaboration with GNHC and UNDP. The UNDP Country Office (CO) released quarterly the necessary funds to the Department of Public Accounts (DPA) under the Ministry of Finance, which then would release the funds onward to the three executing agencies, following RGoB financial procedures. The management of project finances is rated as *highly satisfactory*.

70. It was noted in the Medium Term Review (MTR) that for the first year of the project, funds were released by the UNDP CO to the GNHC Secretariat, which would in turn release them to the DPA, and which would release them onward to the DDM, DGM and DoE. This approach was reviewed after one year and simplified/shortened by transferring the funds directly to the DPA with the endorsement of the GNHC for fund transfer.

71. The executing agencies were required to use Funding Authorization and Certification of Expenditures (FACE) forms to request advances/cash transfers and to report expenditures. The FACE forms are supported by quarterly progress reports. This process allowed all project partners to monitor the project's progress and the disbursements made on a quarterly basis, including the GNHC and the UNDP-CO. Finally, the financial records were consolidated into the UNDP-ATLAS system as the accounting and financial system for all UNDP projects. It allowed the project management team to obtain financial reports at any time for period up to the last point of data entry. The Atlas reports produce financial information that is broken down by line items such as local consultant fees, travel tickets, printing and publications, utilities, etc. and which can be reported by outcome, providing up-to-date consolidated financial information to project managers.

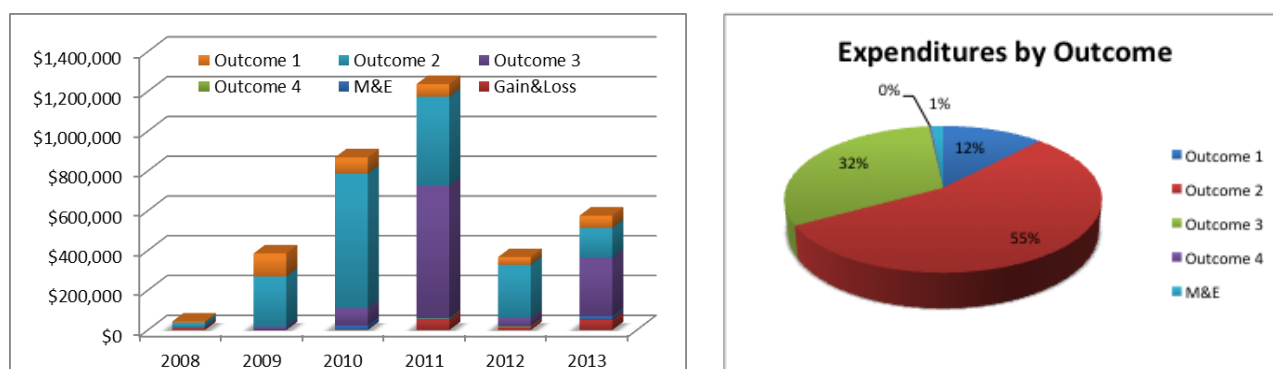
GEF-LDCF Funds

72. The review of financial records – including both the actual expenditures for the years 2008 to 2012 and actual expenditures plus estimates for the remaining period in 2013 - indicates that about 99% of the original GEF-LDCF budget will be expended (USD 3,422,000) by the end of the project in December 2013; an implementation period of 67 months. The breakdown of project expenditures by outcome and by year is presented in the table below.

Table 7: UNDP/GEF-LCDF Funds Disbursement Status (in USD)

Component	Budget	2008	2009	2010	2011	2012	2013	Total
Outcome 1	295,000	5,450	116,294	83,197	64,155	38,270	62,930	370,296
Outcome 2	2,238,012	25,294	251,578	674,601	447,335	266,480	150,343	1,815,631
Outcome 3	832,038		17,914	88,055	665,974	43,613	292,790	1,108,346
Outcome 4	20,000				2,719	4,148		6,867
M&E	60,000	816		20,545	4,841		18,746	44,948
Gain&Loss		11,890	(17,858)	2,567	52,523	14,941	51,246	115,309
TOTAL	3,445,050	43,450	367,927	868,965	1,237,548	367,452	576,055	3,461,398

9 UNDP defines NEX (National Execution) as the management of UNDP programme activities in a specific programme country carried out by an eligible national entity of that country. It is expected to contribute most effectively to: (i) greater national self-reliance by effective use and strengthening of the management capabilities, and technical expertise of national institutions and individuals, through learning by doing; (ii) enhanced sustainability of development programmes and projects by increasing national ownership of, and commitment to development activities; and (iii) reduced workload and integration with national programmes through greater use of appropriate national systems and procedures.



Source: UNDP Financial Reports and notes from the field mission to Bhutan.

73. These financial figures presented above indicate that 55% of the total GEF-LDCF grant was expended on outcome 2 that was to “reduce risks of GLOF from Thorthormi Lake through an artificial lake level management system”. Another 32% of the total GEF-LDCF grant was expended on outcome 3 that was to “reduce human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings”. The remaining expenditures (13%) were expended on outcome 1 and on M&E. It was also noted that the project had an exchange rate loss of USD 115,309 over the implementation period.

74. A “Technical Review and Social Impact Assessment” study conducted in 2012 by the project reveals that the total cost of the GLOF mitigation work at the Thorthormi Lake – which reduced the water level of the Lake by 5 meters - was about USD 2.5 million. It was estimated that about 50% of this cost was spent on salaries for workers. Furthermore, the total cost of the entire EWS, consisting of 18 siren towers and 9 hydro-met monitoring stations (4 Automatic Water Level Sensors (AWLS) and 5 Automated Weather Stations (AWS)) with a central control system with dedicated software and an internet interface, was about USD 1 million. This includes training of the staff by the supplier (testing and calibration) and installation, assisted by a local contractor. A yearly maintenance costs was estimated to be in the order of USD 10,000, mainly to cover the subscription fee of the Iridium satellite communication system. The review noted that the Punatsangchhu 1 & 2 Hydroelectric Project Authority (PHPA) has co-financed the EWS installation and training of DHMS staff to the tune of Nu 20 million (USD 325k).

75. Timeline wise, the graph on the left above indicates that 2010 and 2011 were the years with high expenditures (~\$870k and \$1,237k) representing almost 62% of the total expenditures incurred during the 67 months of implementation. It included a high level of expenditures for the lowering of the Thorthormi Lake and the purchase of the EWS equipment.

76. It was also noted by the Evaluation Team that in the project preparatory phase in 2006-2007, a series of feasibility studies were conducted to formulate the project document. The total budget for this phase was USD 430,000 of which USD 180,000 was funded by a GEF grant.

Co-financing

77. The co-financing commitments at the outset of the project totaled the amount of USD 4,036,224 with 66% in-kind from the RGoB and the rest in cash from ADA, UNDP and WWF. The review noted that all these commitments were confirmed at the outset of this project and reviewed during the inception phase by the Local Project Appraisal Committee (LPAC) and at the project inception workshop in June 2008. The table below presents these co-financing commitment figures as well as the reported actuals co-financing disbursements (see also Annex 7).

Table 8: Co-financing Status

Partner	Type	Commitments (US\$)	Actuals (US\$)	Actuals/Commitments
RGoB	In-kind	2,680,000	2,756,000	103%
Austrian Development Agency	Cash	800,000	839,934	105%
UNDP-TRAC	Cash	526,224	535,000	102%
WWF	Cash	30,000	30,000	100%
PHPA	Cash	367,000	299,000	
Net Gain & Loss (ADA)			(1,338)	
Total (US\$)		4,403,224	4,458,596	101%

(*) Source: Prodoc, PIR 2013 and notes from the mission in Bhutan.

78. Figures in the table above indicate that overall the project was able to leverage above the committed co-financing amount. This is due mostly to the unanticipated participation of the Punatsangchhu Hydroelectric Project Authority (PHPA) I & II that decided to participate in the development of an early warning system in the Punakha-Wangdue Valley with a cash contribution of Nu. 20,000,000 (USD 325k). As discussed in Section 4.1.7, the RGoB - in a joint venture with the Government of India - is building 2 hydroelectric projects in this valley (PHPA I & II) and the risk of GLOF cannot be underestimated. In order to mitigate the risk in case of GLOFs, PHPA developed a DRM plan for each site and are now linked up with the EWS developed with the support of the project in the Punakha-Wangdue Valley.

79. These numbers reflect the good partnership arrangements that were set up at the outset of this project and allowed good synergies for an effective implementation of activities and for a cost-effective project.

4.2.4. Monitoring and Evaluation (M&E) Approach

80. A comprehensive M&E plan was formulated during the formulation of the project in accordance with UNDP and GEF procedures and with a total budget of USD 60,000 representing about 1.7% of the total GEF-LDCF grant. This plan listed all monitoring and evaluation activities that were to be implemented during the lifetime of the project, including a mid-term evaluation and a terminal evaluation. For each M&E activity, the responsible party(ies) were identified, as well as the budget and the timeframe. The plan was based on the logical framework matrix that included a set of performance monitoring indicators along with their corresponding sources of verification. Based on the review of the M&E approach presented in the project document and of progress reports, the M&E function of the project is rated as *highly satisfactory*.

81. A summary of the operating modalities of the M&E plan were as follows:

- A set of performance indicators with their respective baseline and target at end of project as well as their sources of verification were identified and documented in the strategic results framework.
- An inception phase where the M&E plan was reviewed and discussed at an inception workshop. No changes to this plan were made during the inception phase.
- Annual Work Plans: Project Managers prepared Annual Work Plans (AWPs) detailing out project activities and budgets required for the year and also to ensure that the project activities were in line with the project document.
- The Project Managers (3) ensured the day-to-day implementation and monitoring, particularly to monitor the implementation of annual work plans under the guidance of the Project Director/PB Chair. The PMs were also responsible to produce progress reports documenting/measuring the progress made by the project for any given period; it included two main types of progress reports:
 - *Quarterly Progress Reports*: This is a UNDP requirement. These reports were produced by each PM following UNDP guidelines and submitted to the UNDP-CO and the PB.
 - *Annual Project Reports / Project Implementation Reviews (APR/PIRs)*: These reports are both UNDP and GEF requirements, following specific guidelines. It is an annual progress

report measuring the progress made by the project during the past year ending in June 30th of each year. It includes two main parts: (i) the DO (Development Objective) part that monitors the progress made to achieve the overall expected objective and outcomes. Using the set of performance indicators (see below), this progress is measured against established targets at the end of the project; and (ii) the IP (Implementation) part that monitors key outputs achieved under each outcome during the past year. The last PIR produced as of June 30, 2013, gave a project rating of high satisfactory for both DO and IP. It said “*the project set-up, with an integrated approach connecting upstream technical mitigation efforts with a basin-wide EWS and downstream awareness and capacity building efforts, is found to be commendable. The close collaboration among DDM, DGM and DHMS with specific mandates, but cooperating closely in planning, management and execution, has clearly created synergies. The labour-based approach, as chosen by the project, had tangible direct positive livelihood impacts for the workers and local communities involved, but the management of more than 300 workers at site has been complex, challenging and confronted the multidisciplinary team with many challenges beyond their normal technical and professional mandate*”.

- The three PMs had the responsibility to report the progress made by the project to the PB, using the above reports.
- A technical review and social assessment: The purpose of this review was to examine and document technical and social lessons and impact of the project since its inception and until 2012. It was also an opportunity to extract best practices and formulate recommendations for an exit strategy, which would increase the sustainability and enable the scaling-up and replication of project achievements and its approach.
- Mid-term and final evaluations: Conducted at mid-point and at end of project, these 2 external evaluations were opportunities to assess progress made at specific points in time, including progress made against expected results; reviewing the implementation modalities and identify any need for corrective actions and finally to identify any lessons learned.

82. The set of performance indicators presented in the strategic results framework was reviewed during this evaluation. It includes a set of 8 key indicators to monitor the performance of the project at the outcome and objective levels. The list of indicators is presented in the table below.

Table 9: List of Performance Indicators

Project Strategy	Performance Indicators
Objective: To reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.	1. Reduction of vulnerability to climate change-induced GLOFs in the Punakha-Wangdue and Chamkhar Valleys
Outcome 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys.	2. Percentage of national DRM focal points, district authorities, and communities able to prioritize, plan, and implement measures to reduce human and material losses from potential GLOFs 3. Percentage of personnel reporting DRM frameworks support adaptation efforts 4. Existence of DRM legislations and policies that support adaptation and GLOF preparedness
Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system.	5. Level of GLOF risk from Thorthormi Lake
Outcome 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings.	6. Number of vulnerable communities in Punakha-Wangdue Valley reached by early warning system 7. Percentage of households receiving and responding to warnings in time to avoid human losses
Outcome 4: Enhanced learning, evaluation and adaptive management.	8. Number of proposals, papers, and other documents that incorporate learning from the project

83. The set of 8 key indicators did not change over the lifetime of the project. They were used yearly to report progress made in the APR/PIR reports. The review of these indicators and their respective targets

reveals that they are SMART indicators¹⁰. It is a good set of indicators that was used to measure how well the project was progressing. The formulation of these indicators is such that their respective baselines and targets make them unambiguous indicators; they are specific, measurable, attainable and relevant for the project in a time-bound manner. All of them are relatively easy to monitor, except the capacity-based indicators for outcome 1. The indicators #1 and #2 necessitate a survey to be conducted to measure the real progress of national DRM focal points, district authorities, and communities¹¹ to be able to prioritize, plan, and implement measures to reduce human and material losses from potential GLOFs and to measure the capacity of the personnel reporting that DRM frameworks support their adaptation efforts.

84. The M&E plan – including its set of performance indicators - provided the project with a good framework to measure its progress/performance. APR/PIRs were produced timely as well as Quarterly Progress Reports. The review of annual PIRs reveals that they are comprehensive reports that provide good monitoring information documenting the project's progress year over year.

4.2.5. Contribution of Implementing and Executing Agencies

85. The overall efficiency of the UNDP Country Office (CO) and Regional Coordination Unit and of the Ministry of Economic Affairs (MoEA) - as respectively the GEF implementing agency and the national implementing agency of the project - to support the implementation of the project was good; it is rated as satisfactory. In their respective area of responsibility, they provided good support to the project management team to ensure an efficient use of GEF resources and an effective implementation of the project. Both agencies participated actively in the design and the implementation of the project.

86. UNDP provided the required guidance to apply UNDP project management procedures such as procurement, hiring and contracting as well as guidance for reporting project progress. UNDP played a role of quality assurance over the implementation of the project, ensuring that the required qualities for project activities were fulfilled. Overall, UNDP backstopped the project with its own resources, supported the project management team throughout the implementation including the participation in the decision-making process for implementing the project through the PB. It also facilitated the collaboration with other donors and the dissemination of lessons learned and best practices emerging from the project through its global networks.

87. MoEA, as the national implementing agency, played an important role in the success of this project as the main government anchor point of the project. The Secretary of MoEA Chaired the PB; providing excellent leadership in guiding the implementation of the project. Overall, the MoEA played an important facilitator role for the project, providing the government/institutional context for the legitimization of project-supported activities to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.

88. It is also important to note the highly positive role played by the three executing agencies – DGM, DHMS and DDM. They satisfactorily fulfilled their project obligations/responsibilities and were effective in implementing their respective set of project activities. Through the engagement of the three Project Managers (Mr. Dowchu Drukpa at DGM, Mr. Karma Dupchu at DHMS and Mr. Chenchu at DDM) in project activities, they played a major role in legitimizing the objective of the project in their respective departments; hence contributing to the long-term sustainability of project achievements.

4.2.6. Summary of the Mid-Term Review (MTR)

89. A National Consultant conducted an independent Mid-Term Review (MTR) of the project in August-September 2010. The Evaluator reviewed the project at mid-point following the UNDP and GEF evaluation guidelines. It concluded at the time that the implementation of the project was good with a rating of 3 on a scale of 1=excellent to 5=unsatisfactory.

10 SMART: Specific, Measurable, Attainable, Relevant and Time-bound.

11 Two Qualitative Based Surveys (QBS) were conducted – one in 2011 and the second one in 2013 - to assess the level of awareness, preparedness and response capacities related to climate change risks and vulnerabilities in the project areas.

TE of the UNDP-Supported, GEF-Financed Project "Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys"

90. It found that the project was highly relevant in the overall development context of Bhutan and was in line with the UNDAF and particularly with the NAPA. Based on the review of project achievements, it stated that the overall progress against project targets was good at the time of the MTR. The MTR also flagged two activities that were not implemented as planned. It included a national database on GLOF risks and vulnerabilities, and a GLOF website (output 1.3). The reason for the lack of progress toward updating the national database on GLOF was that it became redundant due to the ongoing “*Study on GLOFs in Bhutan Himalayas*” supported by the Japan International Cooperation Agency (JICA) and the Japan Science and Technology (JST) Agency, which also aims to establish a similar database and at a more detailed and comprehensive scale than planned under this project (see Section 4.3.8). As for the GLOF website, a provisional GLOF website was created but it was not maintained due to the fact that the DGM intended to develop a fully functional GLOF website and have it in place by 2011.

91. A set of 13 recommendations was made by the MTR. A management response was developed to plan how to address these recommendations. All recommendations were accepted at the time; UNDP-CO then identified key actions, timeframe, responsibility and tracking for addressing each recommendation. Subsequently, the PB at the 9th PB meeting on January 11, 2011 approved the management response and the recommendations were implemented as planned during the remaining period of the project. However, despite that a revised Strategic Results Framework was approved by the PB, it was noted by the Evaluation Team that the recommended change of indicators and targets for outcome 1 (recommendation #1) were not made to the subsequent PIRs. A list of these recommendations with their respective management responses is presented in Annex 8.

92. The review of the ratings given in the MTR indicates 2 major areas for improvement. “M&E” was rated as 4 “*Satisfactory*” (on a scale of 1 to 5 or “*Excellent*” to “*Unsatisfactory*”) and “Financial Planning” was rated as 5 “*Unsatisfactory*”. Recommendations were made to improve the reporting (M&E), mostly through the improvement of monitoring indicators and their respective targets at the output level. Regarding the finances of the project, the MTR stated, “*the vast gaps that exist between annual planned budgets and actual disbursements need to be jointly examined by the UNDP CO and the IPs*”. This statement was mostly based on large differences between planned annual budgets and actual annual expenditures for the first 2 years of the project (2008 and 2009); and also based on an overall low percentage of actual expenditures as of the date of the MTR. The review “*recommended that a joint review of the financial aspects of the project be carried out as soon as the financial reporting for the current AWP is completed and projections of anticipated expenditures under various outcomes/outputs be made for the rest of the project period*”. This recommendation was implemented and overall the fact is that the rate of disbursement increased drastically between the time of the MTR (Aug.-Sept. 2010) and the end of the project (Dec. 2013). As discussed in Section 4.2.3, the project will have expended about 99% of the GEF-LCDF grant by the end of December 2013.

4.3. Project Results

93. This section discusses the assessment of project results; how effective was the project to deliver its expected results and how sustainable these achievements will be over the long-term.

4.3.1. Overall Achievements/Results

94. As presented in Sections 4.1.1, the project was implemented through four outcomes (that were further divided into 15 outputs). The implementation progress was measured through a set of 8 indicators with their respective baseline and target values. On the next page is a table listing key results achieved by the project against each outcome and their corresponding targets planned at the end of the project.



GLOF EWS Control Center in Wangdue

Dzongkhag Emergency Operation Center in Punakha



Monitoring screens at the Control Center in Wangdue

Large screen in main area in Control Center in Wangdue



Installed Siren

Punakha Valley

Installed Siren

Source: Jean-Joseph Bellamy's own pictures (December 2013).

Table 10: List of Delivered Results

Expected Results	Targets at End of Project	Key Results
Project objective: To reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.		
Outcome 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys.	<ul style="list-style-type: none"> By the end of Year 2, 100% of the national DRM focal points, and 90% of district and community DRM focal points in Punakha-Wangdue Valley and Chamkhar Valley are able to prioritize and plan measures to minimize potential losses from GLOFs. By the end of the project at least 90% of personnel interviewed report that DRM frameworks support their efforts to plan and implement measures to adapt to climate change. 	<ul style="list-style-type: none"> Mainstreaming disaster risk reduction sensitization trainings, including information of national DRM frameworks and GLOF risks, were conducted for 70 national and district disaster risk management focal points (40% women). These activities benefitted 34 sectoral disaster risk management focal points (22 men, 12 women) and 36 district and sub-district officials (20 men, 16 women) such as district disaster focal persons, district health officers, district environment officers, district planning officers, district engineers and gewog administrative officers from the three pilot Dzongkhags (Punakha, Wangdue and Bumthang). Community Based Disaster Risk Management Plans formulated in 44 out of 55 Chiwogs in Punakha, 40 out of 75 Chiwogs in Wangdue and 20 Chiwogs out of 20 in Bumthang. This translates to completion of DM plans in 104 of 150 Chiwogs (groups of villages) or 69%, while DM plans at district levels are yet to be completed. The training of trainers for Safe School Initiative Program/Workshop on Disaster Preparedness and Response for Safe School was conducted for schools under Wangdue Dzongkhag from 19-24 December 2012 and trained around 65 principals and teachers from various schools. The school children are most vulnerable in the case of disaster. In order to address this issue, the DDM carried out series of activities to educate and raise awareness on disaster risk reduction in schools. The “<i>Workshop on Disaster Preparedness and Response for Safe School</i>” aimed at building capacity of teachers on broad spectrum of preparedness planning and testing of preparedness through evacuation drills were conducted in several Dzongkhags. Capacity Development Program for DDM, MoHCA, Dzongkhag officials and local functionaries of three pilot districts of Punakha, Wangdue and Bumthang was organized in Nepal in February 2013 and Istanbul in March 2013, to learn about DRM system and other DRM initiatives being undertaken by the community in the region including CBDRM and other DRR and Climate Risk Reduction initiatives. A total of 14 males and 4 females participated in this capacity building program. DDM conducted Comprehensive training on Community Based Disaster Risk Management –in Gasa Dzongkhag. 24 officials (20 males and 4 females) from Gasa Dzongkhag and Gewog officials including Gyadrungs attended the CBDRM training, which focused on understanding the GLOF Risk, Hazard mapping, CBDRM Planning (preparedness and mitigation) at community level including identification of vulnerable and risk prone areas and assets, formation of Community Disaster Management Teams through CBDRM approach. Disaster Preparedness and Sensitization Program for Dzong and Monastic Institutions were conducted for four Dzongkhags in Bumthang, Gasa, Wangdue and Punakha where Vulnerability and Capacity Assessment of Dzongs were conducted and Disaster Preparedness and Evacuation and Response Plan were developed. 55 people (48 male & 7 female) from Gasa, 68 people (60 male & 8 female) from Bumthang, 60 people (57 male and 3 female) from Punakha and 62 people (3 female and 57 male) from Wangdue took part in the program. A baseline Qualitative Based Survey (QBS) was carried out in 2010. The final gender sensitive QBS related to awareness, preparedness and response capacities in the event of GLOF was conducted in 2013 to really understand the GLOF risk perception by the communities and their preparedness to respond to GLOF disaster in future.

Expected Results	Targets at End of Project	Key Results
	<ul style="list-style-type: none"> By the end of the project, at least three DRM legislation and policies are formulated inclusive of climate-induced GLOF risks and demand long-term mitigative and preparedness planning. 	<ul style="list-style-type: none"> Both houses of the parliament reviewed the DM bill and it was finally enacted in the last session of the first parliament on 27th February 2013. About 1,000 copies of DM Act 2013 were printed for distribution to all relevant agencies and also to the general public. This will significantly strengthen the DRR activities in Bhutan. The Disaster Management Act is an effort to decentralize disaster management activities and to empower the nodal institutions at all levels with the legal status to implement disaster reduction strategies more effectively. The Act also delegates authority and resources at all levels for disaster management. The National Disaster Risk Management (NDRM) framework 2006 was reviewed in line with DM Act and also based on the lessons learnt of recent disasters (May 2009 floods, September 2009 Mongar Earthquake and September 2011 Sikkim Earthquake) and it has been re-named as National Disaster Risk Management Strategy. The Strategy will be put up to the National Disaster Management Authority once it gets constituted as per DM Act for endorsement and to be officially launched. DGM was to develop a geo-sciences database (output 1.3). Following 2 Requests For Proposal (RFP) only one bidder applied but it was disqualified on technical ground. As a result, no progress was made on the development of the geo-sciences database.
Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system.	<ul style="list-style-type: none"> By the end of the project, Thorthormi Lake is no longer considered at high risk of GLOF, as scientifically assessed at the project's completion 	<ul style="list-style-type: none"> Due to acute shortage of civilian workforce forthcoming to work in the project, 123 soldiers from the Royal Bhutan Army (RBA) including 6 officers were involved alongside 112 civilian workforces for the 2012-working season at the Thorthormi Lake. The cumulative lake level lowering were 5.04m in the Main lake, 3.66m in Subsidiary lake I, and 5.08m in Subsidiary lake II. Targets to lower water level were reached for the main lake and the subsidiary lake II. However, the target of reducing the lake water by 5m in the subsidiary lake I was not reached, but, in line with the technical design, gradient of the excavated channel was maintained at 2% along the entire length and therefore it was not necessary to lower subsidiary lake I by 5m as initially planned. A cumulative total of 21,028.5 m3 of soil and rocks were excavated since 2009. The safety of project staff and workforce has been improved through various measures such as improved procedures for medical screenings and evacuation, establishment of additional medical camps with mandatory high-altitude acclimatization halts along the route to the project site, and training of medical personnel. Procurement of geophysical instruments were procured for DGM
Outcome 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings.	<ul style="list-style-type: none"> By end of project, 90% of households in target communities able to receive and respond to early warnings 	<ul style="list-style-type: none"> The installation of an automated GLOF EWS (6 Water level monitoring stations, 2 Automatic Weather Stations, 18 Sirens and a Control room station at Wangdue district) has been completed and operational since September 2011. The automatic EWS provides real-time online data, and shares data with the Indian states of Assam and West Bengal through the Flood warning system of Bhutan. The EWS was expanded to the Mochhu sub-basin in 2013 The system covers more than 90% of households in the 21 vulnerable communities downstream of the Punatsangchu river in the Punakha-Wangdue valley. This amount to 875 households, 4 schools, 2 Vocational Training Institutes, 1 Basic Health Unit, Public Work Department staff, as well as an estimated 15,000 staff and workers currently employed by the Basochu Hydro Project, Punatsangchhu Hydropower Project Authority-I (PHPA-I) and Punatsangchhu Hydropower Project Authority-II (PHPA-II). 4 engineers and 4 technicians from DHMS and 5 technicians from the local contractor company were trained in EWS installation and testing, and 1 engineer and 4 technicians from DHMS were trained in EWS operation and maintenance. The community based manual EWS is operational with designated focal points in the 21 most vulnerable communities. DHMS and DDM developed a Standard Operating Procedure (SOP) for the GLOF EWS, which was launched on Dec 2012. It is a manual/guide on the functioning of the EWS and includes information flow charts linking the automatic and manual Early

Expected Results	Targets at End of Project	Key Results
	<ul style="list-style-type: none"> By end of project, 90% of households in target communities able to take the appropriate actions following the warning 	<p>Warning Systems.</p> <ul style="list-style-type: none"> Spare parts for the installed EWS were procured as per the PB decision at the 13th PB meeting (January 2013) A public awareness program on the risks of GLOF and other disaster hazards, on an automatic and manual GLOF EWS, on safe GLOF evacuation sites based on the GLOF hazard zonation maps, was conducted for all inhabitants along the Punatsangchu river. It benefitted more than an estimated 2,500 people, including 35% women. In Punakha district, the awareness program were conducted in 9 communities (Walakhathang, Samdingkha, Khawajara , old Punakha town, Changyuel, Mendagang ,Khuruthang community, Business Community of Khuruthang, Tsekha), 4 schools (Wolathang Primary School, Punakha Higher Secondary Schools, Khuruthang Middle Secondary School and Ugyen Academy), 1 Vocational training Institute at Khuruthang, for dzongkhag Officials and representatives from regional government offices (RSTA, BAFRA, BPC, Telecom ,etc.), Royal Bhutan Police, hospitals, and the monk body under Punakha District. The programme benefitted more than 1,000 people (30% women). In Wangdue district, the awareness program was conducted for the Royal Bhutan Army, staff and students of 2 schools (Bajo Higher Secondary School, Samthang VTI), district officials and officials of 3 hydropower plants (Punatsangchhu HPA, Basochhu/Rurichhu Hydropower Plant, Basochhu) with an estimated 1,500 participants (40% women). In Tsirang district, 100 representatives from the local business community of Changchey and Sunkosh Dobani attended the awareness program. DHMS and DDM staff conducted education and awareness activities on the GLOF EWS in the Lunana area to sensitize communities in vulnerable areas on the impending disaster risks, in particular from GLOF. More than 141 people from 4 villages of Lunana (i.e. Thanza, Tenchey, Tshoju and Lhedhi), Lunana Community Primary School and Tshoju ECR attended the awareness campaign. DDM in collaboration with DHMS, Dzongkhag and Gewog Administrations conducted the GLOF Evacuation mock drills by activating sirens (for Early Warning) installed in different vulnerable communities along the Punatsangchu Valley in October 2012. The GLOF evacuation mock drills were conducted to ensure fast, organized and smooth evacuation during emergencies and also to test the functionality and effectiveness of GLOF EWS that were installed in the valleys. People from vulnerable communities including schoolteachers, students, monks from Punakha Dzong and Shedra, government officials from the Dzongkhag and local functionaries also took part in drill on GLOF EWS. The DDM with technical assistance from DGM and local authorities completed the Hazard Zonation with actual ground marking with wooden pegs, and identification of Safe GLOF Evacuation site along Sunkosh River starting from Hesothankha till Lamoi Zingkha.
Outcome 4: Enhanced learning, evaluation and adaptive management.	<ul style="list-style-type: none"> By the end of the project, GLOF mitigation and early warning initiatives or studies draw on learning from experiences in Bhutan 	<ul style="list-style-type: none"> Experiences from the project and detailed information were shared with GLOF project teams from the government and UNDP from Pakistan (AF project) and Nepal (LDCF project), and knowledge sharing and cooperation between these projects will continue even after the project has ended. Project experiences were also shared for development of regional GLOF risk reduction initiatives by respectively UNISDR, WB/GFDRR and the government of Korea, and the SAARC Disaster Management Center. A project knowledge repository structure was developed and all documentation compiled and shared with the Adaptation Learning Mechanism (ALM) for sharing through the project website of the new ALM platform. Internal documentation was uploaded in the UNDP/GEF PIMS database. The Adaptation Learning Mechanism-profile of the project was updated in October 2011, and four project factsheets developed,

Expected Results	Targets at End of Project	Key Results
		<p>and uploaded on the ALM-portal. These materials were disseminated at several events in Bhutan (Climate Summit for a Living Himalayas side event in November 2011; UNFCCC LEG-meeting, March 2012) and internationally (Adaptation Forum, March 2012; UNDP cluster meeting, March 2012; UNDP/UNISDR/WB-GFDRR Regional knowledge sharing workshop, March 2012).</p> <ul style="list-style-type: none"> • Presentations of the project were made at the joint JICA-Bhutan GLOF research project coordination committee for GLOF (Japan, February 2012), Adaptation Forum (Bangkok, March 2012) and the UNDP/UNISDR/WB-GFDRR Regional knowledge-sharing workshop (Kathmandu, March 2012). • The TV-productions "<i>Himalayan Meltdown</i>" (Discovery Channel); "<i>One Day on Earth</i>" (UNDP Bhutan); and "...86 centimeters" (Bhutan + Partners) have contributed to present the project and the risk related to GLOF to a wider national and international audience. WWF also published "The Cost of Climate Change, the Story of Thorthormi Glacial Lake in Bhutan" (October 2009)¹² (see more detailed information about these TV productions and publications in Annex 10). • Project implementation approach and lessons learned were captured in the article "<i>Glacial Meltdown - Implementation of a flood EWS in Bhutan</i>", which was published in the magazine <i>Meteorological Technology International</i> (November 2010). • Presentations of the lowering of Thorthomi lake approach and progress were made at the JICA/JST project workshop (Bhutan, March 2011) and the Japan GeoScience Union meeting (Japan, May 2011). • In December 5-6, 2012, the RGoB in collaboration with the UNDP, Austrian Development Assistance (ADA) and the WWF convened an international conference on 'Glacial Lake Outburst Floods – Experiences from Bhutan' at Paro. The conference aimed at sharing experiences and lessons from the implementation of the project and to apply measures in future interventions in Bhutan and other GLOF prone countries in the region and beyond. More than 70 participants attended the conference with representatives from the RGoB and other mountain and/or GLOF-prone countries such as Nepal, India, Japan, Austria, Norway and United States of America (USA). In addition, the conference saw participants from UNDP and USAID. As part of the conference, a field excursion to the GLOF prone areas in Wangdue valley where the participants were introduced on the mechanism of the GLOF Early Warning System. • An independent Technical Review and Social Impact Assessment of the project was completed (Sep 2012) and the report was launched during the International GLOF Conference where a presentation was also made to highlight the findings of the independent review. • The DHMS also completed the documentation of the project implementation procedures followed and lessons learnt of the GLOF Early Warning System in the Punakha-Wangdue valley in the form of booklet, which will be very useful for other countries taking up similar projects on GLOF risk reduction.

Source: Adapted from PIRs and notes from the mission to Bhutan

¹² A book was also published in 2013 "*A deluge of Consequences – A Riveting Adventure in the High Himalayas*" by Jacques Leslie, A World Policy Book (available on iTunes and Amazon).

95. The review of achievements of the project indicates a very successful and effective project; its overall progress is rated as *highly satisfactory*. The project was able to achieve what it was intended to achieve in the planned timeframe.

96. The review found that three major critical success factors explain partially this success: (i) a project that was highly relevant and that was well designed with an excellent engagement and participation of stakeholders. The result was a design that was a direct response to three national priorities: the artificial lowering of the Thorthormi Lake; the piloting of GLOF Hazard Zoning in the Chamkhar Chu Basin; and the installation of an EWS in the Pho Chu Basin; (ii) an excellent collaborative project management team to implement this project. They were able to take the result of an excellent design and implement the project with strong participative and collaborative principles; including excellent guidance from the Project Board; and (iii) an excellent engagement of beneficiaries in project activities. There was a deliberate strategic approach to engage beneficiaries at every steps of the way and as a result, communities in the pilots feel more secure when it comes to the risks of GLOFs.

97. In addition to this summary of project achievements, it is important to note the excellent “*Technical Review and Social Impact Assessment*” report¹³ that was published by UNDP Bhutan in 2012. The purpose of this review was to examine and document technical and social lessons and impact of the project since its inception and until 2012, in order to extract best practices and formulate recommendations for an exit strategy which would increase the sustainability and enable the scaling-up and replication of project achievements and its approach. The scope of the review focused on capturing knowledge built within the project, documenting best practices and extracting key learning from implementing a complex and challenging project in a difficult environmental setting. Special emphasis of the technical review was on the methods applied for the artificial lowering of Thorthormi Lake (outcome 2) and the installation of a GLOF EWS (outcome 3).

98. It is a well-written report, documenting/detailing project activities implemented during the 2008-2012 period. Regarding the “*Artificial Lowering of Thorthormi Lake*”, the report details the technical approach and methodology that were used and the description of the technical work that was undertaken; the assessment of impact of the work on the surrounding environment; the workforce management (over 300 workers) and transportation of goods to Lunana; the high altitude health and safety management; the impacts and benefits of the project related to the livelihoods of project workers and local communities in the vicinity of Lunana; a cost-benefit analysis; best practices and a set of recommendations. Concerning the “*GLOF EWS*”, the report documents the technical approach and methodology, the partnership and co-financing, the challenges, the documentation and operating procedures, the sustainability of the EWS, the community awareness of EWS, evacuation routes and sites, best practices, cost-benefit analysis and recommendations. This report is recommended to those who want to read more details about the achievements of this project; a copy of the executive summary is presented in Annex 9.

4.3.2. Attainment of Project Objective

99. The review of project achievements presented in the previous section 4.3.1 reveals that the implementation was highly successful and met the expected results planned at the outset of the project. Together, these achievements certainly contributed to the attainment of the project objective that was “*to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys*”; it is also rated as *highly satisfactory*. Bhutan is now equipped with a demonstrated approach, lessons learned and best practices to reduce risks of GLOFs and increase the awareness of local communities that could potentially be affected by GLOFs. The table below presents the key results of this project against the objective and its target set at the outset of the project.

¹³ UNDP, GEF, RGoB, ADC and WWF, 2012, *Technical Review and Social Impact Assessment*.

Table 11: Attainment of Project Objective

Expected Results	Targets at End of Project	Key Results
<p>Project objective: To reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.</p>	<ul style="list-style-type: none"> • DRM stakeholders in Bhutan at national, regional and local levels are able to project climate-induced GLOF risks and are able to prioritize, plan and implement efficient mitigation and preparedness options. 	<ul style="list-style-type: none"> • The cumulative reduction of water level in the Thorthormi Lake were 5.04m, 3.66m and 5.08 m in the Main lake, Subsidiary lake I and Subsidiary lake II respectively. The target was exceeded for the main lake and Subsidiary lake II. The target of reducing the lake water by 5 m in the Subsidiary lake I was not reached, but, in line with the technical design, 2 % gradient of the excavated channel was maintained along the entire length and therefore it was not necessary to lower subsidiary lake 1 by 5m as initially planned. • Completed the installation of an automated GLOF EWS (6 water level monitoring stations, 2 automatic weather stations, 18 sirens and a control room station at Wangdue district). It is operational since September 2011. The automatic EWS provides real-time online data, and shares data with the Indian states of Assam and West Bengal through the Flood warning system of Bhutan. The EWS was expanded to the Mochhu sub-basin in 2013. The system covers more than 90% of households in the 21 vulnerable communities downstream of the Punatsangchu river in the Punakha-Wangdue valley. This amount to 875 households, 4 schools, 2 Vocational Training Institutes, 1 Basic Health Unit, Public Work Department staff, as well as an estimated 15,000 staff and workers currently employed by the Basochu Hydro Projects PHPA-I and PHPA-II. • Community Based Disaster Risk Management Plans formulated in 104 of 150 Chiwogs (groups of villages) or 69%. • More than 2,500 people (about 35% women) from vulnerable communities and institutions along the Punatsangchhu River have been sensitized about GLOF risk, preparedness and response. • At the national level, 41 technical professionals are actively involved in GLOF preparedness and mitigation including EWS (8 from DDM, 15 from DHMS and 18 from DGM). • DDM conducted CBDRM training for Gasa Dzongkhag. 24 officials (20 males and 4 females) from Gasa Dzongkhag and Gewog officials including Gyadrungs attended the CBDRM training. • DDM with technical assistance from DGM and local authorities completed the Hazard Zonation and Identification of Safe GLOF Evacuation site for vulnerable community along Punatsangchhu and Sunkosh river from Hesothankha till Lhamoy Zingkha.

100. The review found that the project definitely delivered its expected results. As discussed in Section 4.1.3, it was designed as a direct response mechanism to address three critical national priorities. As a result, the project focused on the Punakha-Wangdue and Chamkhar Valleys where it addressed three main areas for reducing the risks of GLOFs:

- Reduce Risk of GLOF from the Thorthormi Lake:*** The project reduced the water level in the Thorthormi Lake by an average of 5m, including an excavated channel with a 2 % gradient slope. It represents an approximate volume of 21,000 M3 of excavated soil and rocks and the release of over 17 million m3 of water¹⁴.
- Install an automated GLOF EWS in the Valley:*** An EWS was installed including 6 water level

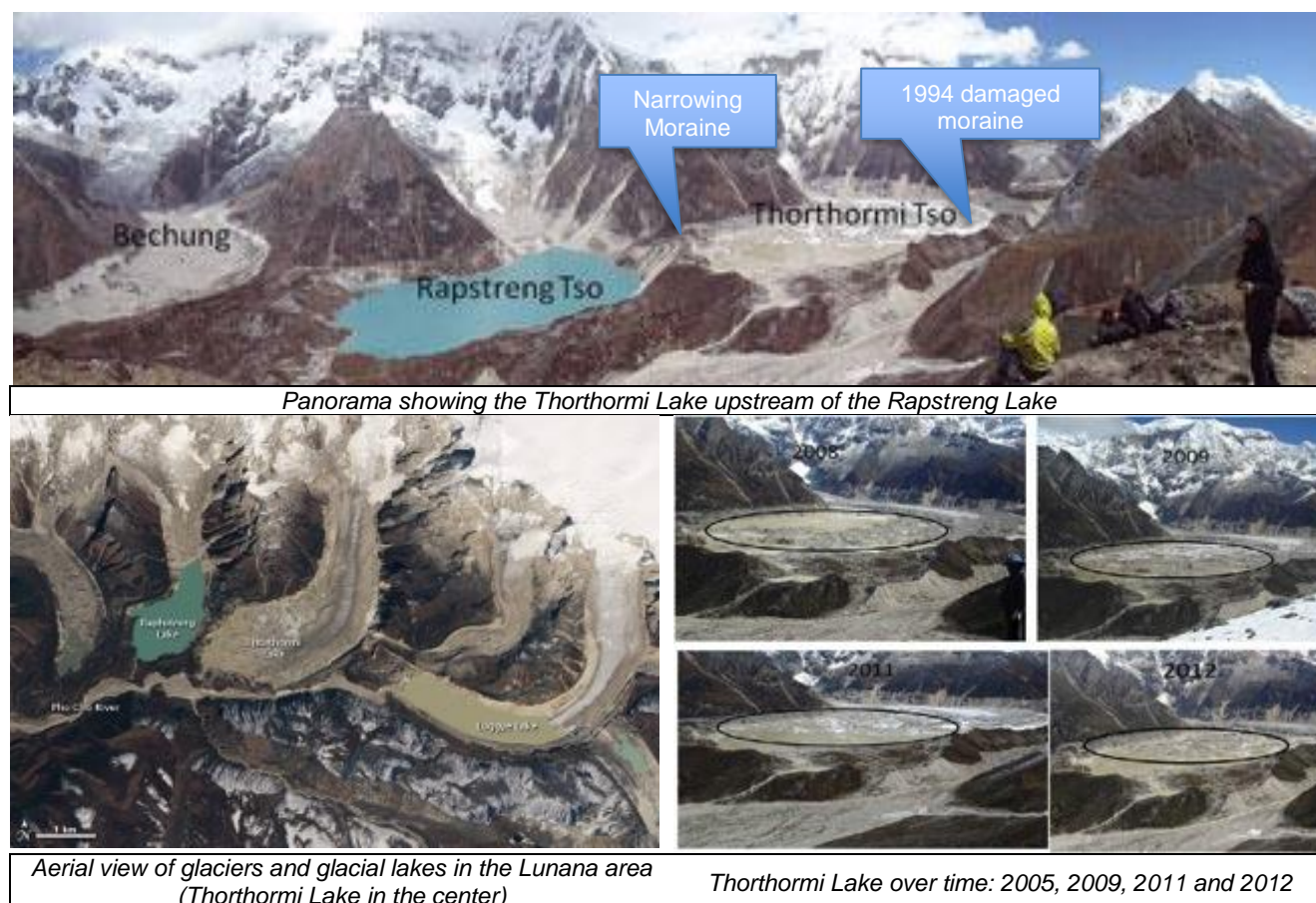
14 This estimated figure is based on the lake surface area of 3.42km² and depth lowering of 5m which comes to water volume of 3.42 x 1,000 x 1,000 x 5= 17,100,000 m³

monitoring stations, 2 automatic weather stations, 18 sirens and a control room station located in the Wangdue district. This system provides real-time online data monitored at the control room that is staffed 24/7. The system covers more than 90% of households in the 21 vulnerable communities downstream of the Punatsangchu river in the Punakha-Wangdue valley. This amount to 875 households, 4 schools, 2 Vocational Training Institutes, 1 Basic Health Unit, Public Work Department staff, as well as an estimated 15,000 staff and workers currently employed by the PHPA-I and PHPA-II Hydropower Projects. Capacity of DHMS and DDM staff were developed to appropriately manage the EWS.

- c) ***Develop capacity of communities to be able to respond better to natural disasters:*** Over 2,500 people (about 35% women) from vulnerable communities and institutions along the Punatsangchu River have been sensitized about GLOF risk, preparedness and response. The project also supported the development of Community-Based Disaster Risk Management Plans in 104 of 150 Chiwogs (groups of villages), representing about 69% of all local communities in the Punakha-Wangdue valley. These plans include identified safe evacuation sites in case of GLOFs.

101. As discussed in the next section, the project provided an excellent demonstration for addressing the risks of GLOFs in Bhutan with numerous lessons learned and best practices. It allowed the government to develop its related policy and legislative framework with a strong basis of lessons, practices and principles, which should support the expansion to other critical valleys in Bhutan and ultimately throughout the country in future years.

102. Some pictures on the lowering of the water level in Thorthormi Lake are presented below:





Excavation work in Thorthormi Lake



Excavation work in Thorthormi Lake



Work on the Outlet Channel



The challenge of moving big boulders

Sources: Technical Review and Social Impact Assessment Study report, and from Google searches.

4.3.3. Relevance

103. As discussed in chapter 4.1, the project was *highly relevant* for Bhutan. Its timing was excellent; it provided RGoB with additional resources to demonstrate the implementation of a series of measures to mitigate risks from potential GLOFs and at the same time to strengthen Bhutan's policy and legislative frameworks benefitting from this demonstration.

104. The project was formulated on the basis of an excellent contextual review, which provided necessary background studies for the preparation of the project. The project concept emerged from national priorities identified in the NAPA 2006 to address disaster risk management and risk management of GLOFs in Bhutan. It was a direct follow up set of activities to the NAPA that was formulated in 2006 addressing 3 key national priorities related to the risks of GLOFs and seeking to attempt as mitigating there risks in Bhutan. It was an excellent instrument to respond to national priorities, and through the strong engagement of national partners, the project has benefited from a strong national ownership.

105. As a result, the project supported government interventions to pioneer activities to mitigate risks of GLOFs in the Punakha-Wangdue and Chamkhar Valleys. It was *de facto* the DRM programme in Bhutan implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. Additionally, through a well functioning Project Board (PB), the planning of project interventions was well planned with the interventions of the Gross National Happiness Commission (GNHC) and of the National Environment Commission (NEC), which allowed a strong linkage with the national planning process in Bhutan through the Five-Year Plan process led by GNHC and also with the environmental management framework led by NEC.

106. Consequently, project achievements were well mainstreamed into the policy, legislation and

institutional frameworks in Bhutan; including the emergence of a DRM programme in the Five-year (Development) Plans of Bhutan. Over time, the project became a supportive instrument to the government to address key national priorities in the DRM area.

107. The project was also *highly relevant* in the context of the implementation of the LDCF. The LDCF was created in 2001 (UNFCCC COP7) with further guidance on climate change adaptation given to GEF by the UNFCCC subsequent Conferences of Parties (COPs). The goal of the adaptation strategy for the newly created fund was “to support developing countries to increase resilience to climate change through both immediate and longer-term adaptation measures in development policies, plans, programs, projects and actions”. Its dual objectives were “(a) to reduce vulnerability to climate change of sectors, areas, countries, communities and ecosystems, and (b) to increase adaptive capacity”. The GLOF project was the first step to fund/support the implementation of NAPA in Bhutan and it was said to the Evaluation Team that this project was among the first projects submitted to GEF for funding under this new financial mechanism (LCDF). The review found that the project was very well in line with most expected outcomes of this adaptation strategy such as the incorporation of adaptation objectives and budget allocations in broader development frameworks, the reduction of absolute losses due to climate change, including variability, the raising of awareness and engagement of communities involved in disaster planning, preparedness and prevention and the strengthening of institutional adaptive capacity to implement adaptation measures.

4.3.4. Efficiency

108. As discussed in other sections above, the project has been efficiently implemented; it is rated as *satisfactory*. The project management team prudently allocated project resources and used adaptive management to adapt to a constantly changing environment and to secure project deliverables while maintaining adherence to the overall project design. It was particularly noted the good implementation of the NEX modality (see Section 4.2.3). Despite a slow process to access the financial resources at the beginning of the project, improvements were made during the second year of implementation. The overall management of project resources by the RGoB was satisfactory and could be a case study to be highlighted.

109. The review of activities that were supported by the project reveals that efficiency was always emphasized when project financial resources would be allocated to specific activities. The PB made most management decisions based on reviews of different options and stretched available dollars to provide a good cost-effectiveness when using project resources.

110. The good efficiency of the project was also due to clear roles and responsibilities assigned to each national partner involved in the implementation of the project and all project activities were well led by the three Project Managers with clear processes and proper documentation. Furthermore, annual work plans and progress reports were produced timely and the project was well monitored by the PB on the basis of well-written progress reports.

111. Given that it is always difficult to analyze the cost-benefit of such projects, the review of all management elements confirm that the implementation of the project was an efficient operation that created a good value for money. The prudent approach to engage project funds was translated into good value for money and the use of adaptive management allowed for the identification and implementation of activities that were very responsive to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.

4.3.5. Country Ownership

112. As discussed in other sections of this report, the country ownership is excellent. The project addressed three key national priorities; it was designed on the basis of an excellent contextual review; and key national

partners involved in DRM in Bhutan implemented it. It was *de facto* the DRM programme in Bhutan implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys.

113. The timing of the project was also good, corresponding to the development of the “*Disaster Management Act of Bhutan*” that was passed by Parliament at the beginning of 2013. It benefitted from the experience of the project in demonstrating mitigation measures to reduce the risk of GLOF and prevent disasters in case of GLOFs through an EWS and the development of local capacities of communities living down the valleys. This recently passed Act now provides a good legislation framework to implement a DRM strategy throughout the country; particularly to the relevant national agencies mandated with DRM responsibilities. It is expected that this good country ownership will contribute to the long-term sustainability of project achievements.

4.3.6. Mainstreaming

114. Disaster management was one priority area of the *UNDAF (2008-2012)* and of the *UNDP Country Programme for Bhutan (2008-2012)*. The project was developed in this context from UNDP point of view. As discussed previously in this report, this formulation of this project was a direct follow up set of activities to the NAPA that was formulated in 2006 addressing 3 key national priorities related to the risks of GLOFs and seeking to attempt as mitigating these risks in Bhutan. It became *de facto* the DRM programme in Bhutan implemented by key government departments including DGM, DHMS, DDM and the Local Governments in Punakha-Wangdue and Chamkhar Valleys. The project was very well integrated in the relevant apparatus of government and provided extra resources to demonstrate how to mitigate GLOF risks in Bhutan.

115. In parallel to the mitigation work at the Thorthormi Lake and in the Punakha-Wangdue and Chamkhar Valleys, the project also contributed to the strengthening of disaster risk management and disaster preparedness policy and legal frameworks in Bhutan. Today, these frameworks are much stronger and the RGoB is in a better position to manage GLOF risks. A summary of related policies and legislation is presented below:

- ***National Disaster Risk Management Framework (NDRMF)***: The RGoB developed this framework in 2006. It was a first attempt of the RGoB to structure a policy addressing the risks of natural disasters in Bhutan in line with the “*Bhutan 2020: A Vision for Peace, Prosperity and Happiness*”. The objectives were to promote a disaster risk management approach instead of an ad hoc reactive approach to dealing with disasters; to recognize the respective roles of different organizations in disaster risk management and provide all possible support to their work within the national framework for disaster risk management; and to establish linkages between disaster risk management and the other ongoing activities in different development sectors. It was also formulated at a time when the formulation of the forthcoming 10th Five-Year Plan started with the hope that the agenda of disaster risk management highlighted in the framework would find due reflection in the formulation of development proposals for the coming years.
- ***Tenth and Eleventh Five-Year Plans (2007-2012 and 2008-2013)***: A DRM programme emerged nationally and became part of the last two Five-Year Plans (FYPs). The GLOF project was mentioned in the Tenth Five-Year Plan 2007-2012 and GLOFs risks are cited in the Eleventh Five-Year Plan 2008-2013 among the challenges that Bhutan is facing for its development.
- ***Framework to mainstream environment, climate change and poverty (ECP) concerns into the 11th Five-Year Plan (2008-2013)***: This framework is an outcome of the mainstreaming exercise carried out with the sectors in Bhutan and aiming at guiding the FYP towards a carbon neutral development. It was developed by the Environment Climate Change and Poverty (ECP) Reference Group with the support of UNDP and was an attempt to further mainstream

environment, climate change and poverty in the 11th FYP. It requires that all central and local agencies formulate ECP-integrated development plans and programmes. It provides guidance for the formulation of these plans and programmes, including a six-step approach to develop such plans and programmes.

- ***Framework to mainstream gender, environment, climate change, disaster risk reduction and poverty (GECDP) in the 11th FYP of the Local Governments (2013)***: This framework was developed by the GECDP mainstreaming reference group (MRG) to support the mainstreaming of all cross-cutting issues in policies, plans and programmes at all levels of government and non-governmental agencies. It was developed to inform and guide local governments in the formulation of integrated, sustainable and smarter 11 FYP and annual plans.
- ***Hyogo Framework of Action 2005-2015***: Bhutan is signatory to the Hyogo Framework of Action, which has 5 main priority areas in building the resilience of nations. It emphasizes the importance of disaster risk reduction under five main areas as mentioned here:
 - i. Governance: organizational, legal and policy frameworks;
 - ii. Risk identification, assessment, monitoring and early warning;
 - iii. Knowledge management and education;
 - iv. Reducing underlying risk factors; and
 - v. Preparedness for effective response and recovery

Currently, there is an opportunity for Bhutan and other countries in the Himalayan region to bring the GLOF agenda within the realm of Priorities of Action under the Hyogo Framework for Action when planning the successor to the Hyogo Framework for Action by 2015.

- ***Disaster Management Act of Bhutan (2013)***: The development of the Bill was done with the support of the GLOF project. The Act was adopted by the Parliament on February 27, 2013. The main points of this Act are:
 - It repeals the NDRMF of 2006 described above.
 - The purpose of this Act is to provide for: a) The establishment and strengthening of institutional; capacity for disaster management; b) Mainstreaming of disaster risk reduction; c) An integrated and coordinated disaster management focusing on community participation; and d) other matters.
 - It sets the institutional framework for disaster management in Bhutan, including a National Disaster Management Authority as the highest decision making body on disaster management in Bhutan chaired by the Prime Minister, district (Dzongkhag) disaster management committees responsible for coordinating and managing all disaster management operations and chaired by the Dzongdags, sub-committees at the Dungkhag, Thromde or Gewog levels, and an inter-ministerial task force chaired by the Head of DDM.
 - The requirement for DDM to develop a Disaster Management and Contingency Plan, which should be approved by the National Disaster Management Authority.
 - The setting-up of a national emergency operation center by DDM.
 - The request for the National Disaster Management Authority to direct relevant agencies to put in place EWS and institute a system of alerts.
- ***NDRM Strategy***: With the support of the GLOF project, the DDM is preparing a revised NDRM framework (now renamed as National Disaster Risk Management Strategy) on the basis on the lessons learned through the GLOF project as well as aligning it with the recently adopted Disaster Management Act. The DDM has also prepared the draft Disaster Management Rules and Regulations.

116. The review of Bhutan's disaster management policy and legislation frameworks reveals that the project is well mainstreamed into the governance system to mitigate natural hazards and to improve disaster preparedness, which will certainly contribute to the long-term sustainability of project achievements.

4.3.7. Sustainability

117. The prospects for the long-term sustainability of project achievements are excellent; it is rated as *likely sustainable*. The respective executing agencies responsible for the implementation of the project (DGM, DHMS and DDM) should continue activities demonstrated with the support of the project. The project supported the development of a national disaster management agenda through the mandated national agencies and the review indicates that it is highly likely that the results achieved with the support of the project will be pursued in the long-term. These executing agencies will pursue their mandates to address GLOF risks and will use the lessons learned and best practices from this project.

118. Additionally, as discussed in the previous section 4.3.6, the demonstration to mitigate the GLOF risks at the Thorthormi Lake and to install a EWS in the Punakha-Wangdue and Chamkhar Valleys was used to strengthen the policy and legislation frameworks in Bhutan, including the mainstreaming of disaster risk management in sectoral development plans and programmes. Currently, this experience is also used by the relevant agencies to revise the National Disaster Risk Management Framework done in 2006 along the lines of the recently adopted Disaster Management Act.

119. Overall, the project was well aligned with national priorities and due to an excellent national ownership the Evaluation Team found that the achievements of the project are likely to be sustained over the long-term after the project end.

Financial risks

120. When reviewing the sustainability of project achievements – particularly the yearly maintenance cost of the EWS - financial risk is the main area where questions related to sustainability arise. Currently, the system installed with the support of the project necessitates a yearly subscription fee to the Iridium satellite communication system estimated at about USD 10,000. The Evaluation Team discussed the matter with DHMS and the sustainability of this recurrent yearly cost does not seem to be an issue over the long-term. Additionally, the department is looking into alternatives for other cheaper similar communication systems. This research will also be done in the context of 2 new initiatives supporting the RGoB in addressing its GLOF risks needs: A JICA project that started in October 2013 and the upcoming NAPA2 project funded by GEF-LDCF (see Section 4.3.8). Based on discussions in Thimphu with key stakeholders during this evaluation, financial sustainability is rated as *likely sustainable*.

Socio-economic risks

121. The project had positive impacts on the communities in the Lunana area but also down in the Valley. The review found two types of socio-economic benefits. The first one was directly linked with the approach used to lower the water level in the Thorthormi Lake. The labor-based approach to do this work necessitated the hiring of about 300 workers every season for 4 years. These people were recruited throughout Bhutan and paid an average salary that was about 4-5 times the regular salaries in the Valleys. They also got some basic equipment such as raincoats and sleeping bags. In addition, the transportation of supplies necessitated the hiring of horses and yaks from the communities along the road from Gasa to Lunana. It is difficult to assess the real benefits of the money compensation for these services (workers and transport) but it certainly contributed positively to the families/communities of the workers and transporters. Some anecdotes gathered by the Consultants who compiled the “*Technical Review and Social Impact Assessment*” Study include the setting up of permanent shops in Thanza and some temporary shops, which eases life considerably for the community members. Other benefits were the construction of a “chorten” by the workers near Thanza and the direct access to medical service; though only temporary during the lifetime of the project. The second socio-economic benefit is the “peace of mind” that reducing the lake level, and thus reducing GLOF risk, gives to the local communities, combined with the existence of an extensive EWS in their communities. Communities in the Punakha-Wangdue and Chamkhar Valleys feel more secure as a result of the project. They now have zonation maps to identify safe areas with limited risks where they can invest in housing or other development

activities.

122. Within the Punakha-Wangdue and Chamkhar Valleys, the review indicated that there is no socio-economic risks that could threaten the sustainability of project achievements; it is rated as *likely sustainable*.

Institutional framework and governance risks

123. When assessing the long-term sustainability of this project, it is important to consider that the project was completely implemented by the relevant government departments in the RGoB. The project was, therefore, very much in line with the institutional and legislation frameworks in place in Bhutan. As discussed in section 4.3.6, the project was very well integrated in the relevant apparatus of government and provided extra resources to the key departments to demonstrate how to mitigate GLOF risks in Bhutan; its sustainability with regards to institutional framework and governance matters is rated as *likely sustainable*.

124. The project was managed by three Project Managers – one from each executing agency: DGM, DHMS and DDM – who implemented the project in addition to their regular job duties in their respective department. The Evaluation Team noted that this set up certainly contributed to the institutionalization of project achievements. These three departments are mandated by the government to address GLOF risks and also benefitted from the demonstration in the Punakha-Wangdue and Chamkhar Valleys; they are now at the forefront of mitigating risks of GLOFs in Bhutan.

Environmental risks

125. The review did not find any particular environmental risks to the sustainability of project outcomes; it is rated as *likely sustainable*. The project demonstrated mitigation measures to reduce the risks of GLOFs and, the lessons learned and best practices were used to strengthen the policy and legislation frameworks; including the passing this past year of the new Disaster Management Act.

126. Regarding the implementation of outcome 2 “*Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system*”, it was noted that the NEC requested an Environmental Impact Assessment (EIA). This request was particularly done in the context of a similar project “*The Rapstreng Mitigation Project*” that was done in 1997-1999 to lower the water level of the Rapstreng Lake in the same Lunana area. As an identical labor-based project with hundreds of temporary workers in a high-altitude environment, the Rapstreng project resulted in serious complaints by local communities regarding excessive collection of firewood and poaching of alpine wildlife such as musk deer and blue sheep. The EIA – done by DGM – identified the potential social and environmental impacts of the project intervention and identified potential alternatives. As part of this EIA, a concise and clear mitigation plan was formulated to limit and counteract the possible negative impacts identified. The Evaluation Team noted that the Team that conducted the “*Technical Review and Social Impact Assessment*” study reviewed this mitigation plan and concluded that *the plan had been implemented adequately and that the organization and management of the project site occupied by the project is clearly in line with the mitigation measures as proposed*. It was also noted that the project – as a mitigation measure – ensured the participation of a forest ranger and a representative from the Jigme Dorji National Park (JDNP) on the multi-disciplinary team in charge of the mitigation work at the Thorthormi Lake.

4.3.8. Catalytic Role and Long-Term Impact

127. The GEF defines the catalytic role of projects as one of the ten operational principles for the development and implementation of the GEF work program. The GEF hopes to fund projects in such a way so as to attract additional resources, pursue strategies that have a greater result than the project itself, and/or accelerate a process of development or change. The review of the catalytic role of the GLOF project is to consider the extent to which the project has demonstrated: a) production of a public good, b) demonstration, c) replication, and d) scaling up.

128. Regarding the extent to which the GLOF project will have long term impacts, it is necessary to assess if the project has demonstrated: (i) verifiable improvements in ecological status; (ii) verifiable reductions in stress on ecological systems; (iii) through specified process indicators, that progress is being made towards achievement of stress reduction and/or ecological improvement.

129. Considering the analysis discussed in all sections of this chapter 4 above, it is clear that the GLOF project has had a catalytic role and will have long-term impacts in Bhutan regarding the reduction of GLOF risks. The implementation of the project focusing on mitigation of GLOF risks from the Thorthormi Lake provided Bhutan with a set of lessons learned and best practices on how to mitigate the risk of GLOFs. Furthermore, this experience was demonstrated in the Punakha-Wangdue and Chamkhar Valleys. The site was selected as the most critical one in Bhutan, based on previous studies of glacial lakes conducted in Bhutan. Now, these valleys have less risk of GLOFs due to the lowering of the water level in the Thorthormi Lake. Moreover, the people living in these valleys have now an EWS to alert them in case of a coming flood and the capacity on what to do in case of a GLOF. The long-term impacts include the fact that the population in these valleys feel now more secure, have zonation maps where development can safely take place and, due to less risks of GLOFs, a better protection of fertile lands along these rivers that is the basis of their livelihoods.

130. The demonstration was successful and the project will leave behind a “live” demonstration, which key government departments should sustained in the future and also from which key stakeholders were able to learn from. The project ends at the end of December 2013. Based on the review conducted for this evaluation, the potential for replication and scaling-up of project achievements is also excellent. The lessons learned and best practices were used to develop the legislation framework. Today, Bhutan has a new Disaster Management Act (2013), which will guide further actions in this area. The Act provides the necessary legislation for the country to implement a disaster management strategy nationwide and the mandated departments have the capacity to scale-up similar initiatives to other valleys in Bhutan.

131. In the medium term, the replication to mitigate risks of GLOFs is also good. The RGoB is now undertaking two initiatives supported by international donors to expand the capacity to manage risks due to climate-induced natural disasters. It includes:

- ***The Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning in the Kingdom of Bhutan:*** This is a DHMS-JICA project that started mid-2013 for 3 years. Its purpose is “*Capacity of DHMS2 and relevant stakeholders on emergency response against GLOF/rainstorm flood is enhanced*”. It will be implemented through three outputs:
 - *Output 1:* Capacity of DHMS and related agencies on GLOF/rainstorm flood risk assessment, development planning, disaster prevention, flood forecasting and warning as well as emergency information sharing among relevant agencies is enhanced.
 - *Output 2:* Early Warning System (EWS) for GLOF/rainstorm is developed and maintained in the pilot basins of Mangdechhu and the Chamkharchhu.
 - *Output 3:* Emergency response capacity against GLOF/rainstorm floods at central and local level is enhanced in the pilot basins.

The project will pilot an EWS for GLOF and rainstorm in 2 basins: Mangdechhu and the Chamkharchhu. The project will also build the capacity of the recently established *National Weather, Flood Forecasting and Warning Center* at DHMS to cope with water related disasters in the country including the development of an adequate multi-tier observation network for in-situ data collection in real or near real time to provide reliable weather forecasting, flood forecasting and warning to safeguard life and property.

The project was developed following a “*Study on Glacial Lake Outburst Floods in Bhutan Himalayas*” funded by JICA and the Japan Science and Technology Agency (JST) during the period 2009-2012 and implemented by DGM. The study assessed GLOF risk in the Mangdechhu river basin in central Bhutan. The study concluded that there were no urgent risks of potential GLOFs in the basin, which needed to be mitigated by counter measures such as lowering the water level of lakes. However, the study recommended the continuous monitoring of glacier lakes as well as the development of an early warning system in the basin.

- ***Addressing the Risks of Climate-induced Disasters through Enhanced National and Local Capacity for Effective Actions:*** This is an RGoB-UNDP project that was recently submitted to the GEF-LDCF for funding. It is a four-year project with a total budget of USD 66M including a requested GEF-LDCF grant of USD 11.5M (pending final approval) and a co-financing of USD 54.5M. The project should start at the beginning of 2014. Its concept is issued from the revised NAPA that was completed in 2012 and it addresses the revised national priorities that are in this revised Plan of Actions. The PIF phase for this project was completed in May 2012 and the PPG in November 2013. The Results Framework includes one objective and three outcomes:
 - *Objective:* To enhance national, local and community capacity to prepare for and respond to climate-induced multi-hazards to reduce potential losses of human lives, national economic infrastructure, livelihoods, and livelihood assets
 - *Outcome 1:* Risk from climate-induced floods and landslides reduced in Bhutan’s economic and industrial center Phuentsholing and Pasakha Industrial Area
 - *Outcome 2:* Community resilience to climate-induced disaster risks (droughts, floods, landslides, windstorms, forest fires) strengthened in at least four Dzongkhags
 - *Outcome 3:* Relevant information about climate-related risks and threats shared across development sectors for planning and preparedness on a timely and reliable basis.

132. In conclusion, the achievements from the GLOF project should be replicated in the future through these 2 initiatives and overall the assessment indicates that there is a good potential for the scaling-up of these achievements. The project will have positive impacts over the long-term in Bhutan when it comes to managing the risks of natural disasters.

5. LESSONS LEARNED

133. A summary of lessons learned is presented below. There are based on the review of project documents, interviews with key informants and analysis of the information collected:

- A good design leads to a good implementation, which in turn leads to good project results. There is more chance for a project well designed to be a success. Every steps of the way count in the success of a project and it is a lot easier to succeed when all these steps are relevant and implemented effectively and efficiently.
- This project is a good example of a demonstration project that could lead to an investment project as per the current GEF types of project (foundational, demonstration and investment). The project demonstrated mitigation measures to climate change for reducing risks of GLOFs (a demonstration project); it is now ready to be replicated (an investment project) throughout Bhutan. Furthermore, the soon-to-start GEF-LCDF NAPA2 project with a total budget of USD 66M could provide the investment opportunity to further demonstrate the measures demonstrated by this project.
- A project that is highly relevant, responding to national needs and priorities, is often highly effective in its implementation and enjoys good country ownership.
- A project of this nature provides a lot of lessons and best practices that is important to document. Conduct a technical review of such project near its end is an excellent way to document/detail the achievements of the project. It provides a body of knowledge – approaches, methodologies, lessons learned and best practices - that can be made available to all through the web and contribute to its replication and scaling-up in the country and in the region.
- A flexible project using adaptive management is a necessary management mechanism to be able to respond to stakeholders and beneficiaries' needs and priorities. It provides the project with the capacity to adapt to changes, including disruptive events and yet keep its overall efficiency and effectiveness.
- In addition to capacity development, a project procuring tangible deliverables that are selected by stakeholders (such as the EWS) brings tangible results to stakeholders and beneficiaries with positive direct and immediate impacts on them. It contributes to a strong participation of stakeholders and beneficiaries in project activities and overall to a better effectiveness of project activities.
- The application of the NEX modality is an effective management tool for GEF Implementing Agencies to develop national ownership of projects funded by international donors. The case of Bhutan could be used as a case study to demonstrate this effectiveness and value for money.

Annex 1: Terms of Reference

TERMINAL EVALUATION TERMS OF REFERENCE

REDUCING CLIMATE CHANGE-INDUCED RISKS AND VULNERABILITIES FROM GLACIAL LAKE OUTBURST FLOODS IN THE PUNAKHA, WANGDUE AND CHAMKHAR VALLEYS

(FULL SIZED PROJECT)

PROJECT/AWARD NO.: 00059841/ 00049210

INTRODUCTION

In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP support GEF financed projects are required to undergo a terminal evaluation upon completion of implementation. These terms of reference (TOR) sets out the expectations for a Terminal Evaluation (TE) of the project „Reducing climate change-induced risks and vulnerabilities from Glacial Lake Outburst Floods (GLOF) in the Punakha, Wangdue and Chamkhar Valleys” (PIMS 3722). The essentials of the project to be evaluated are as follows:

PROJECT SUMMARY TABLE

GEF Project ID:	00059841		<i>At endorsement (Million US\$)</i>	<i>As of 30th June 2013 (US\$)</i>
UNDP Project ID:	48573	GEF financing:	3,445,050	3,387,938.26
Country:	Bhutan	IA/EA own:		
Region:	Asia-Pacific	Government:	2,680,000	2,755,921
Focal Area:	Disaster Risk Management	Other: (PHPA Hydro) ADA WWF	3,67,000 8,00,000 30,000	2,99,099 6,13,539 30,000
FA Objectives, (OP/SP):	Disaster Reduction	Total co-financing:	3,906,224	3,934,471
Executing Agency:	DGM(MoEA) DHMS (MoEA) DDM (MoHCA)	Total Project Cost:	7,351,274	7,322,409.26
Other Partners involved:	<ul style="list-style-type: none"> Austrian Development Agency (ADA) WWF PHPA (Hydro power-Bhutan) 	ProDoc Signature (date project began):		8 Apr 2008
		(Operational) Closing Date: 31 Dec 2013	Proposed: 31 Dec 2013	Actual: -

OBJECTIVE AND SCOPE

The Full Sized Project (FSP) on “Reducing Climate Change-induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys” is a Global Environment Facility (GEF) funded Project through the United Nations Development Program (UNDP). The Project is implemented by the Ministry of Economic Affairs through Department of Geology and Mines and Department of Hydro-met Services, and Ministry of Home and Cultural Affairs through Department of Disaster Management. The Project duration has been extended till the end of December 2013. The Project Board consisting of senior level officials from government agencies and UNDP CO provides overall guidance for project implementation. The project duration is from June 2008 till Dec 2013.

Climate change is contributing to increased melting of glaciers and the formation of glacial lakes in Bhutan. Recent studies suggest rates of glacial retreat in the Himalayas as high as 30 to 60 metres per decade, and the melting of glaciers leading to alarming volumes of water in downstream glacial lakes. Increased temperature also causes melting of ice-cored moraine dams to the point that the ridges can no longer resist the pressure. The concern is that when the current holding capacity of the lakes reaches a critical threshold, loose glacial debris that act as dams or barriers could fail and lead to flash floods that result in severe adverse impacts on downstream communities.

This project supports the UNDP’s global objective for Thematic Area 4 on Disaster Risk Management within the *Monitoring and Evaluation Framework for Adaptation to Climate Change*¹: “Enhanced resilience of settlements, infrastructure, and landscapes to increases in the frequency of climatic extremes, focusing on the reduction of risk associated with increasingly frequent extreme rainfall events and their impacts, through planning, land management, and vulnerability reduction.” It also supports MDG Goal 8, Target 14: “Address the special needs of landlocked countries and small island developing States” and MDG 1: “Eradicate Extreme Poverty and Hunger”.

An inventory of glaciers, glacial lakes, and glacial lake outburst floods (GLOFs) in Bhutan, prepared by a team of Bhutanese and foreign experts in 2001, identified 677 glaciers and 2,674 glacial lakes. The study also revealed a total of 24 glacial lakes posing potentially high risk for GLOFs. Eight of these 24 lakes are located in the Pho Chhu Sub Basin and three are located in the Chamkhar Chhu Sub Basin. An update of the UNEP/ICIMOD GLOF inventory in 2007, shows that the number of high-risk glacial lakes has increased to 25, and the team identified 983 glaciers and 2,794 glacial lakes. This is in line with findings in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report that climate change is contributing to glacier melt.

One of the glacier lakes currently facing a high risk of outburst flooding is Thorthormi lake in Bhutan’s northern Lunana area. Thorthormi glacier had no supraglacial ponds on it during the 1950s but now there are numerous supra-glacial ponds, which are enlarging and becoming interconnected. The Thorthormi glacier is therefore considered as one of the most critical growing glacial lakes with GLOF threat in the near future. The area measured 1.28 km² in 2001 from satellite image (Geocover) and still it is observed to be steadily growing in size. Thus the assemblage of supraglacial lakes, which lie on Thorthormi glacier, has made it one of the most dangerous lakes in Bhutan.

Goal

The **goal** of the project is to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan.

Objective:

The **objective** of the project is to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys.

Outcomes and Outputs:

The Project has four outcomes as indicated below:

OUTCOME 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys

- Output 1.1 Climate-resilient DRM legislation, policy frameworks, and sectoral plans
- Output 1.2 Capacities for climate risk planning strengthened at the district (Dzongkhag) Administrative level
- Output 1.3 Information on climate hazards and vulnerabilities (with a focus on GLOFs) in Bhutan systematically captured, updated, and synthesized
- Output 1.4 Vulnerable communities are aware of, and prepared for, climate-related disasters

OUTCOME 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system

- Output 2.1 Engineering and safety plans for climate change risk reduction measures on Thorthormi Lake are in place
- Output 2.2 Artificial lowering system of Thorthormi Lake waters implemented
- Output 2.3 Water levels of Thorthormi Lake and status of artificial lowering system are regularly monitored and maintained
- Output 2.4 Technical knowledge and lessons in the artificial lowering of glacier lake levels captured and documented for use in future projects

OUTCOME 3: Reduced human and material losses in vulnerable communities in the Punakha- Wangdue Valley through GLOF early warnings

- Output 3.1 Technical components for a GLOF early warning system in the Punakha-Wangdue valley installed and operational
- Output 3.2 Institutional arrangements in place to operate, test, and maintain the GLOF EWS
- Output 3.3 Awareness of communities in the Punakha-Wangdue Valley on operation of the EWS
- Output 3.4 Safe GLOF evacuation areas identified and publicized in each vulnerable community in the Punakha-Wangdue Valley
- Output 3.5 Technical knowledge and lessons in the installation and operation of GLOF EWS captured and documented for use in future projects

OUTCOME 4: Enhanced learning, evaluation and adaptive management

- Output 4.1 Project lessons captured in, and disseminated through, the Adaptation Learning Mechanism
- Output 4.2 Project knowledge shared with other GLOF-prone countries

The TE will be conducted according to the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects.

The objectives of the evaluation are to assess the achievement of project results, and to draw lessons that can both improve the sustainability of benefits from this project, and aid in the overall enhancement of UNDP programming.

EVALUATION APPROACH AND METHOD

An overall approach and method² for conducting project terminal evaluations of UNDP supported GEF financed projects have developed over time. The evaluator is expected to frame the evaluation effort using the criteria of **relevance, effectiveness, efficiency, sustainability, and impact**, as defined and explained in the UNDP Guidance for Conducting Terminal Evaluations of UNDP-supported, GEF-financed Projects. A set of questions covering each of these criteria have been drafted and are included with this TOR ([Annex C](#)). The evaluator is expected to amend, complete and submit this matrix as part of an **evaluation inception report**, and shall include it as an annex to the final report.

The evaluation must provide evidence-based information that is credible, reliable and useful. The evaluator is expected to follow a participatory and consultative approach ensuring close engagement with government counterparts, in particular the GEF operational focal point, UNDP Country Office, project team, UNDP GEF Technical Adviser based in the region and key stakeholders. The evaluator is expected to conduct a field mission to the project sites, including interviews with the organizations and individuals associated with the project (*location and list of project sites, and stakeholders included in the tentative programme*).

The evaluator will review all relevant sources of information, such as the project document, project reports – including Annual APR/PIR, project budget revisions, midterm review, progress reports, GEF focal area tracking tools, project files, national strategic and legal documents, and any other materials that the evaluator considers useful for this evidence-based assessment. A list of documents that the project team will provide to the evaluator for review is included in [Annex B](#) of this Terms of Reference.

EVALUATION CRITERIA & RATINGS

An assessment of project performance will be carried out, based against expectations set out in the Project Logical Framework/Results Framework ([Annex A](#)), which provides performance and impact indicators for project implementation along with their corresponding means of verification. The evaluation will at a minimum cover the criteria of: **relevance, effectiveness, efficiency, sustainability and impact**. Ratings must be provided on the following performance criteria. The completed table must be included in the evaluation executive summary. The obligatory rating scales are included in [Annex D](#).

Evaluation Ratings:			
1. Monitoring and Evaluation	<i>rating</i>	2. IA & EA Execution	<i>rating</i>
M&E design at entry		Quality of UNDP Implementation	
M&E Plan Implementation		Quality of Execution - Executing Agency	
Overall quality of M&E		Overall quality of Implementation / Execution	
3. Assessment of Outcomes	<i>rating</i>	4. Sustainability	<i>rating</i>
Relevance		Financial resources:	
Effectiveness		Socio-political:	
Efficiency		Institutional framework and governance:	
Overall Project Outcome Rating		Environmental:	
		Overall likelihood of sustainability:	

² For additional information on methods, see the [Handbook on Planning, Monitoring and Evaluating for Development Results](#), Chapter 7, pg. 163

PROJECT FINANCE / COFINANCE

The Evaluation will assess the key financial aspects of the project, including the extent of co-financing planned and realized. Project cost and funding data will be required, including annual expenditures. Variances between planned and actual expenditures will need to be assessed and explained. Results from recent financial audits, as available, should be taken into consideration. The evaluator(s) will receive assistance from the Country Office (CO) and Project Team to obtain financial data in order to complete the co-financing table below, which will be included in the terminal evaluation report.

Co-financing (type/source)	UNDP own financing (mill. US\$)		Government (mill. US\$)		Partner Agency (mill. US\$)		Total (mill. US\$)	
	Planned	Actual	Planned	Actual	Planned	Actual	Actual	Actual
Grants								
Loans/Concessions								
• In-kind support								
• Other								
Totals								

MAINSTREAMING

UNDP supported GEF financed projects are key components in UNDP country programming, as well as regional and global programmes. The evaluation will assess the extent to which the project was successfully mainstreamed with other UNDP priorities, including poverty alleviation, improved governance, the prevention and recovery from natural disasters, and gender.

IMPACT

The evaluators will assess the extent to which the project is achieving impacts or progressing towards the achievement of impacts. Key findings that should be brought out in the evaluations include whether the project has demonstrated: a) verifiable improvements in ecological status, b) verifiable reductions in stress on ecological systems, and/or c) demonstrated progress towards these impact achievements.³

CONCLUSIONS, RECOMMENDATIONS & LESSONS

The evaluation report must include a chapter providing a set of **conclusions, recommendations** and lessons.

IMPLEMENTATION ARRANGEMENTS

The principal responsibility for managing this evaluation resides with the UNDP CO in Bhutan. The UNDP CO will contract the evaluators and ensure the timely provision of per diems and travel arrangements within the country for the evaluation team. The Project Team will be responsible for liaising with the Evaluators team to set up stakeholder interviews, arrange field visits, coordinate with the Government etc.

EVALUATION TIMEFRAME

The total duration of the evaluation will be 16 days according to the following plan:

Activity	Timing	Completion Date
Preparation (Home based) 1. Desk review of documents 2. Inception report	2 days	<i>2 November 2013</i>
3. Evaluation Mission including field visit and stakeholder consultation	9 days (3 days in the field and 6 days in Thimphu)	<i>12 November 2013</i>
4. Preparation of final draft evaluation report complete with annexes as per the template	4 days	<i>26 November 2013</i>
5. Final evaluation report submission to UNDP	1 day	<i>8 December 2013</i>

³ A useful tool for gauging progress to impact is the Review of Outcomes to Impacts (ROtI) method developed by the GEF Evaluation Office: [ROtI Handbook 2009](#)

EVALUATION DELIVERABLES

The evaluation team is expected to deliver the following:

Deliverable	Content	Timing	Responsibilities
Inception Report	Evaluator provides clarifications on timing and method	No later than 2 weeks before the evaluation mission.	Evaluator submits to UNDP CO
Presentation	Presentation of initial findings and 1 st draft of the report	End of evaluation mission	To project management, UNDP CO
Draft Final Report	Full report, (per annexed template) with annexes	Within 2 weeks of the evaluation mission	Sent to CO, reviewed by RTA, PCU, GEF OFPs
Final Report*	Revised report	Within 1 week of receiving UNDP comments on draft	Sent to CO for uploading to UNDP ERC.

*When submitting the final evaluation report, the evaluator is required also to provide an 'audit trail', detailing how all received comments have (and have not) been addressed in the final evaluation report.

TEAM COMPOSITION

The evaluation team will be composed of *one international and one national evaluator*. The consultants shall have prior experience in evaluating similar projects. Experience with GEF financed projects is an advantage. The international evaluator will lead the evaluation team and will be responsible for finalizing the report. The evaluators selected should not have participated in the project preparation and/or implementation and should not have conflict of interest with project related activities.

The International consultant must present the following qualification and professional experience:

1. The candidate should have at least Masters or higher degree in any relevant field and should have adequate experience in evaluation of GEF project. The candidate should be physically fit.
2. Professional background in environmental science, climate change adaptation and mitigation, disaster risk management or related fields with in-depth understanding of climate change impacts and disaster management. A minimum of 10 years of working experience is required;
3. Highly knowledgeable of participatory monitoring and evaluation processes, and experience in evaluation of technical assistance projects with major donor agencies; previous evaluation experience of UNDP-GEF projects is an advantage.
4. Previous experience with results- based monitoring and evaluation methodologies.
5. Familiar with climate change adaptation projects in Asia-Pacific either through management and/or implementation or through consultancies in evaluation of climate change adaptation projects.
6. Demonstrated ability to assess complex situations succinctly, distills critical issues, and draw forward-looking conclusions and recommendations;
7. Ability and experience to lead multi-disciplinary and national teams, and deliver quality reports within the given time.
8. Writing and communication will be in English, and must have excellent communication skills in English. The consultant must bring his/her own computing equipment.

The national consultant must present the following qualification and professional experience:

1. The candidate should have at least Masters or higher degree in any relevant field and should have adequate experience in evaluation of GEF project. The candidate should be physically fit.
2. Professional background in environmental science, climate change adaptation and mitigation, disaster risk management or related fields with in-depth understanding of climate change impacts and disaster management with a minimum of 8 years of relevant experience;
3. Familiar with climate change adaptation projects in Asia-Pacific either through management and/or implementation or through consultancies in evaluation of climate change adaptation projects;
4. Proficient in writing and communicating both in English and Dzongkha. Ability to interpret for the international counterpart and also to translate necessary written documents to English.

EVALUATOR ETHICS

Evaluation consultants will be held to the highest ethical standards and are required to sign a Code of Conduct (Annex E) upon acceptance of the assignment. UNDP evaluations are conducted in accordance with the principles outlined in the [UNEG 'Ethical Guidelines for Evaluations'](#)

PAYMENT MODALITIES AND SPECIFICATIONS

%	Milestone
35%	Following the presentation of the evaluation findings to the UNDP CO and the stakeholders at the end of the mission
65%	Following submission and approval (UNDP-CO and UNDP RTA) of the final terminal evaluation report

APPLICATION PROCESS

Applicants are requested to apply by email to procurement at procurement.bt@undp.org by 9th October 2013. Individual consultants are invited to submit applications together with their CV for these positions. The application should contain an updated CV, completed P11 form, a proposed methodology and, a financial offer indicating the total cost of the assignment (including daily fee, per diem and travel costs).

UNDP applies a fair and transparent selection process that will take into account the competencies/skills of the applicants as well as their financial proposals. Qualified women and members of social minorities are encouraged to apply.

Selection Criteria

The consultants who fulfill the above requirements will be assessed based on the following criteria:

- Technical evaluation comprising of 70%, and
- Financial evaluation of 30%

(For space consideration, the annexes of the TORs were not included)

Annex 2: Evaluation Matrix

The evaluation matrix below served as a general guide for the evaluation. It provided directions for the evaluation; particularly for the collection of relevant data. It was used as a basis for interviewing people and reviewing project documents. It also provided a basis for structuring the evaluation report as a whole.

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
Evaluation criteria: Relevance - How does the project relate to the main objectives of the GEF focal area, and to the environment and development priorities at the local, regional and national levels?				
<i>Is the Project relevant to GEF objectives?</i>	<ul style="list-style-type: none"> How did the Project support the related strategic priorities of the GEF? Were GEF criteria for Project identification adequate in view of actual needs? 	<ul style="list-style-type: none"> Level of coherence between project objectives and those of the GEF Extent to which the project is actually implemented in line with incremental cost argument 	<ul style="list-style-type: none"> Project documents GEF policies and strategies GEF web site 	<ul style="list-style-type: none"> Documents analyses Interviews with government officials and other partners
<i>Is the Project relevant to UNDP objectives?</i>	<ul style="list-style-type: none"> How did the Project support the objectives of UNDP in this sector? 	<ul style="list-style-type: none"> Existence of a clear relationship between project objectives and country programme objectives of UNDP 	<ul style="list-style-type: none"> Project documents UNDP strategies and programme 	<ul style="list-style-type: none"> Documents analyses Interviews with government officials and other partners
<i>Is the Project relevant to Bhutan's development objectives?</i>	<ul style="list-style-type: none"> How did the Project support the development objectives of Bhutan? How country-driven was the Project? Did the Project adequately take into account national realities, both in terms of institutional framework and programming, in its design and its implementation? To what extent were national partners involved in the design of the Project? 	<ul style="list-style-type: none"> Degree to which the project support national environmental and development objectives Degree of coherence between the project and national priorities, policies and strategies Appreciation from national stakeholders with respect to adequacy of project design and implementation to national realities and existing capacities? Level of involvement of Government officials and other partners into the project Coherence between needs expressed by national stakeholders and UNDP-GEF criteria 	<ul style="list-style-type: none"> Project documents National policies, strategies and programmes Key government officials and other partners 	<ul style="list-style-type: none"> Documents analyses Interviews with government officials and other partners
<i>Does the Project address the needs of target beneficiaries?</i>	<ul style="list-style-type: none"> How did the Project support the needs of target beneficiaries? Was the implementation of the Project been inclusive of all relevant Stakeholders? Were local beneficiaries and stakeholders adequately involved in Project design and implementation? 	<ul style="list-style-type: none"> Strength of the link between project expected results and the needs of target beneficiaries Degree of involvement and inclusiveness of beneficiaries and stakeholders in project design and implementation 	<ul style="list-style-type: none"> Beneficiaries and stakeholders Needs assessment studies Project documents 	<ul style="list-style-type: none"> Document analysis Interviews with beneficiaries and stakeholders
<i>Is the Project internally</i>	<ul style="list-style-type: none"> Is there a direct and strong link between project expected results (log frame) and the Project design (in terms of Project components, choice of partners, structure, 	<ul style="list-style-type: none"> Level of coherence between project expected results and project design internal logic 	<ul style="list-style-type: none"> Program and project documents 	<ul style="list-style-type: none"> Document analysis Key Interviews

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
<i>coherent in its design?</i>	<ul style="list-style-type: none"> delivery mechanism, scope, budget, use of resources etc.)? Is the length of the Project conducive to achieve project outcomes? 	<ul style="list-style-type: none"> Level of coherence between project design and project implementation approach 	<ul style="list-style-type: none"> Key project stakeholders 	
<i>How is the Project relevant in light of other donors?</i>	<ul style="list-style-type: none"> With regards to Bhutan, does the Project remain relevant in terms of areas of focus and targeting of key activities? How do GEF-funds help to fill gaps (or give additional stimulus) that are crucial but are not covered by other donors? 	<ul style="list-style-type: none"> Degree to which program was coherent and complementary to other donor programming in Bhutan List of programs and funds in which the future developments, ideas and partnerships of the project are eligible? 	<ul style="list-style-type: none"> Other Donors' policies and programming documents Other Donor representatives Project documents 	<ul style="list-style-type: none"> Documents analyses Interviews with other Donors
Future directions for similar Projects	<ul style="list-style-type: none"> What lessons have been learnt and what changes could have been made to the Project in order to strengthen the alignment between the project and the Partners' priorities and areas of focus? How could the project better target and address priorities and development challenges of targeted beneficiaries? 		<ul style="list-style-type: none"> Data collected throughout evaluation 	<ul style="list-style-type: none"> Data analysis
Evaluation criteria: Effectiveness – To what extent have the expected outcomes and objectives of the project been achieved?				
<i>How is the Project effective in achieving its expected outcomes?</i>	<ul style="list-style-type: none"> Is the project being effective in achieving its expected outcomes? <ul style="list-style-type: none"> Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys; Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system; Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings Enhanced learning, evaluation and adaptive management. 	<ul style="list-style-type: none"> New methodologies, skills and knowledge Change in capacity for information management: Knowledge acquisition and sharing; Effective data gathering, methods and procedures for reporting. Change in capacity for awareness raising <ul style="list-style-type: none"> Stakeholder involvement and government awareness Change in local stakeholder behavior Change in capacity in policy making and planning to reduce climate change-induced risks and vulnerabilities from glacial lake outburst floods: <ul style="list-style-type: none"> Policy reform Legislation/regulation change Development of national and local strategies and plans Change in capacity in implementation and enforcement <ul style="list-style-type: none"> Design and implementation of risk assessments Implementation of national and local strategies and action plans through adequate institutional frameworks and their maintenance Monitoring, evaluation and promotion of pilots Change in capacity in mobilizing resources <ul style="list-style-type: none"> Leverage of resources Human resources Appropriate practices Mobilization of advisory services 	<ul style="list-style-type: none"> Project documents Key stakeholders including UNDP, Project Team, Representatives of Gov. and other Partners Research findings 	<ul style="list-style-type: none"> Documents analysis Meetings with main Project Partners Interviews with project beneficiaries

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
<i>How is risk and risk mitigation being managed?</i>	<ul style="list-style-type: none"> How well were risks and assumptions being managed? What was the quality of risk mitigation strategies developed? Were these sufficient? Were there clear strategies for risk mitigation related with long-term sustainability of the project? 	<ul style="list-style-type: none"> Completeness of risk identification and assumptions during project planning Quality of existing information systems in place to identify emerging risks and other issues? Quality of risk mitigations strategies developed and followed 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, Project Staff and Project Partners 	<ul style="list-style-type: none"> Document analysis Interviews
Future directions for similar Projects	<ul style="list-style-type: none"> What lessons have been learnt for the project to achieve its outcomes? What changes could have been made (if any) to the design of the project in order to improve the achievement of the project's expected results? How could the project be more effective in achieving its results? 		<ul style="list-style-type: none"> Data collected throughout evaluation 	<ul style="list-style-type: none"> Data analysis
Evaluation criteria: <i>Efficiency</i> - Was the project implemented efficiently, in-line with international and national norms and standards?				
<i>Is Project support channeled in an efficient way?</i>	<ul style="list-style-type: none"> Was adaptive management used or needed to ensure efficient resource use? Did the project logical framework and work plans and any changes made to them use as management tools during implementation? Were the accounting and financial systems in place adequate for project management and producing accurate and timely financial information? Were progress reports produced accurately, timely and responded to reporting requirements including adaptive management changes? Was project implementation as cost effective as originally proposed (planned vs. actual) Was the leveraging of funds (co-financing) happened as planned? Were financial resources utilized efficiently? Could financial resources have been used more efficiently? How was RBM used during project implementation? Were there an institutionalized or informal feedback or dissemination mechanisms to ensure that findings, lessons learned and recommendations pertaining to project design and implementation effectiveness were shared among project stakeholders, UNDP and GEF Staff and other relevant organizations for ongoing project adjustment and improvement? Did the project mainstream gender considerations into its implementation? 	<ul style="list-style-type: none"> Availability and quality of financial and progress reports Timeliness and adequacy of reporting provided Level of discrepancy between planned and utilized financial expenditures Planned vs. actual funds leveraged Cost in view of results achieved compared to costs of similar projects from other organizations Adequacy of project choices in view of existing context, infrastructure and cost Quality of RBM reporting (progress reporting, monitoring and evaluation) Occurrence of change in project design/ implementation approach (i.e. restructuring) when needed to improve project efficiency Existence, quality and use of M&E, feedback and dissemination mechanism to share findings, lessons learned and recommendation on effectiveness of project design. Cost associated with delivery mechanism and management structure compare to alternatives Gender disaggregated data in project documents 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, Representatives of Gov. and Project Staff Beneficiaries and Project partners 	<ul style="list-style-type: none"> Document analysis Key Interviews

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
<i>How efficient are partnership arrangements for the Project?</i>	<ul style="list-style-type: none"> To what extent partnerships/linkages between institutions/ organizations were encouraged and supported? Which partnerships/linkages were facilitated? Which one can be considered sustainable? What was the level of efficiency of cooperation and collaboration arrangements? (between local actors, UNDP/GEF and relevant government entities) Which methods were successful or not and why? 	<ul style="list-style-type: none"> Specific activities conducted to support the development of cooperative arrangements between partners, Examples of supported partnerships Evidence that particular partnerships/linkages will be sustained Types/quality of partnership cooperation methods utilized 	<ul style="list-style-type: none"> Project documents and evaluations Project Partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews
<i>Does the Project efficiently utilize local capacity in implementation?</i>	<ul style="list-style-type: none"> Was an appropriate balance struck between utilization of international expertise as well as local capacity? Did the Project take into account local capacity in design and implementation of the project? Was there an effective collaboration with scientific institutions with competence in climate change impact and in Glacial Lake Outburst Floods (GLOFs)? 	<ul style="list-style-type: none"> Proportion of total expertise utilized taken from Bhutan Number/quality of analyses done to assess local capacity potential and absorptive capacity 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, Project Team and Project partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews
Future directions for similar Projects	<ul style="list-style-type: none"> What lessons can be learnt from the project on efficiency? How could the project have more efficiently addressed its key priorities (in terms of management structures and procedures, partnerships arrangements etc...)? What changes could have been made (if any) to the project in order to improve its efficiency? 		<ul style="list-style-type: none"> Data collected throughout evaluation 	<ul style="list-style-type: none"> Data analysis

Evaluation criteria: *Impacts* - *Are there indications that the project has contributed to, or enabled progress toward, reduced environmental stress and/or improved ecological status?*

<i>How is the Project effective in achieving its long-term objectives?</i>	<ul style="list-style-type: none"> Will the project achieve its goal that is to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan? Will the project achieve its objective that is to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys? 	<ul style="list-style-type: none"> Changes in capacity: <ul style="list-style-type: none"> To pool/mobilize resources For related policy making and strategic planning, For implementation of related laws and strategies through adequate institutional frameworks and their maintenance, Changes in use and implementation of sustainable alternatives Changes to the quantity and strength of barriers such as change in <ul style="list-style-type: none"> Institutions in charge of disaster risk management and climate change induced GLOF hazards Systems to monitor disaster risk management and climate change induced GLOF hazards Methodologies to manage disaster risks and GLOF induced climate change Policy and legislation controlling disaster risk 	<ul style="list-style-type: none"> Project documents Key Stakeholders Research findings; if available 	<ul style="list-style-type: none"> Documents analysis Meetings with UNDP, Project Team and project Partners Interviews with project beneficiaries and other stakeholders
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Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
		<ul style="list-style-type: none"> management and climate change induced GLOF hazards Disaster risk management and climate change induced GLOF hazards infrastructures Livelihood and organization of mountain communities 		
<i>How is the Project impacting the local environment?</i>	<ul style="list-style-type: none"> What are the impacts or likely impacts of the project on? <ul style="list-style-type: none"> local environment; poverty; and, other socio-economic issues. 	<ul style="list-style-type: none"> Provide specific examples of impacts at those three levels, as relevant 	<ul style="list-style-type: none"> Project documents Key Stakeholders Research findings 	<ul style="list-style-type: none"> Data analysis Interviews with key stakeholders
Future directions for the Project	<ul style="list-style-type: none"> How could the project build on its successes and learn from its weaknesses in order to enhance the potential for impact of ongoing and future initiatives? 		<ul style="list-style-type: none"> Data collected throughout evaluation 	<ul style="list-style-type: none"> Data analysis
Evaluation criteria: Sustainability - To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results?				
<i>Are sustainability issues adequately integrated in Project design?</i>	<ul style="list-style-type: none"> Were sustainability issues integrated into the design and implementation of the project? 	<ul style="list-style-type: none"> Evidence/Quality of sustainability strategy Evidence/Quality of steps taken to address sustainability 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, project staff and project Partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews
<i>Financial Sustainability</i>	<ul style="list-style-type: none"> Did the project adequately address financial and economic sustainability issues? Are the recurrent costs after project completion sustainable? 	<ul style="list-style-type: none"> Level and source of future financial support to be provided to relevant sectors and activities after Project end? Evidence of commitments from international partners, governments or other stakeholders to financially support relevant sectors of activities after Project end Level of recurrent costs after completion of project and funding sources for those recurrent costs 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, project staff and project Partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews
<i>Organizations arrangements and continuation of activities</i>	<ul style="list-style-type: none"> Were results of efforts made during the project implementation period well assimilated by organizations and their internal systems and procedures? Is there evidence that project partners will continue their activities beyond project support? What degree is there of local ownership of initiatives and results? Were appropriate 'champions' being identified and/or 	<ul style="list-style-type: none"> Degree to which project activities and results have been taken over by local counterparts or institutions/organizations Level of financial support to be provided to relevant sectors and activities by in-country actors after project end Number/quality of champions identified 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, project staff and project Partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
	supported?			
<i>Enabling Environment</i>	<ul style="list-style-type: none"> Were laws, policies and frameworks addressed through the project, in order to address sustainability of key initiatives and reforms? Were the necessary related capacities for lawmaking and enforcement built? What is the level of political commitment to build on the results of the project? 	<ul style="list-style-type: none"> Efforts to support the development of relevant laws and policies State of enforcement and law making capacity Evidences of commitment by the political class through speeches, enactment of laws and resource allocation to priorities 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, project staff and project Partners Beneficiaries 	<ul style="list-style-type: none"> Document analysis Interviews
<i>Institutional and individual capacity building</i>	<ul style="list-style-type: none"> Is the capacity in place at the regional, national and local levels adequate to ensure sustainability of results achieved to date? 	<ul style="list-style-type: none"> Elements in place in those different management functions, at appropriate levels (regional, national and local) in terms of adequate structures, strategies, systems, skills, incentives and interrelationships with other key actors 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, Project staff and project Partners Beneficiaries Capacity assessments available, if any 	<ul style="list-style-type: none"> Interviews Documentation review
<i>Social and political sustainability</i>	<ul style="list-style-type: none"> Did the project contribute to key building blocks for social and political sustainability? Did the project contribute to local Stakeholders' acceptance of the new practices? 	<ul style="list-style-type: none"> Example of contributions to sustainable political and social change with regard to disaster risks management and GLOF management 	<ul style="list-style-type: none"> Project documents and evaluations UNDP, project staff and project Partners Beneficiaries 	<ul style="list-style-type: none"> Interviews Documentation review
<i>Replication</i>	<ul style="list-style-type: none"> Were project activities and results replicated elsewhere and/or scaled up? What was the project contribution to replication or scaling up of innovative practices or mechanisms that reduce climate change-induced risks and vulnerabilities from glacial lake outburst floods? 	<ul style="list-style-type: none"> Number/quality of replicated initiatives Number/quality of replicated innovative initiatives Volume of additional investment leveraged 	<ul style="list-style-type: none"> Other donor programming documents Beneficiaries UNDP, project staff and project Partners 	<ul style="list-style-type: none"> Document analysis Interviews
<i>Challenges to sustainability of the Project</i>	<ul style="list-style-type: none"> What are the main challenges that may hinder sustainability of efforts? Have any of these been addressed through project management? What could be the possible measures to further contribute to the sustainability of efforts achieved with the project? 	<ul style="list-style-type: none"> Challenges in view of building blocks of sustainability as presented above Recent changes which may present new challenges to the Project 	<ul style="list-style-type: none"> Project documents and evaluations Beneficiaries UNDP, project staff and project Partners 	<ul style="list-style-type: none"> Document analysis Interviews
Future directions for the Project	<ul style="list-style-type: none"> Which areas/arrangements under the project show the strongest potential for lasting long-term results? What are the key challenges and obstacles to the sustainability of results of the project initiatives that must be directly and quickly addressed? How can the experience and good project practices influence the strategies for reducing climate change-induced risks and vulnerabilities from glacial lake 		<ul style="list-style-type: none"> Data collected throughout evaluation 	<ul style="list-style-type: none"> Data analysis

Evaluated component	Sub-Question	Indicators	Sources	Data Collection Method
	<p>outburst floods in Bhutan and in the region?</p> <ul style="list-style-type: none"> Are national decision-making institutions (Parliament, Government etc.) in Bhutan ready to improve their measures to reduce climate change-induced risks and vulnerabilities from glacial lake outburst floods? 			

Annex 3: List of Documents Reviewed

ALM, September 2010, *Bhutan Case Study: Reducing Climate Change-Induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha-Wangdi and Chamkhar Valleys*

Center for Research Initiatives, *Report: Assessment to Awareness, Preparedness and Response Capacities Related to Climate Change Induced Risks and Vulnerabilities*

Department of Geological Sciences, University of Vienna, October 2003, *Glacier Lake Outburst Flood (GLOF) Mitigation Project, Lunana, Bhutan – Technical Mitigation Measures, Thorthormi Outlet*

Department of Local Governance, Ministry of Home and Cultural Affairs, *National Disaster Risk Management Framework – Reducing Disaster Risks for a Safe and Happy Bhutan*

DGM, *Demarcation of Hazard Zones and Identification of Safe Evacuation Area along Chamkhar Chhu in Bumthang*

DGM, 2010, *Report on Demarcation of Hazard Zones and Identification of Evacuation Areas from Samdingkha to Hesothangkha along Puna Tsnag Chu in Punakha-Wangdue Valley*

DGM, *PDF-B Project Document*

DHMS, *GLOF Early Warning System in the Punakha-Wandue Valley: Project Implementation Procedures Followed and Lessons Learned*

EC, UNDP, *GLOF Risk Reduction through Community-based Approaches*

GEF, *Accessing Resources under the Least Developed Countries Fund*

GEF, March 8, 2013, *Draft GEF Programming Strategy for Adaptation to Climate Change under the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF)*

GEF, October 19, 2010, *Revised Programming Strategy on Adaptation to Climate Change for the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF)*

GEF, *Request for PDF-B Approval Document*

GEF, *Strategy on Adaptation to Climate Change for the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF)*

GEF Evaluation Office, *OPS4 – Progress Toward Impact, The TOTI Handbook: Towards Enhancing the Impacts of Environmental Projects – Methodological Paper #2*

Graduate School of Environmental Studies, Nagoya University, June 2012, *Final Report of SATREPSE Project - Study of Glacial Lake Outburst Floods in the Bhutan Himalaya*

GLOF Project, July 2008, *GLOF Inception Report*

GLOF Project, 2008, *Report on Engineering and Safety Plan for Thorthormi Lake Mitigation Project*

GLOF Project, 2012, *Technical Review and Social Impact Assessment*

GLOF Project, June 17-18, 2008, *Minutes GLOF DGM-UNDP/GEF Project Inception Workshop*

GLOF Project, *Annual Work Plans (2008, 2009, 2010, 2011, 2012, 2013)*

GLOF Project, *MTR Management Response*

GLOF Project, *Project Board Meeting Minutes (1st to 13th meeting)*

GLOF Project, *Project Implementation Review Reports (2009, 2010, 2011, 2012, 2013)*

GLOF Project, *Quarterly Reports (from 2008 to 2013)*

GLOF Project, *Report on Thorthormi Lake Mitigation Work (2009, 2010, 2011, 2012)*

GLOF Project, *Terms of Reference for the National Consultant (QBS)*

GLOF Project, *TSAT Meeting Minutes (July 2008 and January 2011)*

GNHC, *Eleventh Five Year Plan – 2013-2018 – Self Reliance and Inclusive Green Socio-Economic Development*

GNHC, *Framework to Mainstream Environment, Climate Change and Poverty (ECP) Concerns into the Eleventh Five Year Plan (2013-2018)*

GNHC, *Framework to Mainstream Gender, Environment, Climate Change, Disaster Risk Reduction and Poverty (GECDP) in the 11 FYP of the Local Governments (2013)*

GNHC, October 28, 2011, *Letter to DPA (forwarding PHPA cheque)*

GNHC, *Tenth Five Year Plan 2008-2013*

ICIMOD, *Formation of Glacial Lakes in the Hindu Kush-Himalayas and GLOF Risk Assessment*

Jacques Leslie, A World Policy Book, *A Deluge of Consequences – A Riveting Adventure in the High Himalayas*

JAXA, February 25, 2011, *Description of Glacial Lake Inventory of Bhutan using ALOS (Daichi) Data*

JICA, September 2013, *The Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning – Inception Report (Draft)*

Karma, *DGM Bhutan, Reducing Lake Water Level in Thorthormi Glacial Lake in Bhutan: An Adaptation Project to the Adverse Impact of Climate Change*

NEC, *National Adaptation Programme of Action: Update of Projects and Profiles 2012*

NEC, *Second National Communication to the UNFCCC*

NEC, September 2000, *First Greenhouse Gas Inventory*

NEC, *The Middle Path – National Environmental Strategy for Bhutan*

NEC, UNDP, GEF, 2006, *Bhutan National Adaptation Programme of Action*

Planning Commission, *Bhutan 2020: A Vision for Peace, Prosperity and Happiness*

RGoB, 2013, *Disaster Management Act of Bhutan*

RGoB, *Economic Development Policy of the Kingdom of Bhutan, 2010*

RGoB, *National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011 and 2011-2013)*

RGoB, UN, *Common Country Programme Action Plan (cCPAP) 2008-2012*

RGoB, UNDP, *Bhutan National Human Development Report 2011 – Sustaining Progress: Rising to the Climate Challenge*

RGoB, UNDP, GEF, *Project Document: Addressing the Risks of Climate-induced Disasters through Enhanced National and Local Capacity for Effective Actions*

Ugen P. Norbu, September 15, 2010, *GLOF Project - Mid-Term Review*

UN, 2000, *Bhutan - Moving toward a common understanding of the key development challenges in the country, Common Country Assessment*

UN, December 5-7, 2012, *Glacial Lake Outburst Flood (GLOF) – Reducing Risks and Ensuring Preparedness; The Report on the International Conference*

UN, RGoB, *Agreement Between the Government of the Kingdom of Bhutan and the United Nations Development Programme*

UN, RGoB, May 2007, *United Nations Development Assistance Framework for the Kingdom of Bhutan 2008-2012*

UNDP, *Combined Delivery Report (CDR - finances) (2008, 2009, 2010, 2011, 2012)*

UNDP, *GLOF Project Document*

UNDP, *UNDP Country Programme Bhutan (2008-2012)*

UNDP Bhutan, *UNDP Annual Report 2011*

UNISDR, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*

WWF, *The Cost of Climate Change – The Story of Thorthormi Glacial Lake in Bhutan*
_____, March 27, 2008, *Local Project Appraisal Committee (LPAC) Meeting on GLOF Project*
_____, *Annexure A: The Framework of Cooperation (Climate Summit 2010)*
_____, *Climate Change Adaptation – LDCF/SCCF, Adaptation Monitoring and Assessment Tool*

Main Web Sites Consulted:

DDM: <http://www.ddm.gov.bt/index.php>

GEF: <http://www.thegef.org/gef/>

GNHC: <http://www.gnhc.gov.bt>

ICIMOD: <http://www.icimod.org>

JAXA: http://www.eorc.jaxa.jp/ALOS/en/bhutan_gli/bhutan_index_v1102.htm

National Portal of Bhutan: <http://www.bhutan.gov.bt>

NEC: <http://www.nec.gov.bt>

No GLOF in Winter, a Wrong Siren by Yeshey Penjor: <http://www.kuenselonline.com/no-glof-in-winter-a-wrong-siren/#.Utr4GXn0COF>

UNDP-BCPR: http://www.managingclimaterisk.org/regional_project_home.php

86 centimetres (video): <http://vimeo.com/37679476>

Annex 4: Interview Guide

Note: This was a guide for the interviewers; it is a simplified version of the evaluation matrix. Not all questions were asked to each interviewee; it was a reminder for the interviewers about the type of information required to complete the evaluation exercise and a guide to prepare the semi-structured interviews.

I. RELEVANCE - *How does the project relate to the main objectives of the GEF focal area, and to the environment and development priorities at the local, regional and national levels?*

- I.1. Is the project relevant to the GEF objectives?
- I.2. Is the project relevant to UNDP objectives?
- I.3. Is the project relevant to Bhutan's development objectives?
- I.4. Does the project address the needs of target beneficiaries?
- I.5. Is the project internally coherent in its design?
- I.6. How is the project relevant in light of other donors?

Future directions for similar projects

- I.7. What lessons have been learnt and what changes could have been made to the project in order to strengthen the alignment between the project and the Partners' priorities and areas of focus?
- I.8. How could the project better target and address priorities and development challenges of targeted beneficiaries?

II. EFFECTIVENESS – *To what extent have the expected outcomes and objectives of the project been achieved?*

- II.1. How is the Project effective in achieving its expected outcomes?
 - Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys;
 - Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system;
 - Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings
 - Enhanced learning, evaluation and adaptive management.

- II.2. How is risk and risk mitigation being managed?

Future directions for similar projects

- II.3. What lessons have been learnt for the project to achieve its outcomes?
- II.4. What changes could have been made (if any) to the design of the project in order to improve the achievement of project's expected results?
- II.5. How could the project be more effective in achieving its results?

III. EFFICIENCY - *Was the project implemented efficiently, in-line with international and national norms and standards?*

- III.1. Was adaptive management used or needed to ensure efficient resource use?
- III.2. Did the project logical framework and work plans and any changes made to them use as management tools during implementation?
- III.3. Were the accounting and financial systems in place adequate for project management and producing accurate and timely financial information?
- III.4. Were progress reports produced accurately, timely and respond to reporting requirements including adaptive management changes?
- III.5. Was project implementation as cost effective as originally proposed (planned vs. actual)?
- III.6. Was the leveraging of funds (co-financing) happening as planned?
- III.7. Were financial resources utilized efficiently? Could financial resources have been used more efficiently?

- III.8. How was RBM used during project implementation?
- III.9. Were there an institutionalized or informal feedback or dissemination mechanism to ensure that findings, lessons learned and recommendations pertaining to project design and implementation effectiveness were shared among project stakeholders, UNDP and GEF Staff and other relevant organizations for ongoing project adjustment and improvement?
- III.10. Did the project mainstream gender considerations into its implementation?
- III.11. To what extent were partnerships/ linkages between institutions/ organizations encouraged and supported?
- III.12. Which partnerships/linkages were facilitated? Which one can be considered sustainable?
- III.13. What was the level of efficiency of cooperation and collaboration arrangements? (between local actors, UNDP/GEF and relevant government entities)
- III.14. Was an appropriate balance struck between utilization of international expertise as well as local capacity?
- III.15. Did the project take into account local capacity in design and implementation of the project?

Future directions for the project

- III.16. What lessons can be learnt from the project on efficiency?
- III.17. How could the project have more efficiently addressed its key priorities (in terms of management structures and procedures, partnerships arrangements etc...)?

IV. IMPACTS - *Are there indications that the project has contributed to, or enabled progress toward, reduced environmental stress and/or improved ecological status?*

- IV.1. Will the project achieve its goal that is to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan?
- IV.2. Will the project achieve its objective that is to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdue and Chamkhar Valleys?
- IV.3. How is the Project impacting the local environment?

Future directions for the project

- IV.4. How could the project build on its apparent successes and learn from its weaknesses in order to enhance the potential for impact of ongoing and future initiatives?

V. SUSTAINABILITY - *To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results?*

- V.1. Were sustainability issues adequately integrated in project design?
- V.2. Did the project adequately address financial and economic sustainability issues?
- V.3. Is there evidence that project partners will continue their activities beyond project support?
- V.4. Were laws, policies and frameworks being addressed through the project, in order to address sustainability of key initiatives and reforms?
- V.5. Is the capacity in place at the national and local levels adequate to ensure sustainability of results achieved to date?
- V.6. Did the project contribute to key building blocks for social and political sustainability?
- V.7. Were project activities and results being replicated elsewhere and/or scaled up?
- V.8. What are the main challenges that may hinder sustainability of efforts?

Future directions for the project

- V.9. Which areas/arrangements under the project show the strongest potential for lasting long-term results?
- V.10. What are the key challenges and obstacles to the sustainability of results of the project initiatives that must be directly and quickly addressed?

Annex 5: Evaluation Mission Agenda and List of People Interviewed

Bilateral meetings held with stakeholder agencies/officials (4-14 Dec 2013)

Dates	Agency	Time	Meeting held with
Wednesday 4/12/2013	Arrive Paro/Thimphu	15:00	Arrive at Bhutan Suites, Thimphu at 15:00 hours
	Department of Hydro-Met Services (DHMS)	15:30-16:00	Mr. Karma Tshering, Director Mr. Karma Dupchu, Chief Hydro-Met Officer, Project Component Manager, Early Warning Systems (EWS), Mobile: +975 17629918, Email: kdupchu@gmail.com
Thursday 5/12/2013	National Environment Commission (NEC)	10:00-11:00	Ms. Sonam Lhadon Khandu, Senior Environment Officer, Climate Change Division/NAPA Focal Person, NEC Mobile: +975 17618827, Email: sonamk@nec.gov.bt
	World Wildlife Fund (WWF)	14:00-15:00	Mr. Vijay Moktan, Director, Projects & Programmes Mobile: +975 17681653, Email: vmoktan@wwfbhutan.org.bt Mr. Phurba Lhendup, Programme Officer/Climate Change Focal Person.
	Ministry of Agriculture and Forest (MoAF)	15:00-16:00	His Excellency <i>Lyonpo</i> Yeshe Dorji, Minister, MoAF Mobile: +975 17114114, Email: tshezam@moaf.gov.bt
Friday 6/12/2013	UNDP	09.00-09.30	Mr. Pema Dorji, Policy Specialist (Climate Change) Mobile: +975 17713339, Email: pema.dorji@undp.org
	Department of Geology and Mines (DGM)	10.00-11.00	Mr. Dowchu Drukpa, Project Component Manager, Artificial water level lowering of Thorthormi lake, Mobile: +975 17609487, Email: dowchu@druknet.bt
	Department of Disaster Management (DDM)	15:00-16:00	Mr. Sangay Dawa, Project Component Manager, Disaster Risk Reduction Initiative, Mobile: +975 17116065, Email: sdawa08@gmail.com Mr. Chencho, Previous Project Component Manager, Mobile: +975 17819841, Email: chencho@mohca.gov.bt
Monday 9/12/2013	Gross National Happiness Commission (GNHC)	10.30-11.30	Ms. Tenzin Wangmo, NAPA Focal Person, Mobile: +975 17113989, Email: twangmo@gnhc.gov.bt Mr. Throwa Tenzin, GLOF Project Focal Person
	Austrian Development Agency (ADA)	12.00-13.00	Mr. Ramesh Chhetri, Programme & Project Officer, Mobile: +975 17162845, Email: thimphu@ada.gv.at
	NEC	14:00-15:00	Mr. Thinley Namgyel, Chief of Climate Change Division, Mobile: +975 17604200, Email: tn@nec.gov.bt
	Ministry of Economic Affairs (MoEA)	15:00-16:00	His Excellency <i>Lyonpo</i> Norbu Wangchuk, Minister, MoEA Mobile: +975 77106331, Email: ugyendorjibtn@gmail.com , pema_choks@yahoo.com
Tuesday 10/12/13	Travel to Punakha, site visits/meeting in Punakha	07:00–09:30	Travel to Punakha with Mr. Sangay Dawa, DDM
		10:00–13:00	Visiting Siren Tower sites and Meeting with local communities, Samingkha, Chubu Geog, Punakha

Dates	Agency	Time	Meeting held with
		14:00-15:00	Meeting with Dasho Phub Tshering, Dzongda, Dzongkhag Administration, Punakha
		15:00-16:00	Visit to Emergency Operation Centre (EOC) at Khuruthang
		16:00	Travel to Wangduephodrang
Wednesday 11/12/13	Visits/meeting in Wangduephodrang	09:00-10:00	Visit to EWS Control Center at Gangrithangkha, Wangduephodrang
		10:00-11:00	Meeting with Dasho Lhendup R. Wangchuk, Dzongda, Dzongkhag Administration, Wangduephodrang
		11:00-13:00	Meeting with Mr. Phurba, Gup, Thedtsho Geog/Chairman of Dzongkhag Tshogdue (District Legislative) of Wangduephodrang Dzongkhag
		14:00-15:00	Meeting with Mr. Sangay Dorji, Chief Environment Officer of Punatsangchhu Hydropower Project Authority (PHPA)-II & Ms. Lobzang Choden, Junior Environment Officer of PHPA-I.
Thursday 12/12/13	Japanese International Cooperation Agency (JICA)	10:00-11:00	Mr. Yasuhiko Kato, Chief Advisor, JICA EWS-Mangdechu Project Team with DHMS Mobile: +975 17944309, Email: kato-yasuhiko@ess-jpn.co.jp
	MoEA	11:00-12:00	Dasho Sonam Tshering, Secretary, MoEA and Chairman of the GLOF Project Board, Email: sonamtshering39@gmail.com
	Consultant, GLOF Project Technical Review and Social Impact Assessment	16:00-17:00	Ms. Dil Maya Rai, National Consultant, Social Impact Assessment Mobile: +975 17113674, Email: dilbanos@yahoo.com
Friday 13/12/13	Terminal Review Mission debriefing	15:00-16:00	Project Component Managers, UNDP, NEC, GNHC

Annex 6: Project Expected Results and Planned Activities

Expected Results	Financial resources	Indicative Activities
Outcome 1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdue and Chamkhar Valleys.		
Output 1.1: Climate-resilient DRM legislation, policy frameworks, and sectoral plans	295,000	<ul style="list-style-type: none">• Inter-ministerial working group to incorporate climate change risk management considerations into existing and new legislation, policy frameworks, and sectoral plans• Develop and institutionalize comprehensive DRM guidelines, including climate risks, for use at the district and community levels• Revise the existing National Disaster Management Act, incorporating climate risk issues for GLOF, and submit it for endorsement• Identify, and take advantage of, opportunities to integrate long-term climate risk planning into the NDRMF and DRM guidelines
Output 1.2: Capacities for climate risk planning strengthened at the district (Dzongkhag) Administrative level		<ul style="list-style-type: none">• Develop and implement a capacity building roadmap for national, district, and local DRM focal points to integrate long-term climate risk planning into their daily activities. Based on DRM guidelines, develop training materials that include climate risk reduction strategies, early warning systems, preparedness, and response planning, for use at the Dzongkhag and Gewog levels• Train DDMCs on climate change resilient DRM in each target Dzongkhag• Formulate and institutionalize three Dzongkhag Disaster Management plans• Form Gewog Disaster Management Committees (GDMCs) to do what...• Train GDMC members on climate change resilient DRM (training conducted by DDMCs)
Output 1.3: Information on climate hazards and vulnerabilities (with a focus on GLOFs) in Bhutan systematically captured, updated, and synthesized		<ul style="list-style-type: none">• Update content on DGM’s database on climate hazards and vulnerabilities, which was established during the PPG phase, and ensure accessibility and usage by relevant government departments• Train relevant sectoral departments on information available and accessing the database• Continue updating DGM’s website with information on climate risks and GLOFs• Conduct annual briefing workshops for relevant government departments and other stakeholders on the status of GLOF and climate risks in Bhutan• Develop, print, and disseminate a catalogue of climate risk information available in the database
Output 1.4: Vulnerable communities are aware of, and prepared for, climate-related disasters		<ul style="list-style-type: none">• Identify focal points in each target community for GLOF awareness campaign and training activities• Develop awareness campaign and training materials• Implement awareness campaign and training in Punakha, Wangdue, and Chamkhar Valley communities
Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system.		
Output 2.1: Engineering and safety plans for climate change risk reduction measures on Thorthormi Lake are in place	2,238,012	<ul style="list-style-type: none">• Confirm the geostatic status of the moraine dam and update geotechnical assessments on the most appropriate location for the mitigation channel• Prepare a safety and evacuation plan in case of a collapse of the Lake• Assess the economic, environmental and social impact of risk reduction measures on the project site, surrounding areas, and downstream of the project site

Expected Results	Financial resources	Indicative Activities
		<ul style="list-style-type: none"> • Prepare an engineering plan, including the location of the channel along the moraine dam, procedures, required equipment, etc. • Convene a PB meeting to 1) review the safety and engineering plans, and 2) joint decide on the continuation of the risk reduction measures on the basis of geostatic updates
Output 2.2: Artificial lowering system of Thorthormi Lake waters implemented		<ul style="list-style-type: none"> • Conduct a meeting of relevant departments and organizations to present the engineering and safety plans • Identify available workforce • Assess wages and contract workers • Procure materials, rations, and other necessities • Transport materials to the worksite and prepare worksite for mitigation works • Implement excavation activities according to the engineering plan
Output 2.3: Water levels of Thorthormi Lake and status of artificial lowering system are regularly monitored and maintained		<ul style="list-style-type: none"> • Institutionalize a monitoring system, including systems and staff • Design and conduct training module on monitoring and maintaining the appropriate water flow • Conduct training for current monitoring staff and establish a process for training future monitoring staff • Establish guidelines for field reports on the status of the lake level and artificial lowering system • Undertake monitoring missions by DGM staff to Thorthormi Lake at least twice per year and disseminate reports to relevant stakeholders
Output 2.4: Technical knowledge and lessons in the artificial lowering of glacier lake levels captured and documented for use in future projects		<ul style="list-style-type: none"> • Document process used for planning and establishing the artificial glacial lake lowering system • Conduct an evaluation of the lowering system, focusing on the operational lessons learned and potential for replication within Bhutan • Draft a manual on lowering glacial lake water levels • Hold a national lessons learned workshop to share the project's results and experiences with relevant stakeholders • Develop an agreement with a plan to transfer the technology and replicate the glacial lake management system in at least one other GLOF-vulnerable region in Bhutan
Outcome 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdue Valley through GLOF early warnings.		
Output 3.1: Technical components for a GLOF early warning system in the Punakha-Wangdue valley installed and operational;	832,038	<ul style="list-style-type: none"> • Develop a plan for an early warning system that incorporates climate change risk management needs; • Tender and procure components (sensors, siren towers, and communications equipment) for the Punakha-Wangdue Valley GLOF early warning system • Survey appropriate sensor and siren tower locations in the Punakha-Wangdue Valley and draft plan for construction works • Install and test sensor and siren towers • Prepare contingency plan, including backup EWS
Output 3.2: Institutional arrangements in place to operate, test, and maintain the GLOF EWS		<ul style="list-style-type: none"> • Train DDMC members on the functioning, testing, and maintenance of the EWS • Train EWS focal points • Develop and operationalize the GLOF EWS maintenance schedule and mechanism
Output 3.3: Awareness of communities in the		<ul style="list-style-type: none"> • Design and implement community awareness workshops on EWS in each target community • Plan and conduct mock drills, involving all relevant DRM actors for a simulated GLOF in the Punakha-Wangdue

Expected Results	Financial resources	Indicative Activities
Punakha-Wangdue Valley on operation of the EWS		<div>Valley</div> <ul style="list-style-type: none">Set in place appropriate regulatory and economic incentives schemes to induce behavioral changes that are necessary for the EWS to be effective
Output 3.4: Safe GLOF evacuation areas identified and publicized in each vulnerable community in the Punakha-Wangdue Valley		<ul style="list-style-type: none">Identify evacuation sites in each target communityDevelop safe evacuation protocols that are coordinated between all relevant actorsDesign and implement an awareness campaign for safe evacuation procedures, ensuring awareness of evacuation sites
Output 3.5: Technical knowledge and lessons in the installation and operation of GLOF EWS captured and documented for use in future projects		<ul style="list-style-type: none">Conduct an evaluation of the GLOF EWS, with a focus on the operational lessons learned and potential for replicationDraft a manual on GLOF EWS and evacuationDisseminate project results through publications and an instructive videoDevelop replication plans for an EWS in the Chamkhar Valley
Outcome 4: Enhanced learning, evaluation and adaptive management.		
Output 4.1: Project lessons captured in, and disseminated through, the Adaptation Learning Mechanism	20,000	<ul style="list-style-type: none">Capture lessons learned from the project on a continual basisSynthesize results of activities under Outputs 2.4 and 3.5 and contribute to the ALM
Output 4.2: Project knowledge shared with other GLOF-prone countries		<ul style="list-style-type: none">Develop workshop concept paperConduct workshop with relevant partnersPublish proceedings

(*) Source: Prodoc

Annex 7: Co-financing Table

CO-FINANCING

Co financing (Type/Source)	UNDP Financing (mill US\$)		Government (mill US\$)		Partner Agencies (mill US\$)		Total (mill US\$)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Grant	0.526	0.535			0.830	1.159	1.356	1.694
Loans / Concessions								
* In-kind Support			2.680	2.756			2.680	2.756
* Other								
TOTAL	0.526	0.535	2.680	2.756	0.830	1.159	4.036	4.450

(*) Source: Prodoc and notes from the Project Team.

Annex 8: List of Recommendations from the MTR

Recommendations	Management Responses
<p>1. The Strategic Results Framework (SRF) in general was found to be well-formulated. The project effectively captures the GLOF-relevant components identified in the Bhutan NAPA document and integrates them in the SRF. However, since project conception, a few developments have taken place influencing project circumstances. Furthermore, there is better inference of indicators and targets now than during project formulation. In order to reflect new project circumstances and needs and to improve the quality of project monitoring and reporting, the MTR recommended a review of the project SRF.</p>	<ul style="list-style-type: none"> The changes recommended in section 2.4.1 of the MTR (page 26-28) will be reviewed and presented for endorsement at the 9th Project Board meeting scheduled for 11 January 2011.
<p>2. The MTR recommends strengthening of monitoring and reporting especially in relation to the SRF. It is recommended that the AWP and quarterly progress reports are linked to the expected outputs and targets and not just the broad outcomes. This will ensure that the AWP and progress reports are consistent with the SRF. Furthermore, progress reports will need to be more perceptive to capture progressive results, lessons and issues that emanate from project implementation.</p>	<ul style="list-style-type: none"> The AWP 2011 is linked to the outputs of the revised SRF. Furthermore, quarterly progress reports should be linked to the expected outputs and targets as per the revised SRF to ensure consistency, and should be more perceptive to capture progressive results, lessons and issues that emanate from project implementation. Documentation of activities should also be addressed during the quarterly coordination meetings.
<p>3. The MTR observed that some of the project results, especially those related to capacity development under outcome 3, require to be assessed through QBS. Since no baseline was established at the beginning of the project, a baseline QBS need to be carried out as well as an assessment towards the end of the project.</p>	<ul style="list-style-type: none"> Baseline QBS should be conducted in the 1st quarter of 2011 to establish the baseline for comparison with the QBS to be conducted by the end of the project.
<p>4. The MTR found that project implementation is affected by the considerable amount of time that goes into procedural work pertaining to reporting and fund releases. To increase the expeditiousness of procedural work and prevent delays in fund disbursements, the UNDP CO and the IPs need to coordinate and jointly examine the causes of delay, and implement corrective measures to address these causes.</p>	<ul style="list-style-type: none"> Based on discussions between UNDP and the project managers following the MTR, timely fund releases and reporting have already improved. A UNDP HACT training on reporting was conducted in October 2010 and attended by the project managers/accountants to improve reporting. The UNDP CO will ensure efficient use of staff twinning arrangement to ensure swift approval of fund releases. Quarterly coordination meetings (refer issue 7) will also help to improve financial reporting, financial planning and fund releases.
<p>5. The MTR found that the vast gaps that exist between annual planned budgets and actual disbursements need to be jointly examined by the UNDP CO and the IPs. It is therefore recommended that a joint review of the financial aspects of the project be carried out as soon as the financial reporting for the 2010 AWP is completed and projections of anticipated expenditures under various outcomes/outputs be made for the rest of the project period. This is expected to aid early detection of any adjustments required in the budget programming and enhance financial planning. While financial disbursements and expenditures are way below planned budgets, some activities such as the GLOF-EWS may require additional fund. A joint review and projection of future expenditures for the rest of the project period would help rationalize budget allocation.</p>	<ul style="list-style-type: none"> Joint review of the financial aspects of the project should be carried out following the completion of financial reporting for the 2010 AWP, and again following the completion of the EWS and the 4th phase of the mitigation works in the beginning of 2012.
<p>6. The MTR recommends to carry out activities to progressively build up and analyze</p>	<ul style="list-style-type: none"> Conduct workshop within the 1st and 2nd quarter of 2011.

Recommendations	Management Responses
<p>knowledge and lessons that can be fed into the Adaptive Learning Mechanism (ALM). It is recommended that a workshop be conducted within 2011 to take stock of and discuss the knowledge and experience accrued through the project. Particularly important will be to capture knowledge and lessons pertaining to capacity development for CBDRM as this component is less discernible than the artificial lowering of Thorthormi lake and GLOF-EWS components.</p>	<ul style="list-style-type: none"> • The ALM profile from 2008 should be updated capturing lessons learned, issues and best practice.
<p>7. The MTR recommends that linkages between the various project components/ outcomes need to be enhanced so that the project is implemented in a more integrated manner. Particularly important is the linkage between the capacity development component and the EWS component as the capability of the local authorities and communities to effectively respond to the EWS will be of utmost importance.</p>	<ul style="list-style-type: none"> • Project linkages and coordination should be improved through quarterly coordination meetings taking place at the beginning of each quarter, also addressing linkages, challenges and overlaps, planned field work, etc. • Project managers should share their quarterly progress reports with each other for mutual information.
<p>8. The MTR recommends establishment of a formal partnership with the JICA/JST supported project 'Study on GLOFs in Bhutan Himalayas' to develop inter-project synergy and address GLOF issues in Bhutan in a more integrated and comprehensive manner.</p>	<ul style="list-style-type: none"> • Management Response: • The MTR recommends establishment of a formal partnership with the JICA/JST supported project 'Study on GLOFs in Bhutan Himalayas' to develop inter-project synergy and address GLOF issues in Bhutan in a more integrated and comprehensive manner.
<p>9. In view of the deaths that occurred due to altitude sickness and other ailments in the 2010 working season, the MTR strongly recommended that a detailed strategy be developed and implemented to improve health and safety measures for the workers and field staff during the trek to Thorthormi lake and at the excavation site. This strategy must be developed soon after the return of the workers and field staff from the current phase of the excavation work.</p>	<ul style="list-style-type: none"> • Management Response: In view of the deaths that occurred due to altitude sickness and other ailments in the 2010 working season, the MTR strongly recommended that a detailed strategy be developed and implemented to improve health and safety measures for the workers and field staff during the trek to Thorthormi lake and at the excavation site. This strategy must be developed soon after the return of the workers and field staff from the current phase of the excavation work. • Review recommendations of the Health and Safety Assessment and endorse decisions. Actions and yearly budget to carry out the decisions will be incorporated in the Annual Work plan for 2011.
<p>10. Early consultations with potential donors are recommended by the MTR in order to prepare and plan for replication of the project interventions in other areas that face similar GLOF challenges and risks. A logical future proposal would be to build upon the GLOF-EWS established through the project to cover the Mo Chhu sub-basin by installing sensors in the headwaters and linking them to the siren network established by the project. Other potential areas for replication of the mitigation works are the Mangde Chhu and Chamkhar Chhu sub-basins.</p>	<ul style="list-style-type: none"> • The replication/follow-up to the project is also part of the targets set in the project logframe, and all project stakeholders are exploring possible avenues in dialogue with potential donors. Department of Energy submitted a proposal to JICA in July 2010 for set-up of a GLOF-EWS in the Mangchhu and Chamkarchuu. If approved the project will be implemented before the end of 2013. DDM is also discussing with ADRC regarding a GLOF EWS for Mochhu basin.
<p>11. An overhaul of the existing CBDRM training curriculum, especially taking into account the need to use more visual training methods to overcome literacy constraints of the local communities and focus on the practical aspects of CBDRM, is deemed necessary by the MTR to improve the trainings. The training curriculum will also need to be complemented with appropriate training tools and materials (e.g. flip chart, poster, illustrated handbook).</p>	<ul style="list-style-type: none"> • DDM has reviewed the CBRDM curriculum with technical assistance from a national consultant in 2010. The CMDRM ToTs and training are completed in the 3 target districts under the project, but will be continued in other districts as part of other projects/programmes. To ensure sustainability and national coverage of the CBDRM trainings, the reviewed curriculum and further improvement of training methods and materials should be used and pursued under other projects/programmes, in particular the WB and planned GFRDD-funded project. By the end of the project, documentation

Recommendations	Management Responses
	capturing the lessons learnt of the CBDRM training and planning processes should be prepared and disseminated.
<p>12. The MTR highlighted that one of the good practices associated with the project is the implementation of an EIA study to identify potential adverse environmental impacts and implement necessary mitigation measures. An 'ecological footprint' study towards the end of the project is recommended to assess the scale of environmental impacts created by the project, identify environmental management trade-offs, and draw lessons for future environmental management of similar projects. Environmental management trade-offs may be necessary as it may so happen that some of the ecological footprints may actually be too small to warrant logistically-difficult and cumbersome mitigation measures. On the other hand, it may also be the case that certain environment impacts are substantial enough to require special mitigation measures despite logistical difficulties and associated costs.</p>	<ul style="list-style-type: none"> • An EIA assessment should be conducted by the end of the project, if resources are available (based on financial review in January 2012).
<p>13. The MTR recommends monitoring of the glacial lakes as a key area in future GLOF work in Bhutan, given that potential GLOF risks will change, and probably increase, over time. Since physical monitoring of GLOFs is basically impossible due to the rugged mountain terrain, harsh weather and lack of physical communication infrastructure, virtual monitoring tools and techniques such as use of time-series satellite/ radar maps need to be considered for GLOF projects in the future.</p>	<ul style="list-style-type: none"> • This point is already being addressed by the JICA/JST project as well as other activities conducted by the Department of Geology and Mines.

Annex 9: Technical Review and Social Impact Assessment – Executive Summary

The purpose of the review was to examine and document technical and social lessons and impact of the project since the beginning of its implementation from 2008 till date, in order to extract best practices and formulate recommendations for an exit strategy which increases sustainability and enables scaling-up and replication of the project and its approach. The scope of the review focused on capturing knowledge built within the project, documenting best practices and extracting key learning from implementing a complex and challenging project in a difficult environmental setting.

Special emphasis of the technical review is on the methods applied for the artificial lowering of Thorthormi Lake (outcome 2) and the installation of a GLOF Early Warning System (outcome 3). Additional attention was given to the development and implementation of a community based disaster risk management planning (CB-DRM) approach (outcome 1) and the documentation and dissemination of lessons learned (outcome 4).

The review's focus was on learning and documentation and therefore relied heavily on the feedback, comments and experiences of all stakeholders involved, at national, district and local level. A concise desktop review phase with a literature review was followed by a stakeholder consultation round at national and district level. Further consultations were carried out at community level with municipality level (gewog) staff and community members. Additionally, school representatives were met and other stakeholders, such as those responsible for hydropower development. An extensive field visit to the remote Lunana area enabled the review team to consult the multi-disciplinary team members involved with the lake mitigation work at Thorthormi Lake site and the labour force and communities involved. To facilitate the consultative meetings at decentralized level, questionnaire formats were prepared with a series of questions related to experience with GLOF, expectations and impact of Project, hazard zonation and implications, the EWS and CB-DRM training and awareness, and finally key lessons and suggestions for recommendations aligned to sustainability and replication.

After return from the field, the observations and meetings were worked out as key information for the report. A debriefing presentation was held for the Project Board on October 4th, 2012. Comments, feedback and suggestions by the Project Board members incorporated in the report.

Artificial Lowering of Thorthormi Lake (Outcome 2)

Based on extensive scientific research of the glaciers and glacial lakes in the Lunana area and their inherent Glacial Lake Outburst Flood (GLOF) hazard a comprehensive site investigation was carried out to weigh mitigation options and to come to a detailed engineering plan for excavation work to lower Thorthormi Lake. A conscious decision was taken to lower the existent spillover channel with a labour-based approach, involving the multi-year recruitment of over 300 workers per year in a very remote location at 10 days walk from road head, in contrast to a more high-tech approach, which would require extensive use of helicopter services.

Clearing and breaking of large boulders required a lot of effort and slowed down the excavation process considerably. The use of drilling machines and silent explosives proved successful, but procurement issues and reliability limited their effectiveness. During the excavation work in the 2012 season, ice lenses were encountered in the immediate inlet zone of the channel. This hampered the excavation works, was difficult for the labourers (safety concerns) and ultimately caused concern for the stability of the immediate surroundings of such ice lenses. In a broader context, ice cores along the Rapstreng-Thorthormi moraine are of serious concern. At surface, active collapse structures can be observed and there is very active mass wasting on either side of the moraine ridge, resulting in the thinning of the moraine. The on-going monitoring of this fragile section of the terminal moraine is critical.

It appeared to be complicated to create dry working conditions along the outlet channel making only use of sand bags, tarpaulin sheets and boulders. This has resulted in the necessity for the labourers to stand in at least knee-high, and often hip-high streaming water of just a couple of degrees. These are sub-optimal working conditions and this has created very unfavourable working conditions. It has seriously affected the output of the labour force, and ultimately, affected overall progress.

Despite the very adverse site conditions and many logistical challenges the lowering target of 5m was achieved at the end of the 2012 season. The lowering was reached in gradual steps, spread over 4 years. The gradual lowering is essential to limit the inducement of any slope failure of the moraine slopes bordering the lake shore.

An Environmental Impact Assessment (EIA) was carried out to identify possible negative impacts of project interventions and a mitigation plan was compiled to reduce the negative impact, while weighing alternative options. It is noted that the EIA was compiled by the project team itself and not by an independent authority.

The project made use of a multi-disciplinary team with representatives, with well-defined tasks, of all key stakeholders. The management of a large work force, with over 300 persons in the first 2 years, proved to be a serious challenge. Apart from the logistical challenges of supplying such a large group in a very remote location, occupational safety and health issues and medical care at high altitude, the most difficult challenge were related to law and order and discipline. Recruitment became a problem in the last two years of the project as the daily wage, which initially was found to be attractive, was perceived to be just sufficient. During the last year of field work (2012) personnel of the Royal Bhutan Army (RBA) assisted the project in reaching its set target.

Apart from the technical challenges of a GLOF mitigation project at high altitude, the project had to face a set of serious logistical challenges to be able to get all the necessary resources and materials from road head to project site and back. Over 1500 horse loads a year were needed to transport 70 to 80 tonnes of equipment, supplies and food. A number of additional challenges complicated logistical matters even further, amongst which the tropical Cyclone Aila in May 2009, late snow in 2011 and a flash flood in June 2012 washing out parts of the Gasas access road.

In 2010 three work force members died due to Acute Mountain Sickness (AMS) and the project reviewed its medical management system through an independent study. The recommendations made by this assessment were incorporated and have become standing procedure:

- An extensive medical screening for all work force and team members;
- Medical transit camps en route to Lunana and back, with obligatory stop-overs to check for any signs of AMS symptoms, and
- A targeted training of the medical staff in High Altitude Medicine and Remote Emergency Care;
- The medical team provides important medical services to the local communities.

Direct benefits of the project are through daily wages, personal gear as rain jackets and sleeping bags and payment to horsemen for ferrying goods and supplies. Indirect benefits are related to an increased ease of mind with the achieved risk reduction, and additional services to the local communities.

The assessment of the artificial lowering is completed with an overview of a series of key findings, best practices and a number of recommendations, of which the most essential ones are presented at the end of this Executive Summary.

Review of the Early Warning System (EWS) (Outcome 3)

Design and specifications of the desired GLOF EWS had to be taken up by DHMS staff and turned out to be rather complicated. As one cannot purchase such a system off the shelf, the compilation of the bidding documents for the procurement of the hard- and software of the EWS were complicated tasks. Ultimately, it was decided to procure turn-key system with a 3-year warranty (subject to fund availability), which is important to avail technical support and guidance when the system was going through its “infancy”, with usual “teething problems”. This can be regarded as a “best practice” to replicate for future system development, if scaling-up or replication is considered to other river basins. Initially, the supplier provided training on testing and installation of the equipment, but in the upper region system elements were installed independently by DHMS staff, in collaboration with a local contractor.

In total there are 17 siren stations and six hydro-met monitoring stations, of which four check water levels

(AWLS) and two monitor both water levels and meteorological parameters (AWS). The system is divided into two geographical areas: the upper sites near the glacial lakes in Lunana, and the lower sites in the Punakha-Wangdue valley, where the majority of the population lives (Tagg, 2010). It was preferred to make use of satellite communication. This ensures a reliable communication platform, not perturbed by atmospheric problems and without the need for repeater stations for extended line of sight (ELOS) communication, taking into account the considerable distance between the upper region and the lower regions and the EWS control room in particular (over 100km). The existing flood warning system functions as a back-up system and was already equipped with satellite phones.

The EWS installation is supported extensively by Punatsanchu Hydropower Authority (PHPA), presently developing two large hydropower schemes downstream along Punatsangchu, employing 7 to 8,000 staff and very vulnerable to flood hazard as the dams are being constructed. The present partnership with the hydropower sector is seen as an important collaboration, which should be continued if the present EWS is expanded to other river basins where hydropower is being developed, such as Mangdechhu and Chamkarchu basins.

Installation of sensitive high-tech equipment at high altitude under extreme climatic conditions is seen as a complex challenge. The EWS installed is considered to be well-tailored to Bhutanese conditions, robust and versatile, as it also monitors meteorological parameters. The GLOF EWS is a first of its kind, in producing real-time information and offering the ability to be monitored over the internet. However, it has to prove its apparent robustness over time.

The EWS elements are comprehensively documented and detailed in the EWS Manual, as compiled by the supplier. The Manual describes not only the stream gauge station, the meteorological stations and siren stations, but also the control centre software and website configuration. Additionally, DHMS has compiled Standard Operating Procedures (SOP) for the standardized operation of the EWS. As the Punakha-Wangdue GLOF EWS is the first of its kind and there is little experience with real-time monitoring systems, the SOP is essential to prescribe standard procedures and to offer a crystal clear series of steps in case a GLOF alert or alarm levels are triggered. The SOP is a critical document to ensure that the operation of the EWS will conform to the prescribed expectations and that it offers a platform to improve the EWS parameters, by building on experience gained over time.

A series of detailed key findings, best practices and recommendations are presented, of which the most essential ones are presented at the end of this Executive Summary.

Community Based Disaster Risk Management Approach (Outcome 1 &3)

Awareness raising and capacity building on GLOF hazard of local government authorities and communities along Pho Chhu and Punatsangchu is the responsibility of the Department of Disaster Management, to complement the lake lowering mitigation work and the installation of the EWS. At policy level, DDM developed the crucial Disaster Management Bill, which is submitted to Parliament and will, when passed, provide a comprehensive legal and regulatory framework on disaster risk management for the country.

In the pilot Dzongkhags of Wangdue, Punakha and Bumthang, DDM developed and tested a comprehensive participatory community-based disaster risk management planning methodology (CB-DRM). The process started with the development of a tailor-made CB-DRM planning manual. With the help of this manual a ToT was organized at Dzongkhag level for Dzongkhag Officials forming the Dzongkhag Disaster Management Committee and Dzongkhag Disaster Management Planning teams. These members then trained gewog officials and local functionaries such as gup, mangmi, tshogpas and geydrung, who carried out the CB-DRM planning process at chiwog level with the local communities. Making use of participatory tools, hazard, vulnerability and capacity assessment in particular on GLOF is conducted and reflected in a chiwog DM planning template, compiled, prioritized and consolidated into a gewog DM plan. At Dzongkhag level the gewog plans are prioritized and consolidated into a Dzongkhag DM plan.

Key challenges of the CB-DRM approach are related to a certain lack of sustainability due to the fact that presently there is no permanently designated person or Department of Disaster Management's officials at Dzongkhag level to be responsible for the CB-DRM planning process. This results in complications as staff

transfers have a negative effect on the base of trained local officials. Suggestions are made to enhance sustainability of the CB-DRM approach at decentralized level.

In the pilot Dzongkhags critical facilities for disaster management like basic Emergency Operation Centres (EOCs) are established, equipped with communication tools like VHF sets, office equipment, basic Search & Rescue (SAR) equipment and emergency family kits, aimed at improved coordination and quick response in case of disasters and related emergency operations.

The review made use of focus group discussions with Dzongkhag, gewog and chiwog representatives to record their experiences with the CB-DRM approach and their knowledge and awareness on risk of GLOF, hazard zonation for land use planning, GLOF evacuation sites and related evacuation procedures. Although the review did not aim at quantification of awareness levels, it became evident that the majority of community members are well aware of the GLOF hazard present, the EWS and foreseen evacuation procedures.

Some recommendations are made to enhance the CB-DRM planning approach as developed and to improve the sustainability of the planning process. A series of detailed key findings, best practices and recommendations are presented, of which the most essential ones are presented at the end of this Executive Summary.

For each of the three outcome areas discussed above, a concise qualitative cost-benefit analysis (CBA) is presented. For all three outcome areas, the investments made are considered to be reasonable and cost efficient in comparison to the tangible direct and indirect benefits to the communities and socio-economic infrastructure downstream in the river basin.

Finally, in Chapter 6 outcome 4, documentation and dissemination of project outputs, is discussed. This is based on compilation and documentation of field experiences related to the mitigation works, the development and installation of the EWS and the CB-DRM awareness raising and capacity development. The project has received considerable attention internationally, as can be deduced from the fact that three separate documentaries are made of the project activities, with an emphasis on the lake lowering activities in Lunana. Other important means of dissemination are through a regional UNDP project on GLOF, providing a platform to exchange experiences on CB-DRM and the Adaptation Learning Mechanism (ALM) of UNDP, mapping good practices, providing information, sharing knowledge and building networks on climate change adaptation. In December 2012 the project will organize an international GLOF workshop offering an excellent platform to share the project experiences with a wider international audience and to discuss how to scale up activities and to link with upcoming GLOF related projects in the regions and in other mountainous areas exposed to GLOF hazard. Overall, the last year of the project will be essential to consolidate the large amount of information gathered during the field activities, documenting the learning and lessons and sharing the experiences of the project.

In Chapter 7 attention is given to the series of challenges the project was faced with and had to overcome during its implementation period. Many of these challenges were out of the direct control of the project management, or force majeure, and required the project management to adapt to the new conditions. Apart from climate related incidents, the Cyclone Aila in May 2009, late snow in 2011 and flash floods in June 2012, challenges were related to issues posed by procurement regulations and difficulties with labour recruitment.

Chapter 8 formulates an exit-strategy for the project as it enters its last year of implementation. The focus is on measures recommended to enhance the sustainability of impacts the project has been able to make for the main outcome areas. In Chapter 9 recommendations are made for replication and scaling-up of project interventions inside Bhutan and in the region. As GLOF hazard is a reality for other river basins within Bhutan a number of key lessons of the project are extracted and discussed in the light of replication and scaling-up. Key recommendations are:

- A move towards a more high-tech based approach, away from the present labour-based method,
- EWS as a catalyst for an upgraded flood warning and monitoring system,
- Expand the CB-DRM approach from the present pilot experience,

- The integrated management approach, bringing technical line departments together in a management set-up,
- The necessity of an adequate high altitude medicine management, and
- A focus on good OHS standards and proper technical equipment.

The review draws up a number of Key Findings and Recommendations in the final Chapter 10.

Key Findings

- The project set-up, with an integrated approach connecting upstream technical mitigation efforts with a basin-wide EWS and downstream awareness raising and capacity building efforts, is found to be commendable. The close collaboration of three technical line departments with specific mandates, but cooperating closely in planning, management and execution, has clearly created synergies.
- The labour-based approach, as chosen by the project, has tangible direct positive livelihood impacts for the workers and local communities involved, but the management of more than 300 workers at site has been complex, challenging and confronted the multidisciplinary team with many challenges beyond their normal technical and professional mandate.
- The project has achieved its set target of lowering Thorthormi lake level and thereby has reduced risk levels. Risk however remains to exist and the fragility and complexity of icecored moraines and the challenge of neighbouring glacial lakes in Lunana will require continued vigilance and on-site monitoring. It is thought to be not unlikely that the present trend continues, with a gradual transition from a glacier with multiple supra-glacial lakes to a glacier in retreat with an extending pro-glacial lake. An analogue development towards a pro-glacial lake as Rapstreng would counteract the present risk reduction achieved and would increase the risk of ice- and rock avalanches as potential trigger of a flood wave and related risk of overtopping and back-cutting erosion.
- The EWS installed is considered to be well tailored to Bhutanese conditions, robust and versatile, as it also produces meteorological information. The GLOF EWS is a first of its kind, in producing real-time information and offering the ability to be monitored over the internet. However, it has to prove its apparent robustness over time.
- The sirens of the EWS are located on locations close to communities and PHPA facilities. It is thought that the spatial spread of the system is such that all inhabitants at risk can hear the siren (audibility). Mock drills of the EWS however, have to confirm this and will be essential to train the population to evacuate to the designated evacuation areas.
- The present EWS set-up is seen to be a catalyst for an upgraded hydro-meteorological monitoring network for the whole nation. It sets standards and can be expanded by adding additional river basins to the existing system.
- The manual and SOP for the EWS are essential to enhance sustainability, maintain a clear information flow between all stakeholders and to improve system parameters as experience is gained over time.
- The CB-DRM planning approach constitutes a commendable methodology to build awareness at local levels related to disaster management, capturing in a participatory manner local knowledge and infusing this into local planning procedures.
- The piloting of the CB-DRM planning approach is seen as a stepping stone for national roll-out of the planning process to all Dzongkhags.

Recommendations

- Working in “wet conditions” has proven to be extremely challenging and it has certainly reduced the effectiveness of the work force. In future GLOF mitigation projects it is recommended to work as much as possible under dry conditions through more advanced engineering of the outlet channel/excavation site through use of water pumps, pipes, temporary dams etc., based on study of possible alternatives.
- Considering the challenges faced in managing a large work force, it is recommended for future GLOF mitigation projects to consider a more high-tech approach, with less dependence on

unskilled labour, if local site and access conditions allow.

- The multi-disciplinary team, with representatives of all key agencies involved, is a recommendable approach to be replicated. It is however advisable to try to maintain the same staff members over the years to enhance the learning and experience gained in the project work.
- Considering the critical importance to have information on the condition of the 4 Lunana pro-glacial lakes, and Thorthormi in particular, it is recommended to consider the possibility to add a visual check to the EWS. A simple CCTV or webcam could give a visual confirmation if anything has changed at lake level. The present B-mobile coverage in Lunana has simplified communication and a dedicated mobile connection could be an opportunity to have a regular visual update of the lakes.
- At present the AWLSs record an arbitrary water level. It is recommendable to measure the exact water level to allow the measurement of river discharge, assuming the wet perimeter at site is known. Discharge expressed in m³/sec would give additional information about the yearly band width of discharge and to monitor change over time from the various lakes. Continued monitoring of the discharge volume of the glacial lakes over time will be extremely helpful to better understand lake levels and glacial development.
- To enhance community engagement and ownership, and thereby ensure sustainability of the EWS, it is recommended to think of arrangements to involve the local communities in the maintenance of the EWS facilities. It is recommended that DHMS collaborates with the Dzongkhag authorities to explore modalities to enhance the involvement of geog authorities (drafting of by-laws etc.).
- It is recommended to consolidate the present chiwog, gewog and Dzongkhag DRM plans to document all the local knowledge and to review the CB-DRM planning process, based on feedback of the stakeholders involved.
- Mock drills of the EWS are needed at regular intervals to test the siren towers and to review the community awareness and ability to reach the designated evacuation areas in case a GLOF alarm is triggered.
- As the project moves into its final phase, attention has to shift to documentation of the field activities, lessons learned and approaches developed in a more analytical manner. A series of tools to disseminate information efficiently has been set up by the project (website, ALM, publications, international workshop) and will assist in sharing experiences.

Annex 10: Visual Documentation: TV Productions and Publications

(Adapted from the “Technical Review and Social Impact Assessment” study, page 54)

It is striking to note how much attention the project has been able to generate internationally, considering the considerable interest to cover the project in visual documentaries. A series of documentaries has been filmed of the project activities and shown on international TV channels such as Discovery Channel and during numerous film festivals. The following documentaries were filmed:

Himalayan Meltdown: Arrowhead Films, at the request of GEF and broadcast on Discovery Network. This program was screened at various international film festivals, and was included in Himalayan Meltdown, a feature-length documentary that is part of the Discovery Asia “Revealed” series. It won the prestigious Platinum Award in April 2012 in the broadcast documentary category at the 45th Annual Worldfest International Film Festival, the oldest independent film festival in the world.

<http://www.undp.org/content/undp/en/home/presscenter/pressreleases/2012/04/23/undps-himalayan-meltdown-wins-top-prize-at-international-film-festival/>

<http://asiancorrespondent.com/56978/himalayan-meltdown-new-climate-change-film-toscreen-at-asia-society/>

86centimetres: Peter Jan van der Burgh, Tshering Gyeltshen for Bhutan and Partners (2012). A documentary about Tashi and his fight against the threat of a glacial lake outburst flooding (GLOF) in Bhutan. www.86centimetres.org. This documentary was screened at various international film festivals such as the Washington DC Environmental Film festival in 2012:

<http://www.dcenvironmentalfilmfest.org/films/show/813>.

The Cost of Climate Change, the Story of Thorthormi Glacial Lake in Bhutan: a communication project by the WWF Living Himalayas Network Initiative conducted in October 2009. The project highlights the plight of the Himalayas in the wake of climate change with a publication and a documentary.

<http://worldwildlife.org/stories/wwf-sponsored-documentary-the-cost-of-climate-changewins-award-at-the-national-annual-journalism-award>.

Tsunami from the Sky: A short documentary compiled by United Nations TV in September 2009 and uploaded to youtube in March 2010:

<http://www.youtube.com/watch?v=HxOz2v6HKQo>. It was featured on CCN and BBC.

GLOF RISK Reduction through Community-based Approaches, Regional GLOF Risk Reduction Initiative in the Himalayas: Some of the initial experiences from the project have been shared with regional partners by UNDP (UNDP/BCPR 2010). In a regional context, UNDP is preparing projects on GLOF hazard mitigation in Nepal and Pakistan. Lessons and experiences from the project are considered to be very valuable to be shared with these upcoming projects.

ALM (Adaptation Learning Mechanism): Documentation generated through the project is being shared through the Adaptation Learning Mechanism (ALM) of UNDP. ALM is mapping good practices, providing information, sharing knowledge and building networks on climate change adaptation. www.adaptationlearning.net/bhutan-reducing-climate-change-induced-risks-andvulnerabilities-glacial-lake-outburst-floods-punakh.

International GLOF Conference: The project organized an international Conference on GLOF in Bhutan in December 2012. This was an excellent platform to share project experiences with a wider international audience and to discuss how to scale up activities and to link with upcoming GLOF related projects in the regions and in other mountainous areas exposed to GLOF hazard. See the conference website at: <http://conference.bhutanglofproject.gov.bt>.

A deluge of Consequences – A Riveting Adventure in the High Himalayas: This ebook by Jacques Leslie – A World Policy Book - was published in 2013 (available on iTunes and Amazon).

Annex 11: Summary of Potentially Dangerous Glaciers, Glacial Lakes and Lakes

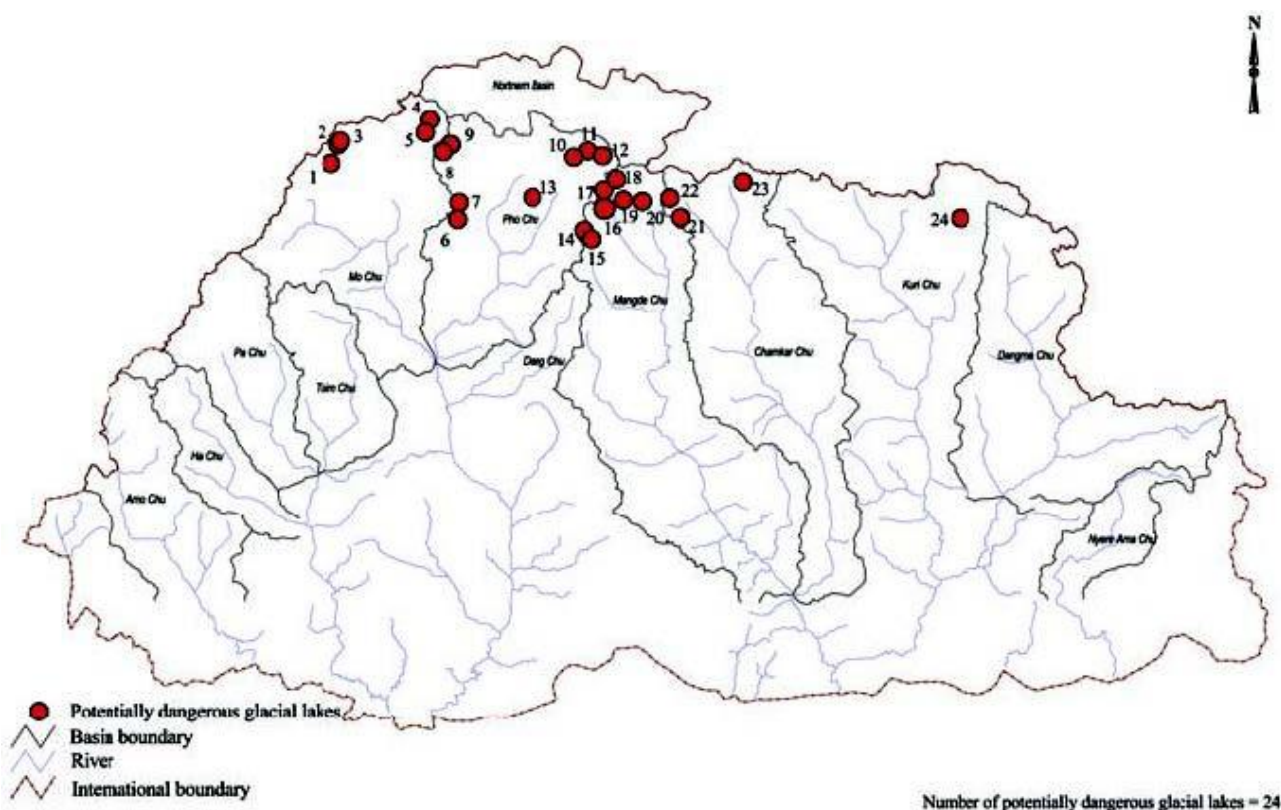
(Extract from the report “Formation of Glacial Lakes in the Hindu Kush-Himalayas and GLOF Risk Assessment, ICIMOD, May 2010”, page 7 for the table and page 9 for the map)

Summary of glaciers, glacial lakes, and lakes identified as potentially dangerous in selected parts of Bhutan

River basin	Glaciers			Glacial lakes		
	Number	Area (sq.km)	Ice reserves (cu.km)	Number	Area (sq.km)	Potentially dangerous
Amo Chu	0	0	0.00	71	1.83	0
Wang Chu	36	49	3.55	221	6.47	0
Puna Tsang Chu	272	503	43.27	980	35.08	13
Manas Chu	310	377	28.77	1383	55.51	11
Nyere Ama Chu	0	0	0.00	9	0.07	0
Northern basins	59	388	51.72	10	7.81	0
Total	677	1317	127.31	2674	106.77	24

Note: The Thorthormi lake in Bhutan has also been identified as potentially dangerous (Karma et al. 2008)

Location of glacial lakes that were considered to be potentially dangerous in Bhutan in the 2001 inventory



Note: the Thorthormi Lake was identified later and is not shown on the map above. It is located near the lake numbered 18 on the map.