Disaster Risk Management Strategy

Nias Livelihoods and Economic Development Program

Consulting Services for the World Bank
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REVISED REPORT

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Disaster Risk Management Strategy

Nias Livelihoods and Economic Development Program

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Cover picture: flooded pathway in Nias

For and on behalf of
Environmental Resources Management:

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Signature:

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Contents

1 INTRODUCTION

This is the report of the assignment *Indonesia Aceh - Nias Livelihoods and Economic Development Program (LEDP) - Disaster Risk Management Strategy Design* which the World Bank has contracted ERM China to undertake.

This report presents a framework for the Disaster Risk Management Strategy to be incorporated into the proposed Livelihoods and Economic Development Program (LEDP).

1.1 Background

The North Sumatra Provincial Government has, together with the BRR (Badan Rehabilitasi dan Rekonstruksi; the Government of Indonesia (GOI) agency responsible for post tsunami reconstruction) and the Nias local government, requested support from the Multi-Donor Fund (MDF) for the proposed Nias Livelihood and Economic Development Program. The World Bank is the Partner Agency.

The Multi Donor Fund (MDF) supports the GOI and the people of Aceh Province in undertaking post-tsunami reconstruction. Of particular note is the urgent need to support livelihoods in the island complex of Nias, which suffered in the 2004 Indian Ocean Tsunami and three months later from a major earthquake. Nias is the second poorest district in North Sumatra, and one of the poorest overall in Indonesia.

A key factor to be taken into account during project preparation of the Nias LEDP is the fact that Nias Island, similar to most places in Indonesia, is prone to natural hazards such as earthquakes, localized flooding, and landslides. These events can quickly become disasters due to poor land use planning, dilapidated infrastructure, and environmental degradation. Nias' high poverty levels are an indicator of the high vulnerability of the population to the impacts of natural hazards. Based on Nias' exposure to natural hazards, the task team and the government have determined that risk reduction and mitigation should be incorporated into the project to the extent possible.

LEDP will consist of the components indicated in *Box 1.1* overleaf (based on the Project Appraisal Document dated 11 March 2009).

Box 1.1 Components of LEDP

- ***Component 1: Community Empowerment*** to empower beneficiaries to acquire the management, financial and technical skills for livelihoods activities, including: 1) technical assistance to form, fund and strengthen about 150 farmer groups for agricultural development under Component 2; and 2) technical assistance and funding to 50 women's groups.

  Contents of the training would include: 1) community sanitation and hygiene promotion in communities and schools, and small scale water supply improvements (e.g., rainwater collection, shallow wells, spring box and pipe delivery systems); and 2) training of government staff to improve capacity for taking responsibilities for activities beyond project life.

- ***Component 2: Agricultural Livelihoods Improvement*** to increase productivity, post-harvesting processing and market prices in rubber, cacao, rice and livestock, including the following:

  - Cacao, rubber and livestock: Grants of about $1,500 - $2,000 will be provided to farmer groups, who would choose a menu of activities in cacao, rubber and livestock improvement.

  - Rice: Provision of high yield varieties to rice-growing villages and fertilizer inputs, involving roughly 15,000 farmers. Allowances will be made for purchase of post-harvesting processing units (e.g., thresher, winnower, tractor and trailer), which could be developed as a mobile post-harvest handling business among villages or within several larger villages.

- ***Component 3: Management, Monitoring and Evaluation*** to develop management and technical capacity for implementation of livelihoods investment within the local administrations, including:

  1. Program management support, which would provide consultants (mostly field-based) with expertise to support i) monitoring and evaluation, ii) financial management, iii) safeguards, iv) quality assurance, v) procurement, vi) anti-corruption action plan, vii) technical advisory services, and viii) project reporting.

  2. Provision of technical consultants at Provincial, Kabupaten and village levels for group strengthening and technical assistance under Components 1 and 2 and for monitoring and evaluation of the project.

- ***Off-budget Component: Rural Access and Capacity Building Program,*** including:

  1. Strategic Rural Access Improvements, including:
     - spot improvement and reconstruction of existing dirt roads (3 m wide)
     - upgrading of existing paths to all-weather light traffic paths (1.5 m wide) with limited access to two- and three-wheeled vehicles
     - stream crossings and small bridges

  2. Program Management and Skills Development to improve:
     - capacity of communities and local government to build and maintain assets
     - technical support for quality assurance of physical works, detailed engineering and design, construction supervision, and safeguards oversight
     - labour intensive construction management and supervision

1.2 Objectives of this Assignment

The objective of this assignment is *to support the development of a disaster risk management (DRM) strategy for the Nias LEDP project to ensure that risk reduction is mainstreamed into project design, especially the livelihoods and civil works/access components.*

To achieve the above objective, this report identifies the key principles of DRM relevant to the LEDP, presents the results of a high-level assessment of the hazards potentially relevant to Nias and the LEDP, and outlines the risk reduction approaches that can be incorporated into the overall program and its components.

Although the DRM strategy will address the mainstreaming of disaster risk reduction throughout all components of the LEDP, a number of areas are of greatest importance. First, technical aspects of physical access improvements to be included under Component II (*ie* design, materials, siting and construction methods of roads and footpaths) in order that physical access improvements are resilient to earthquake, flooding and landslide hazards. Other consultants have been mobilized to focus on these technical issues, although they are summarised here.

1.3 Methodology

The assignment has been carried out through a combination of site visits, review of documentation and secondary literature, and interviews with various stakeholders in Nias. The consultant team visited the island of Nias in June 2008.

Based on concepts of mainstreaming disaster risk reduction into development projects, the consultant team prepared a framework for analysis. The framework was used to assess the implications of each LEDP component and groups of activities for people's vulnerability to disasters and their capacity to cope or recover from disasters. On this basis, the team developed practical measures for integration into LEDP activities.

The preparation of the DRM strategy was carried out in coordination with the preparation of an environmental analysis and management framework for the LEDP, and reference is made to the relevant parts of the environmental report where necessary.

1.4 Layout of this Report

This report consists of the following sections:

Section 2 – Mainstreaming Disaster Risk Reduction;
Section 3 – Framework for LEDP Disaster Risk Management;
Section 4 – Component-level Assessment and Risk Reduction Approaches;
Section 5 – Existing Setting of DRM in Nias;
Section 6 – Next Steps; and
Section 7 – References.

2 MAINSTREAMING DISASTER RISK MANAGEMENT

This section sets out a framework of analysis, through which disaster management will be mainstreamed into the LEDP, and culminates in the initial identification of the disaster risks that people in Nias are exposed to.

2.1 Why Mainstream Disaster Risk Management?

The World Bank recognises that "poorly planned development can turn a recurring natural phenomenon into a human and economic disaster[(1)]" and seeks to integrate disaster prevention and mitigation efforts into the range of development activities. For example, allowing dense populations on a floodplain or permitting poor or unenforced building codes in earthquake zones is as likely as a natural event to cause casualties and losses. Similarly, allowing the degradation of natural resources increases the risk of a disaster.

This approach is supported by a wide range of agencies involved in disaster response, for example the agencies linked through the 'Provention Consortium.' The website of the Provention Consortium states that "Flawed development often lies at the heart of disaster risk and therefore risk reduction strategies and measures are most effective when integrated into the framework of overall development." There has been a shift in perspective from previous views of disasters as unpredictable, unavoidable events to be dealt with by emergency specialists. Development initiatives do not necessarily reduce vulnerability to natural hazards. Instead they can unwittingly create new forms of vulnerability or exacerbate existing ones, sometimes with tragic consequences. Exposure to risk and income shocks has been widely acknowledged as one of the fundamental dimensions of poverty. This acknowledgement has triggered considerable focus on the analysis of forms and underlying causes of vulnerability and related initiatives to increase resilience.

Mainstreaming risk reduction has three goals:

- To reduce existing risks where possible to mitigate the impacts of future disasters;
- To ensure that development does not drive risk, (*ie* that projects do not inadvertently increase risk to the beneficiary population); and
- To ensure the sustainability of the individual projects, thus protecting the project's investment.[(2)]

The framework for the integration of disaster risks in Nias into the LEDP that is presented here is based largely on the guidelines provided by the

(1) http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTDISMGMT/0,,menuPK:341021~pagePK:149018~piPK:149093~theSitePK:341015,00.html

(2) Kryspin-Watson, J., Arkedis, J., and Zakout, W. April 2006. *Mainstreaming Hazard Risk Management into Rural Projects.* The World Bank Hazard Risk Management Team Working Paper Series No. 13.

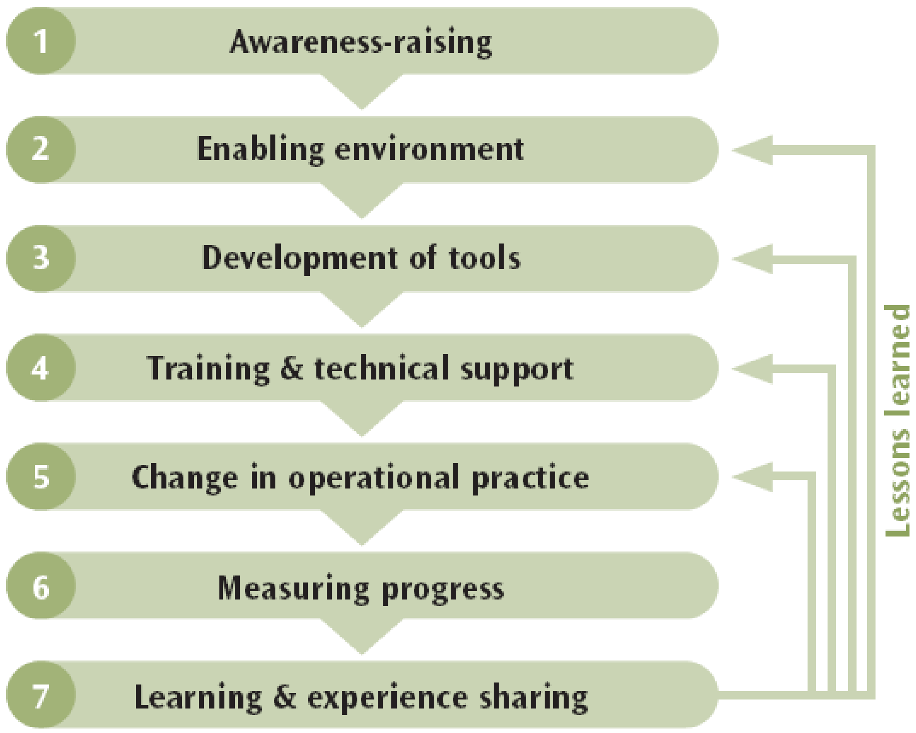
Provention Consortium's *Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations* as well as the World Banks' *Mainstreaming Hazard Risk Management into Rural Projects.* Note that Provention's guidelines are also available in Bahasa Indonesian on the Provention Consortium website.

http://www.proventionconsortium.org
http://www.proventionconsortium.org/themes/default/pdfs/tools_for_mainstreaming_DRR_Bahasa.pdf
http://gfdrr.org/index.cfm?Page=home&ItemID=200

2.2 How to Mainstream Disaster Risk Management?

The above guidelines present a series of approaches for the integration of DRM into development programmes and projects. The guidelines emphasise the importance of integrating disaster risk management into the process of development planning (see *Figure 2.1*), as well as highlighting specific programme-level and project-level opportunities for mainstreaming disaster risk management.

Figure 2.1 Measures to Take for the Integration of Disaster Risk Management



Source: Provention Consortium.

Guidelines concerning the following are of particular relevance:

- Project cycle management and logical and results-based frameworks;
- Environmental assessment;
- Vulnerability and Capacity Analysis, and Sustainable Livelihoods Approaches;
- Construction Design, Building Standards and Site Selection; and
- Evaluating Disaster Risk Reduction Initiatives(1).

2.2.1 Project Cycle Management and Results-based Frameworks

The design processes of programmes and smaller projects offer important opportunities for addressing DRM, not least the opportunity to identify the risks that people are exposed to. This report is part of the process that World Bank is taking to integrate DRM into the overall LEDP design.

However, there are also opportunities to integrate DRM into the project identification, appraisal and implementation cycle for smaller projects.

Implications for LEDP:
- Identify the hazards that people are exposed to during project design;
- Include measures to identify the possibility of increasing exposure to risks, in the sub-project cycle.

2.2.2 Environmental Assessment

The environmental assessment process offers important opportunities to integrate DRM. In this case, the environmental risk analysis for LEDP has been carried out by the same consulting team as has prepared this report. There is a considerable degree of cross-referencing between this report, and the report of the environmental risk analysis.

Implications for LEDP:
- Include measures to avoid increasing exposure to risks in the sub-project cycle, through the environmental assessment procedures in the sub-project cycle.

2.2.3 Vulnerability and Capacity Analysis, and Sustainable Livelihoods Approaches

Vulnerability and Capacity Analysis (VCA) is a key component of disaster risk analysis. Its purpose is to:

- identify vulnerable groups;

(1) In addition, at a programme level, the guidelines include: collecting and using information on natural hazards; poverty reduction strategies; country programming; and budget support. Although they may offer useful guidance for Nias district-level planners, these particular guidelines are not of direct relevant to the integration of disaster risk reduction into the LEDP, and therefore are not discussed here.

- identify the factors that make them vulnerable and how they are affected;
- assess their needs and capacities (and empower them to assess these); and
- ensure that projects, programmes and policies address these needs, through targeted interventions or prevention and mitigation of potentially adverse impacts.

Crucially, VCA seek to assess people's existing capacity to cope with their exposure to a risk (*ie* their vulnerability), and to assess the likely effects of an intervention on their capacity to cope, as well as on their exposure. VCA typically involves the assessment of vulnerabilities and capacities alongside a range of physical, social, economic, environmental and institutional factors.

'Sustainable Livelihoods Approaches' take a similar approach, by promoting the assessment of a 'vulnerability context' which is distinct from the capabilities and capacities that people have to cope. Two main aspects of vulnerability are considered within the SL approach:

- The extent to which different groups are exposed to particular trends, shocks and seasonality (the 'external dimension' of vulnerability; and
- How their livelihoods are affected by these influences (the 'internal dimension').

Further to this, the vulnerability context would include: trends (long-term, large-scale trends such as trends in population, economic, climate, etc); shocks (sudden onset or slow onset shocks, such as a disease epidemic, natural hazard, or drought); and seasonality (seasonal shifts in employment opportunities, prices, climate, etc).

Implications for LEDP:

- Use a framework for mainstreaming DRM that takes account of established concepts of vulnerability and capacity;
- Integrate Vulnerability and Capacity Analysis effectively into the LEDP.

2.2.4 Construction Design, Building Standards and Site Selection

The design and construction of infrastructure to reduce its vulnerability to natural hazards is often ignored in development initiatives, due to perceived higher costs and lack of appropriate expertise. Furthermore the selection of the location of infrastructure is often based on land cost and availability, rather than on the avoidance of potential hazards. Typically development organisations rely on 'best local practices' in hiring contractors to undertake construction work, yet the adoption of best local practice, and opportunity-based land-use can lead to a promotion of existing weaknesses in buildings and infrastructure.

Contrary to common perception, the implementation of hazard-proof measures in building, can, according to the Provention Consortium, be relatively inexpensive in terms of construction costs, and provide long-term benefits. Investment in disaster mitigation can result in a manifold saving in disaster relief and development setbacks.

What can be expensive is the provision of an effective framework for the uptake of these measures, for example the provision of skills training, appropriate hazard studies, and research into low-cost strengthening solutions. The problem in many cases is the lack of legal mandating of building codes and a consequent lack of enforcement. *Box 2.1* cites the Provention Consortium's suggestions for activities 'beyond building' to improve construction standards.

Finally, schools and hospitals can be particularly vulnerable to disasters, but are equally important in disaster risk reduction. The World Disaster Reduction Campaign 2006-2007, launched by the UN/ISDR secretariat and UNESCO, took the theme, "Disaster Risk Reduction Begins at School."(1)

Box 2.1 Beyond Building

Proposing safe building or repair and strengthening practices is not sufficient to ensure take-up by communities. Integrated community-based approaches for safer building should be promoted by:

- Raising hazard awareness through education;
- Community-participation in developing the project, decision-making and design selection;
- Developing effective ways of communicating technical messages to target groups;
- Skills development training for local builders and craftspeople;
- Improvement in general living conditions;
- Training architects and engineers, building officials and building by-law enforcement officers;
- Community-based disaster-preparedness planning.

Implications for LEDP:

- Develop clear guidelines on road and bridge construction to ensure they are resilient to disasters;
- Incorporate training and skills development and advice on the costs (and cost-effectiveness) of road/bridge construction design standards;
- Consider schools and hospitals in particular in their relation to LEDP activities.

2.2.5 Evaluating Disaster Risk Reduction Initiatives

Monitoring and evaluation of efforts in mainstreaming are an important aspect of disaster risk reduction, including through the use of indicators and periodic reviews or evaluations.

(1) A UNESCO publication offers useful lessons learnt: http://www.unisdr.org/eng/public_aware/world_camp/2006-2007/good-practices-en.htm

Implications for LEDP:

- Identify indicators of vulnerability and capacity, as part of LEDP impact assessment;
- Identify key performance indicators of LEDP's mainstreaming of disaster risk reduction;
- Include disaster risk reduction in the annual World Bank review / monitoring of the LEDP.

3 FRAMEWORK FOR LEDP DISASTER RISK MANAGEMENT

3.1 Introduction

Based on the above principles, a framework has been developed for mainstreaming DRM into the LEDP. The DRM framework is divided into assessment and risk reduction measures as described below. A program-level hazard assessment and identification of risk reduction approaches are presented in *Sections 3.2* through *3.8* by type of hazard. The existing setting for DRM in Nias is presented in *Section 4*. Analysis by LEDP project components is presented *Section 5*.

Throughout the project cycle (including planning, implementation and evaluation), the following should be considered:

- **Designation of persons with DRM responsibilities:** Persons responsible for implementation of DRM should be assigned for each project component.
- **Consultants and contractors requirements:** DRM should be incorporated into the scope of work / contract documents for consultants and contractors involved in the planning and implementation process.
- **Allocation of budget:** Budget should be estimated and allocated for DRM.
- **Training:** Relevant personnel should be provided with training on DRM.
- **Monitoring and evaluation:** Provisions should be made for monitoring and evaluating the implementation status and effectiveness of DRM, as well as making adjustments.

3.1.1 Assessment Approach

The assessment phase involves the appraisal of hazards, vulnerability and the community's capacity to cope / recover so that appropriately tailored risk reduction measures can be identified and implemented.

Natural hazards may include hydro-meteorological hazards (floods, rainfall-induced landslides, tropical cyclones, drought, temperature extremes, etc.), geological hazards (earthquakes, tsunamis, volcanic activity, earthquake-induced landslides, etc.) or biological hazards (diseases, plant/animal infestations, etc.).

Based on the project location and characteristics, the following types of hazards are considered to be primarily relevant to the LEDP:

- Earthquakes
- Tsunamis
- Flooding
- Landslides (earthquake- or rainfall-induced)

In addition, fires, pests / plant diseases and tropical cyclones are briefly discussed, as they are also potentially relevant.

The key factors to be considered for the assessment include the following:

- **Types of hazards** – The hazards listed above are considered relevant for Nias Island as a whole. The suite of hazards relevant to each project component should be determined individually and would differ by project location and type. Consideration of hazard types should cover:

a) hazards that may directly impact project activities and facilities;

b) secondary hazards, such as earthquake- or rainfall-induced landslides;

c) risks that may be inadvertently induced or exacerbated by project facilities/activities (such as landslides induced by aggregate mining for construction projects); and

d) hazards/risk factors outside of the project area that may impact the project (e.g., impacts on key utilities / material supplies for the project, soil disturbing activities nearby that undermine slope stability at the project site).

- **Location / extent** – Which geographic areas are likely to be affected by the hazard;
- **Frequency / probability** – How often and with what likelihood the hazard is expected to occur;
- **Intensity / severity** – The severity of impacts resulting from the hazards. While catastrophic events are important to consider, less severe impacts (such as falling objects from a relatively minor earthquake) must also be considered;
- **Duration** / **timing** – How long the hazard is expected to last and whether there is any seasonality or other timing factors to its occurrence;
- **Predictability** – Whether and how well an occurrence of a hazard can be predicted;
- **Impact receptors** – Who / what are likely to be impacted by the hazard, including people, habitable structures, and livelihood support systems such as farmland, transportation infrastructure (e.g., roads, bridges, harbours, airports) and utilities (e.g., power, water supply and communication); and
- **Vulnerability and Resilience** – Vulnerability is the susceptibility of a community to the impact of hazards, as determined by physical, environmental, social and economic factors. Resilience, a closely related concept, is the capacity of a community to adapt and maintain an acceptable level of functioning in the face of hazards. Factors that contribute to vulnerability and resilience should be identified during the hazard assessment process (see *Table 3.1* for types of factors to consider and Nias-specific conditions).

Table 3.1 Hazard-related Vulnerability and Resilience Factors

Type	Vulnerability Factors	Resilience Factors	Factors specific to Nias
Social	• Occupation of unsafe areas • High-density occupation of sites and buildings • Lack of mobility • Low perceptions of risk • Vulnerable occupations • Vulnerable groups and individuals • Corruption • Lack of education • Poverty • vulnerability and capacity unknown due to lack of analysis • Poor management and leadership • Lack of disaster planning and preparedness	• Social capital • Coping mechanisms • Adaptive strategies • Memory of past disasters • Good governance • Ethical standards • Local leadership • Local non-governmental organisations • Accountability • Well-developed disaster plans and preparedness	• Are the two poorest districts in Northern Sumatra province • Low education level and lack of local technical experts • Low local government capacity for governance, enforcement of existing regulations and codes, and land use planning / management • Low availability and low dependence on infrastructure such as communications, power and piped water
Physical	• Buildings at risk • Unsafe infrastructure • Unsafe critical facilities • Rapid urbanisation	• Physical capital • Resilient buildings and infrastructure that cope with and resist extreme hazard forces	• Many existing structures not likely built to seismic code or other engineering standards • Bridges have been undermined due to aggregate extraction in riverbeds
Econ-omic	• Mono-crop agriculture • Non-diversified economy • Subsistence economies • Indebtedness • Relief/welfare dependency	• Economic capital • Secure livelihoods • Financial reserves • Diversified agriculture and economy	• Largely subsistence economies • Increasing dependence on external relief since the 2004/2005 tsunami and earthquake
Environ-mental	• Deforestation • Pollution of ground, water and air • Destruction of natural storm barriers (e.g., mangroves) • Global climate	• Natural environmental capital • Creation of natural barriers to hazards • Natural environmental recovery processes • Biodiversity	• Vegetation cover is high • High year-round rainfall • Coastal areas impacted due to sand/gravel /rock extraction

Type	Vulnerability Factors	Resilience Factors	Factors specific to Nias
	change	• Responsible natural resource management	• Global climate change effects (rising sea levels, intensity / changes in pathways of tropical cyclones and changes in rainfall intensity/ occurrence)

Source: Provention Consortium, 2007.

For each project activity and facility, information regarding the above factors should be gathered from available sources.

The following issues should be considered during the data collection and use process:

- **Data availability and quality:** Existing scientific and reliable data required for hazard assessment are often limited, as is the case in Nias. The Asian Development Bank (ADB) financed *Spatial Planning and Environmental Management Study*, prepared by Black and Veatch (2007) contains information regarding Nias topography, soils and vegetation cover, as well as maps showing general areas prone to flooding and landslide hazards. However, ground-truthing conducted as part of this mapping effort was limited. Detailed hazard maps have not been developed for Nias. Qualitative information collected from local communities should be utilized, but with data quality limitations in mind;
- **Information sharing**: A platform should be established for sharing hazard information amongst the program components as well as other development assistance projects in the region. Existing platforms such as SiGaNa (see *Section 4.1*) could be utilized for this effort.

3.1.2 Risk Reduction Approaches

Based on the hazard assessment outcomes, corresponding risk reduction measures should be identified and incorporated into project design and implemented. It should be noted that all types of hazards and conditions should be considered in an integrated manner, as mitigation specific to one type of hazard may exacerbate risks associated with another type of hazard.

Types of risk reduction measures include:

- **Facility site selection, design and construction** – Damages to structures and associated loss of lives and property are the main effects of natural hazards; thus avoiding and reducing risk of structural damage to project facilities is a main focus for DRM. The key principles include:

- **Site selection:** Avoid hazard-prone areas if impact areas are localized (e.g., flooding, landslide); if they cannot be avoided, incorporate appropriate mitigation measures into facility design.
- **Materials:** Use materials appropriate for protection from year-round weather conditions and other hazards.
- **Structure:** Use hazard-resistant structures (e.g., earthquake resistance, elevated structures in flood prone areas, etc.).
- **Associated facilities:** Ensure that utilities such as power and water supply systems for the project facilities are also protected from hazards.

- **Early warning systems:** Early warning systems combine tools to collect and evaluate weather or other data and communication networks to disperse warnings about imminent hazards, such as rainfall-induced flooding or tsunamis. It should be noted that means of disseminating hazard warnings are limited as communication systems are underdeveloped in Nias; radios are likely the most feasible and widespread communication method. While mobile phones are held by some residents, local stakeholders noted that the system may become overloaded and unusable after major hazard events due to high call/text volumes. Development of a more robust island-wide information collection, analysis and dissemination system could be considered in conjunction with the LEDP.
- **Contingency and continuity planning:** Contingency and continuity planning is the process of preparing an institution or other operations for disasters in order to minimize interruption and mitigate a disaster's physical and economic impact. Depending on the scope of the project, the planning process could include:
  - Understanding which hazards (considering both daily hazards and major disasters) could interrupt operations and how;
  - Planning for the physical security and evacuation of people;
  - Identification and designation of safe areas / meeting places for families. Schools (if sited and constructed in a safe manner), are considered good candidates, as their locations are well-distributed and well-known by local communities and parents will tend to go to schools to look for their children in the event of a disaster;
  - Establishment of logistics centres for the distribution of emergency aid in case of destruction of critical facilities (ports or other major transport facilities) due to earthquake or tsunami;
  - Considering alternative transportation methods and routes for bringing goods to market, accessing clients, etc.;
  - Ensuring that documents and other records (both electronic and hard copies) are backed up either physically or electronically in an off-site location;

- Implementing back-up communication systems for receiving disaster warnings and updates and for communicating with staff or other involved people and their families;
- Stock-piling food, basic medicines and other supplies necessary to maintain operations during an interruption; and
- Conducting training and emergency drills.

3.2 Earthquakes

The entire island of Nias is susceptible to frequent earthquakes, owing to its proximity to seismic fault lines. Minor earthquakes are felt in Nias on a weekly basis, and occasionally the island suffers from more significant quakes.

Earthquakes in the Sumatra region are generated either along the Sunda Trench in the Indian Ocean southwest of Nias or from the Sumatran fault, which runs the length of Sumatra northeast of Nias. A list of historic earthquakes in Indonesia is presented in *Table 3.2* (those that occurred in the Nias or Sumatra region are shown in bold font).

Table 3.2 Historic Earthquakes in Indonesia

Date (YYYY MM DD)	Location	Magnitude	Fatalities
1917 01 20	Bali	--	1,500
1938 02 01	Banda Sea	8.5	
1965 01 24	Sanana (Ceram Sea)	7.6	71
1976 06 25	Papua	7.1	5,000
1992 12 12	Flores Region	7.8	2,500
2000 06 04	**Southern Sumatra**	**7.9**	**103**
2002 10 10	Irian Jaya	7.6	8
2002 11 02	**Northern Sumatra**	**7.4**	**3**
2003 05 26	Halmahera	7.0	1
2004 01 28	Seram	6.7	
2004 02 05	Irian Jaya	7.0	37
2004 02 07	Irian Jaya	7.3	
2004 07 25	**Southern Sumatra**	**7.3**	
2004 11 11	Kepulauan Alor	7.5	34
2004 11 26	Papua	7.1	32
2004 12 26	**Sumatra-Andaman Islands**	**9.1**	**227,898**
2005 01 01	**Off the West Coast of Northern Sumatra**	**6.7**	
2005 02 19	Sulawesi	6.5	
2005 02 26	Simeulue	6.8	
2005 03 02	Banda Sea	7.1	
2005 03 28	**Northern Sumatra**	**8.6**	**1,313**
2005 04 10	**Kepulauan Mentawai** (West Sumatra)	**6.7**	
2005 05 14	**Nias Region**	**6.7**	
2005 05 19	**Nias Region**	**6.9**	
2005 07 05	**Nias Region**	**6.7**	
2005 11 19	Simeulue	6.5	
2006 01 27	Banda Sea	7.6	
2006 03 14	Seram	6.7	4
2006 05 16	**Nias Region**	**6.8**	
2006 05 26	Java	6.3	5,749
2006 07 17	South of Java	7.7	730
2007 01 21	Molucca Sea	7.5	4

Date (YYYY MM DD)	Location	Magnitude	Fatalities
2007 03 06	**Southern Sumatra**	**6.4**	**67**
2007 07 26	Molucca Sea	6.9	
2007 08 08	Java	7.5	
2007 09 12	**Southern Sumatra**	**8.5**	**25**
2007 09 12	**Kepulauan Mentawai** (West Sumatra)	**7.9**	
2007 09 20	**Southern Sumatra**	**6.7**	
2007 10 24	**Southern Sumatra**	**6.8**	
2007 11 25	Sumbawa Region	6.5	3
2008 02 20	Simeulue	7.4	3
2008 02 25	**Kepulauan Mentawai** (West Sumatra)	**7.2**	
2008 11 16	Minahasa, Sulawesi	7.3	6
2009 01 03	Near the North Coast of Papua	7.6	5
2009 01 03	Near the North Coast of Papua	7.4	

Source: USGS. Historic Worldwide Earthquakes.

Earthquakes on the Sunda Trench are generated by the subduction process and are amongst the world's largest earthquakes. Four earthquakes with magnitude (MW) greater than 8 have occurred in the region within the last two centuries, including the recent MW 9.3 event on 26 December 2004 and the MW 8.7 event on 28 March 2005, which resulted in approximately 1,300 deaths, mostly in Nias.

Earthquakes on the Sumatran Fault are generated by the strike slip motion along that fault. It is considered that the maximum magnitude event that could occur is about MW 8. The Aceh segment of the fault has no recorded rupture in the last century, which may suggest that an earthquake may be imminent. Furthermore, there are concerns that segments of the Sumatran Fault closest to the 26 December 2004 and 28 March 2005 events might also be triggered by the changes in stress associated with these large events (Ove Arup 2006).

Earthquake-related hazards include ground shaking, fault rupture, liquefaction, fires, tsunamis, landslides and floods. Fault rupture hazards are limited to areas immediately adjacent to faults, and thus are not considered a significant hazard for Nias. Liquefaction is an earthquake-induced hazard in which solids abruptly change from a solid state to a liquefied state, thereby causing significant damage to the structures above. Fires, tsunamis, landslides and floods are addressed separately in the following sections.

For ground shaking and liquefaction, a hazard assessment is presented in *Table 3.3* and risk reduction approaches are presented in *Table 3.4*.

Table 3.3 Ground shaking and liquefaction hazard assessment

Factor	Ground shaking	Liquefaction
Hazard types and receptors	Projects involving new or rehabilitated structures will be vulnerable to structural damages from ground shaking and liquefaction. In addition, project activities that make use of existing structures (eg, as training venues) may also increase vulnerability of people to effects of ground shaking or liquefaction. A wide range of structures are vulnerable, including housing, institutions (schools, hospitals, government	

Factor	Ground shaking	Liquefaction
	buildings, etc.), roads, bridges/stream crossings and utility infrastructure.	
Location / Extent	Everywhere in Nias	Most likely to occur in loose to moderate saturated granular soils with poor drainage, such as silty sands or sands and gravels. Coastal and alluvial areas of Nias are likely contain soils susceptible to liquefaction.
Frequency / Probability	One earthquake (0-70 km depth) with Magnitude 5 or greater per year. Minor earthquakes are experienced on a weekly basis (USGS Seismic Hazard Map). Peak horizontal acceleration, a measure of earthquake acceleration on the ground for a given geographic area and the principal parameter used for earthquake engineering design, with 10% probability of exceedance in 50 years is 0.3 to 0.4g.	
Intensity / Severity		
Duration / Timing	Seconds to minutes in duration. No seasonality.	Vertical and horizontal earth movements. Sudden loss of structural support. No seasonality.
Predictability	Low predictability, with the exception of aftershocks after a major earthquake	
Special Vulnerability and Resilience Factors	Households can avoid risk by exiting buildings during earthquakes, and to some extent may benefit from traditional means of predicting earthquakes (i.e., observations of the behaviour of animals). In addition, traditional building methods incorporate resistance to tremors and earthquakes, although understanding of these techniques is disappearing. Bridges and stream crossings are especially vulnerable points in Nias given the limited road and pathway infrastructure, as they could constrict access to the more remote villages if they are damaged by earthquake or consequent flooding. Local geotechnical engineering capacity is considered low, although substantial knowledge has been accumulated by various relief agencies in the post-tsunami and earthquake relief efforts. Hilly areas away from the major coastal roads are considered more vulnerable since they would have limited access to rescue resources in the event of catastrophic earthquakes.	

Table 3.4 Ground shaking and liquefaction risk reduction approaches

Category	Risk reduction approaches
Facility site selection, design and construction	The Indonesian seismic design code (SNI.03-1726-2002) is considered comparable to seismic design codes from the USA, Japan and Europe (Ove Arup, 2007). Based on the Code, Nias falls under seismic zone 6, the highest risk zone on a scale of 1 to 6. Areas with liquefiable soils should be avoided to the extent feasible when siting structures. While established geotechnical engineering measures exist for earthquake resistant design and construction, the key challenge for Nias would be lack of qualified local contractors and quality control during

Category	Risk reduction approaches
	construction to ensure that the design intent is implemented. For both new and existing buildings, secondary construction (lighting, shelving, and other equipment contained within buildings) should be designed/ checked so that they are securely fitted and appropriately attached so that they will not move or fall and injure people during an earthquake.
Early warning systems	Early warning systems for earthquakes are generally not available, although Japan has begun implementing a system that provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion, giving people more time (10-20 seconds) to get away from high-risk areas. A similar system is not yet available in Indonesia, and development of such a system is considerably beyond the scope of this program.
Contingency and continuity planning	Contingency and continuity planning is of particular importance for earthquake hazards since impacts are likely to be felt island-wide (if not over a larger area), with many critical facilities outside of the project area (utilities, government facilities, etc.) also likely suffering damage. An earthquake contingency and continuity plan should be prepared for each LEDP facility and activity, minimally covering evacuation and secure gathering location, responsible persons and roles, emergency communication systems for families of personnel and other involved people (e.g., workshop participants) and protection of critical records/data (if any).

3.3 Tsunamis

Seismic activity in the region can potentially cause tsunami, as most tragically seen in the tsunami on 26 December 2004. This tsunami caused the deaths of over 200,000 people in the region and enormous damage. It resulted in over 200 deaths on Nias Island, although Nias was less severely affected by the 2004 tsunami than by the following 2005 earthquake.

For the 26 December 2004 tsunami, impacts were markedly more severe on the western coasts of Nias as well as Sumatra due to the origin of the earthquake. On the west coast of Sumatra the tsunami waves were up to 10 m in height and swept several kilometres inland. On the east coast of Sumatra the wave heights varied from 2 to 6 m. In Nias, the highest waves were likely experienced in Sirombu (a protruding part in western Nias), with waves reaching over 5 m.

Total damage from the tsunami was estimated at USD 4.5 to 5 billion – almost equal to the entire GDP of Aceh, and the sectors most impacted were primarily private-sector dominated assets and activities that relate directly to the personal livelihoods of affected urban and rural communities: housing, commerce, agriculture, and fisheries, and transport vehicles and services. The biggest public sector damage was to infrastructure, the social sectors, and government administration. Environmental damages included damage to coral reefs and mangrove swamps.

While earthquakes are the most common cause of tsunamis, volcanic activities in the ocean or landslides can also trigger them.

Coastal regions and adjacent low lying areas are the most susceptible to tsunamis. A tsunamis hazard assessment is presented in *Table 3.5* and risk reduction approaches are presented in *Table 3.6*.

Table 3.5 Tsunami hazard assessment

Factor	Tsunami
Hazard types and receptors	Structures and inhabitants in coastal zones are vulnerable to the effects of tsunami. In Nias, households have traditionally been located on hilltops; however, a recent trend has seen migration to coastal areas, especially the east and southern coast lines where there is better transportation access. Most businesses (including shops and industrial facilities such as quarries and cement plants) are located near the coast. Harbours/docks are also highly vulnerable to tsunamis, and thus fisheries is the most vulnerable industry. Bridges and stream or river crossings in coastal zones would also be vulnerable. Hilltop households are less exposed to tsunami danger, although it is possible family members who are wage earners are located in coastal areas. In addition to structural damage, farmland may be impacted from soil erosion or deposition from the wave action, including loss of fertile soil or deposition of debris and soils unsuitable for agriculture, such as saline or sandy soils.
Location / Extent	Coastal areas (less than 4-5 meters above sea level are most vulnerable). As largest earthquakes are expected to occur west/southwest of Nias along the Sunda Trench, western and southern coasts of Nias are relatively more susceptible. (There is no map with risk zones identified, although some government staff in Nias referred to a tsunami risk map.)
Frequency / Probability	Tsunamis are relatively infrequent in Nias, although no system of collecting wave heights exists.
Intensity / Severity	Depends on various factors, such as distance to and intensity of earthquake, geomorphology, etc. Waves were reportedly over 30 m high (outside of Sumatra) in the 26 December 2004 tsunami. In Nias, waves are estimated to have been 2 to 5 m high.
Duration / Timing	Each wavelength of a tsunami can be few minutes to a few hours long; up to a dozen tsunami waves may occur from a single seismic event.
Predictability	Predictable (ranges from several minutes to several hours after an earthquake). In addition, in some (not all) instances, the water along the shoreline recedes dramatically prior to the onset of the crest of the wave.
Special Vulnerability and Resilience Factors	The national government of Indonesia established the Indonesian Tsunami Early Warning System (InaTEWS) following the 2004 tsunami. It has two main components: 1) a mechanism of data collection and analysis, and 2) dissemination of early warning to authorized parties and communities. Red Cross Indonesia

Factor	Tsunami
	reportedly has a radio system capable of receiving the nation-wide Tsunami warning information. However, there is not yet an island-wide information dissemination system within Nias. Several NGOs have trialled simple systems and drills for earthquake and tsunami hazards, and worked with communities to identify recognised evacuation routes. National Disaster Prevention Offices have offices in sub-districts of Nias Island, but they have very limited capacity. Local NGOs reported that there are radio programs in Nias that aim to increase public awareness on what to do in the event of a tsunami. The local government has low land use management capabilities, and has not controlled building in coastal areas.

Table 3.6 Tsunami risk reduction approaches

Category	Risk reduction approaches
Facility site selection, design and construction	Designing structures for tsunami with water heights of more than a couple of metres is both difficult and costly. The optimum solution is therefore to locate structures away from exposed coastline areas (ideally 4-5 m above sea level) whenever possible.
Early warning systems	Establishment of early warning systems utilizing the national InaTEWS and existing local resources such as Red Cross Indonesia's radio system should be considered as part of the project.
Contingency and continuity planning	An evacuation plan linked to an early warning system would be an effective way to reduce loss of lives from tsunamis. In addition, contingency plans for tsunami impacts on farmland should be developed.

3.4 Flooding

Rainfall is very high on Nias Island, with on average over 3,000 mm falling annually, with rain on around 270 days per year. Annual rainfall varies from 2,600 mm in the northeast to 4,000 mm in the southwest. Drainage patterns show a main northwest to southeast watershed along the central ridge of the island, dissected by short, steep rivers. There are fifteen catchments, varying from 110 to 880 km^2 in size. Major rivers are the How, Susua, Masio and Lalimbo flowing to the east coast and the Siwalawa, Oou, Eho, and Aramo rivers flowing to the west coast.

Rainfall falls in intense tropical downpours, and leads to localised flooding, which is a serious hazard. Flooding cuts off access routes and in many cases destroys roads and river or stream crossings, and in extreme cases causes significant fatalities. Inhabitants in Nias refer to damaging flooding events in 1997, 2001, and 2003. There were more than 100 fatalities due to flooding in Lahusa sub-district in Nias Selatan in 1997, and more than 50 fatalities in Teluk Dalam sub-district in 2001. Increasingly, damaging flooding is attributed to widespread clearance of forest for the planting of patchouli (a plant used for the extraction of an essential oil). Gomo sub-district is widely cited as vulnerable to flooding and landslides. Informants have also indicated that flooding is of particular concern in Lahusa (southeastern Nias) and Lahewa (northern Nias).

For flooding, a hazard assessment is presented in *Table 3.7* and risk reduction approaches are presented in *Table 3.8*.

Table 3.7 Flooding hazard assessment

Factor	Flooding
Hazard types and receptors	Flooding can damage structures and farmland, reduce access through the destruction or waterlogging of pathways and stream/river crossings.
Location / Extent	Floodplain areas in Nias have not been mapped. The Spatial Planning and Environmental Management Study, prepared by Black and Veatch (2007) contains maps showing general areas prone to flooding. In addition to areas near rivers, localized flooding/waterlogging of the ground can occur after rainfall events due to inadequate drainage systems (either inadequate design or improper maintenance such as sediment and debris removal).
Frequency / Probability **Intensity / Severity** **Duration / Timing**	Data was not available regarding frequency/probability, intensity/ severity (floodwater levels, velocity, amount of sediments or debris) or duration of flooding. October to January is considered the rainy season; July to September are considered mixed months for rainfall, while February to June is considered the dry season. Due to the topography of Nias, many floods are likely to be flash floods.
Predictability	Data regarding the onset of flooding was not available. In addition to rainfall induced flooding, flooding can also occur due to changes in topography or the destruction of large structures within the floodplain following major earthquakes.
Special Vulnerability and Resilience Factors	Communities in remote highland areas are particularly vulnerable to the failure of bridges and stream crossings due to flooding, as they would lose access to markets, etc. The government does not have the capacity to manage factors that exacerbate flooding risks, such as land conversion (deforestation for patchouli planting), or overexploitation of sand and gravel sources, or to respond to extreme heavy rainfall events. No early warning system for flooding is currently available.

Table 3.8 Flooding risk reduction approaches

Category	Risk reduction approaches
Facility site selection, design and construction	Wherever possible, structures should not be placed within floodplains. If avoidance is impossible, structures should be placed on stilts that would elevate the structure while allowing flood flows to pass under the structure. Due to the year-round heavy rainfall conditions in Nias, adequate drainage must be provided for structures, regardless of location, to

Category	Risk reduction approaches
	prevent flooding/waterlogging. In addition, drainage systems must be regularly maintained to remove sediments and debris to keep them clear and allow better control of floodwaters. Bridges and stream crossings should be designed to minimize impact on channel morphology to prevent increasing risk of flooding in upstream areas. Provisions should be incorporated for regular removal of debris from the channel area near bridges and stream crossings, particularly during the wet season and after significant rainfall events.
Early warning systems	A community-based flood warning system can be developed and implemented with rain gages and water level gages; manual systems are inexpensive but more labour intensive to monitor and record data while automatic systems are more expensive to install but less labour intensive to use.
Contingency and continuity planning	Contingency plans should be established for both impacts on structures and farmland. Consideration of impacts should include both structural damage and waterlogging damage.

3.5 Landslides

A landslide is defined as a ground stability failure resulting in the movement of a mass of rock, debris, or earth down a slope. The term encompasses events such as rock falls, topples, slides, spreads and flows, such as debris flows commonly referred to as mudflows or mudslides. Landslides can be initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made activities that result in reduced soil stability, soil disturbance or a change in drainage pattern, or any combination of these factors.

Nias is highly susceptible to landslides due to a combination of factors, including high rainfall, steep slopes in many parts of the island, frequent earthquakes, and poor land use controls.

For landslides, a hazard assessment is presented in *Table 3.7* and risk reduction approaches are presented in *Table 3.8*.

Table 3.9 Landslide hazard assessment

Factor	Landslides
Hazard types and receptors	In Nias, landslides are likely to be induced mainly by rainfall, earthquakes or a combination of both. Man-made factors such as deforestation, sand/gravel extraction, vibration from construction equipment, increased loading at the top of the slope (e.g., from heavy buildings), construction-related earthwork and changes in drainage patterns can also contribute to landslide risk. Landslides can impact facilities or areas both on and above the slope and below the slope (down-slope areas) due to falling soil mass/debris. They can destroy and bury buildings, cause flooding by blocking waterways, cut transportation routes and utility infrastructure and interrupt communications.
Location / Extent	Steep slope areas are generally susceptible to landslides. A significant part of Nias, in the central and southern parts of the

Factor	Landslides
	island can be considered sensitive owing to slopes >40%; slopes of more than 16% cover almost all of the southern two-thirds of the island, i.e., the whole area except the coastal plain on the eastern coast of south Nias and the coastal plain on the western side of central Nias. The Indonesian Centre for Volcanology and Geological Hazard Mitigation has an ongoing landslide hazard mapping and warning program, but landslide hazard maps have not been prepared for Nias. High-resolution slope data are not available. The Spatial Planning and Environmental Management Study, prepared by Black and Veatch (2007), contains maps showing general areas prone to landslides.
Frequency / Probability **Intensity / Severity** **Duration / Timing**	Landslides can move slowly, (millimetres per year) or can move quickly and disastrously (in seconds). Debris-flows can travel down a hillside with speeds of up to 300 km per hour (more commonly, 50 - 80 km per hour), depending on the slope angle, water content, and type of earth and debris in the flow (USGS Landslide Hazards Program).
Predictability	Risks are higher during and after heavy rainfall and earthquakes. Signs of landslide occurrence include: new cracks or unusual bulges in the ground, street pavements or sidewalks; soil moving away from foundations; tilting or cracking of concrete floors and foundations; broken water lines and other underground utilities; leaning telephone poles, trees, retaining walls or fences; offset fence lines; sunken or down-dropped road beds; rapid increase in creek water levels, possibly accompanied by increased turbidity; sudden decrease in creek water levels though rain is still falling or just recently stopped; sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb; a faint rumbling sound that increases in volume is noticeable as the landslide nears; unusual sounds, such as trees cracking or boulders knocking together, might indicate moving debris (USGS Landslide Hazards Program).
Special Vulnerability and Resilience Factors	The government does not have the capacity to manage factors that exacerbate landslide risks, such as land conversion (deforestation), or overexploitation of aggregate resources, or to respond to extreme heavy rainfall events.

Table 3.10 Landslide risk reduction approaches

Category	Risk reduction approaches
Facility site selection, design and construction	Habitable structures should be located on flat ground with a gentle slope (<5 degrees) to facilitate drainage; for sloping sites (5 to 20 degrees), creating small level platforms on which to seat individual structures, as opposed to varying the height of the plinths and/or posts; structures should also be built at least 1.5 m away from slope edges or small retaining walls (Ove Arup, 2006). Where developments are to be built on slopes, the whole site should be landscaped with appropriate drainage, terracing, retaining walls and earthworks, designed and supervised by qualified geotechnical and civil engineers.

Category	Risk reduction approaches
	Offsite risk factors, such as nearby mining activities, earthwork, or vegetation removal should be identified and assessed. In addition, changes in drainage patterns due to new or modified structures (including pathways) must be evaluated to avoid inadvertent increase in landslide risk, as wetting of previously dry soils on or above slopes can induce landslides. Vegetation planting and minimization of natural vegetation removal, particularly trees, helps to stabilize soils and reduce landslide potential by reducing the effective rainfall infiltration from interception by foliage, evapo-transpiration and root water uptake.
Early warning systems	Early warning systems for landslides after earthquakes and heavy rainfall may be considered for incorporation into projects in hillside areas. Training for identification of signs of landslides can also be provided to potentially affected people.
Contingency and continuity planning	Contingency plans should be established for both impacts on structures and farmland. Surveys to identify areas/settlements vulnerable to landslides would be needed as part of contingency planning.

3.6 Pests / Plant Diseases

As LEDP involves improvements to rubber, cacao and rice planting practices, pests/plant diseases should be considered in hazard assessments of relevant program components. LEDP is likely to be mostly beneficial in terms of pest/plant disease management; however, potential negative impacts may occur if new varieties introduced as part of LEDP are susceptible to Nias-specific pests/plant diseases. It should also be noted that Nias has no quarantine procedures for the import of plants/animals. Being an island, Nias' ecosystem and agriculture should be considered vulnerable to effects of pests/plant diseases.

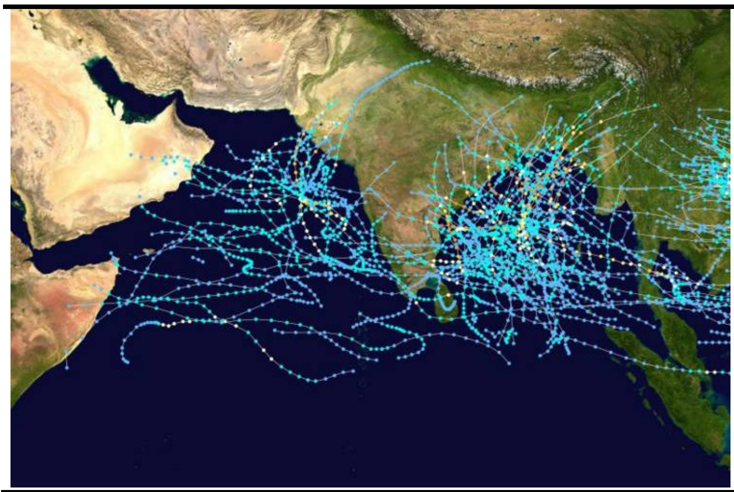
3.7 Fires

Due to the high humidity (over 90% year-round) and high rainfall as well as low density of habitable structures, fires are not considered a significant hazard in Nias. However, project-related structures should incorporate basic fire safety measures, such as incorporation of fire hazard into the contingency and continuity plan (evacuation procedure, basic fire extinguishers and drills).

3.8 Tropical Cyclones

Nias is not located in an area which is frequently subject to damaging tropical cyclones. However, Nias occasionally may be subject to weakening tropical cyclones tracking westwards from the Pacific, as indicated in *Figure 3.1*, which shows the tracks of all tropical cyclones in the northern Indian Ocean between 1980 and 2005. The possibility of damaging tropical cyclones in Nias therefore cannot be ruled out, especially in view of the long term trend of climate change, and at the least, Nias may be subject to increasingly intense rainfall events and strong winds. This should be kept in mind during future hazard assessment.

Figure 3.1 Tropical Cyclone Tracks, Northern Indian Ocean, 1980-2005



The colours of the tracks are based on the Saffir-Simpson Hurricane Scale. The purple colour crossing the area of Nias is the lowest on the scale, a 'Tropical Depression' (winds no more than 38 mph, and no sea storm surge).

Source: Joint Typhoon Warning Centre.

4 EXISTING SETTING OF DRM IN NIAS

Based on the findings from the field visit to Nias conducted by the consultant team in June 2008, the existing DRM activities, capacities and associated issues in Nias are summarized below.

4.1 The SiGaNa Coalition

In general, the focus of government and NGO activities in Nias has been on disaster recovery and reconstruction in the past several years. There is currently no active formal framework for integrating DRM into projects in Nias. DRM activities have been carried out largely on a project-by-project basis by individual NGOs (see below).

In 2007, a coalition of agencies and NGOs in Nias called SiGaNa was formed to foster information exchange and experience sharing amongst DRM practitioners in Nias. The SiGaNa coalition is lead by BRR and includes Satlak PBP (Coordination of Natural Disasters Relief Executive Unit in Nias), UNORC, UNDP, SurfAid International, PKPA (Research Center for Protection of Children), Church World Service, Medina, Save The Children, Indonesian Red Cross (PMI), International Federation of Red Cross and Red Crescent Societies (IFRC), Forniha (a Nias-based NGO mainly for community-based development capacity building), and Aceh Nias Reconstruction Radio Network (ARRNet). SiGaNa blog: http://sigana007.wordpress.com/

4.2 Current Initiatives

The Planning Department (BAPEDDA) serves as the focal point for disaster risk coordination efforts in North Nias. Mr. Rudi of BAPEDDA is the main coordinator. When interviewed, he indicated that no detailed mapping of high risk disaster zones has been conducted to date.

As mentioned in Section 3.1.1, Black and Veatch (2007, financed by ADB) conducted surveys and mapping on Nias, providing details of topography, soils and vegetation cover, as well as maps showing general areas prone to flooding and landslide hazards. However, ground-truthing conducted as part of this mapping effort was limited. Detailed hazard maps have not been developed for Nias.

The Indonesian Red Cross (PMI) has established a tsunami early warning system based on a network of radios with the base station in Banda Aceh. The radio has been installed but is not yet operational in Nias. (Information obtained from Mr. Jordi Casafont, Spanish Red Cross, in Teluk Dalam as PMI staff were not available for interview during the field visit.)

SurfAid International has been conducting a community-based emergency preparedness program in three areas (Teluk Dalam, Afulu, Sirombu) in Nias with funding from the Australian Government (AusAID) since 2006/2007. The types of disasters addressed by this program include floods, landslides and tsunamis. Specific activities include:

a) Awareness raising through radio programs and community organizing.
b) Emergency evacuation training and identification of emergency escape routes and safe areas for schools and villages. Signage (e.g., "500 meters to safe area") have been provided in selected areas on bamboos or lamp posts along some pathways.
c) Emergency preparedness activities, including establishment of nutrition gardens and food preparation teams for emergency.

(Information obtained from Mr. Declan Hearne of SurfAid and SurfAid website, http://www.surfaidinternational.org/site/pp.asp?c=ekLPK4MOIsG&b=1841293)

International Federation of Red Cross and Red Crescent Societies (IFRC) activities in Nias have included disaster preparedness training. Specific activities have included establishment of four shipping containers with emergency relief materials (each container sufficient for 800 families) and one warehouse in Afia (containing tarps, blankets, lamps, etc.). (Information obtained from Dr. Eka Airlangga and Mr. Rio Augusta, IFRC.)

Save The Children's activities in Nias have included some DRM activities, including development of community-based hazard maps working with children and parents. (Information obtained from Mr. Abdi, Save The Children).

Oxfam has a staff member (Ms. Jessa Serna) responsible for integrating DRM into its livelihoods program (e.g., drainage improvements to cope with flooding impacts on farmland). (Information obtained from Mr. Wilianto, Mr. Alex and Mr. Andri Isyunanto).

4.3 Reliance on Public Utilities

Informants indicated that mobile phones are not reliable in case of emergency in Nias. As elsewhere, networks quickly become jammed during an emergency situation and there is only limited capacity of the relevant infrastructure on Nias. Radios are generally considered a more suitable means of information dissemination due to their prevalence and reliability.

Because of the relatively low development levels and low reliance on utilities and other public facilities (power, piped water and roads) in Nias, people are not very vulnerable at present to disaster-induced damage to public facilities, especially in remote villages where such infrastructure, if it exists, is generally rudimentary. (As provision of roads and water/sanitation facilities is a part of LEDP, care should be taken to ensure that the program does not result in increased vulnerability associated with the provision of and people's reliance on such facilities.)

4.4 Other Resources for DRM

Other Indonesian resources for DRM identified by informants include:

- Indonesian Development of Education and Permaculture (IDEP) has developed a Community Based Disaster Management program, including education tools and publication materials available for download at: http://www.idepfoundation.org/cbdm.html

- Community Based Disaster Preparedness in Indonesia (Komunitas Siaga Bencana di Indonesia), website: http://www.siagabencana.lipi.go.id/

- Indonesian Society for Disaster Management (MPBI), website: http://www.mpbi.org/

5 COMPONENT-LEVEL ASSESSMENT AND RISK REDUCTION APPROACHES

As summarized in *Section 1*, the LEDP consists of four main components: community empowerment; agricultural livelihoods improvement; management, monitoring and evaluation; and transportation network improvement. From the perspective of DRM, the LEDP can be divided into the following types of activities:

1) **New habitable structures**, potentially including facilities used to carry out various training programs for farmers and government personnel and farmers' association meetings, offices for field-based staff, etc.

2) **Use of existing habitable structures**, potentially including for training programs and farmers' association meetings

3) **Agricultural improvement activities**, potentially including establishment of nurseries (cacao / rubber), planting of improved stock (cacao / rubber), production and distribution of higher yield rice varieties

4) **New or improved transport infrastructure** (roads, pathways, bridges, stream crossings) **and other civil engineering components** (community sanitation and hygiene facilities, and small scale water supply facilities such as rainwater collection, shallow wells, spring box and pipe delivery systems).

Based on the framework presented in *Section 3*, checklist templates were developed to outline the hazard assessment and risk reduction approaches for each type of project activity (see *Table 5.1* to *Table 5.4*).

Table 5.1 Checklist for New Habitable Structures

Category	Assessment and risk reduction checklist – New Habitable Structures
Procedural	☐ Designation of person(s) with DRM responsibilities
	☐ DRM is incorporated into consultants and contractors' requirements
	☐ Allocation of budget for DRM
	☐ Monitoring and evaluation plan for DRM
	☐ Documentation and filing system for DRM
Relevant Hazards	☐ Ground shaking (from earthquakes)
	☐ Liquefaction
	☐ Tsunamis
	☐ Flooding
	☐ Landslides
	☐ Fire
	☐ Other: _______________

Category	Assessment and risk reduction checklist – New Habitable Structures
Hazard Types to be Considered	☐ Hazards that may directly impact project activities and facilities ☐ Secondary hazards, such as earthquake-induced landslides ☐ Risks that inadvertently induced or exacerbated by project facilities/activities ☐ Offsite hazards / risk factors that may impact the project
Hazard Data Sources	☐ Local government ☐ Relief agencies and NGOs ☐ Local communities ☐ Sharing of information amongst LEDP components ☐ Observations and local measurements (soil type, topography/slope, proximity to streams, high water marks, vegetation cover, etc.) ☐ Are there any significant data quality issues or data gaps that need to be resolved?
Vulnerability and Resilience Factors	☐ Location / extent ☐ Frequency / probability ☐ Intensity / severity – Consider both catastrophic and everyday impacts ☐ Duration / timing ☐ Predictability ☐ Sensitive receptors ☐ Existing coping mechanisms
Facility site selection, design and construction	☐ Site selection – avoid hazard prone areas as priority ☐ Design (including building materials and structures as well as fixtures) ☐ Ensure that key utilities (power, water supply, drainage) are also protected ☐ Involvement of engineering expert ☐ Training of construction contractors ☐ Supervision to ensure construction is carried out according to design specifications ☐ Routine and post-hazard event inspection and preventative maintenance program to detect and repair minor damages to decrease risks in subsequent hazard events; drainage systems associated with the main structure should be included in the inspection/maintenance to prevent localized flooding
Early warning systems	☐ Utilization of / linkages to existing early warning systems ☐ Consider whether community-based data collection, analysis and dissemination of warning information system can be developed for groups of facilities sharing similar hazard characteristics ☐ Response to warning
Contingency and continuity planning	☐ Fire extinguishing tools ☐ Physical security and evacuation of people ☐ Alternatives for utilities, transportation/access to materials and people and other inputs critical to the operation of the facility ☐ Backup and protection of document and records (electronic and hard copies) ☐ Back-up communication systems for receiving disaster warnings and updates and for communicating with staff or other involved people and their families ☐ Stock-piling food, basic medicines and other supplies necessary to maintain operations during an interruption (if relevant) ☐ Training and emergency drills ☐ Assessment and decision-making procedures for re-entering a structure and re-starting operation if damage may have been

Category		Assessment and risk reduction checklist – New Habitable Structures
		sustained from a hazard

Table 5.2 Checklist for Use of Existing Habitable Structures

Category		Assessment and risk reduction checklist – Use of Existing Habitable Structures
Procedural	☐	Designation of person(s) with DRM responsibilities
	☐	DRM is incorporated into consultants and contractors' requirements (if any renovations required)
	☐	Allocation of budget for DRM
	☐	Monitoring and evaluation plan for DRM
	☐	Documentation and filing system for DRM
Relevant Hazards	☐	Ground shaking (from earthquakes)
	☐	Liquefaction
	☐	Tsunamis
	☐	Flooding
	☐	Landslides
	☐	Fire
	☐	Other: _______________
Hazard Types to be Considered	☐	Hazards that may directly impact project activities and facilities
	☐	Secondary hazards, such as earthquake-induced landslides
	☐	Risks that inadvertently induced or exacerbated by project facilities/activities (including gathering people in high-risk structures)
	☐	Offsite hazards / risk factors that may impact the project
Hazard Data Sources	☐	Local government
	☐	Relief agencies and NGOs
	☐	Local communities
	☐	Sharing of information amongst LEDP components
	☐	Observations and local measurements (soil type, topography/slope, proximity to streams, high water marks, vegetation cover, etc.)
	☐	Are there any significant data quality issues or data gaps that need to be resolved?
Vulnerability and Resilience Factors	☐	Location / extent
	☐	Frequency / probability
	☐	Intensity / severity – Consider both catastrophic and everyday impacts
	☐	Duration / timing
	☐	Predictability
	☐	Sensitive receptors
	☐	Existing coping mechanisms
Facility site selection, design and construction	☐	Facility selection – avoid use of existing facilities in hazard prone areas, if feasible
	☐	Conduct a safety review of candidate facilities, including ease of evacuation, structural integrity, signs of damage from previous hazard events, fixtures and materials that may pose a hazard in the event of an earthquake, etc. Prepare and implement a corrective action plan based on the review for the selected facility.
	☐	If any renovations are to be carried out: • Incorporate risk reduction measures / seismic retrofits, if feasible • Involvement of engineering expert, if significant modifications

Category	Assessment and risk reduction checklist – Use of Existing Habitable Structures
	are proposed • Supervision to ensure renovations are carried out according to design specifications ☐ Routine and post-hazard event inspection and preventative maintenance program to detect and repair minor damages to decrease risks in subsequent hazard events; drainage systems associated with the main structure should be included in the inspection/maintenance to prevent localized flooding
Early warning systems	☐ Utilization of / linkages to existing early warning systems ☐ Consider whether community-based data collection, analysis and dissemination of warning information system can be developed for groups of facilities sharing similar hazard characteristics ☐ Response to warning
Contingency and continuity planning	☐ Provision of fire extinguishing tools ☐ Physical security and evacuation of people ☐ Alternatives for utilities, transportation/access to materials and people and other inputs critical to the operation of the facility ☐ Backup and protection of document and records (electronic and hard copies) ☐ Back-up communication systems for receiving disaster warnings and updates and for communicating with staff or other involved people and their families ☐ Stock-piling food, basic medicines and other supplies necessary to maintain operations during an interruption (if relevant) ☐ Training and emergency drills ☐ Assessment and decision-making procedures for re-entering a structure and re-starting operation if damage may have been sustained from a hazard

Table 5.3 Checklist for Agricultural Improvement Activities

Category	Assessment and risk reduction checklist – Agricultural Improvement Activities
Procedural	☐ Designation of person(s) with DRM responsibilities ☐ DRM is incorporated into consultants and contractors' requirements (if relevant) ☐ Allocation of budget for DRM ☐ Monitoring and evaluation plan for DRM ☐ Documentation and filing system for DRM
Relevant Hazards	☐ Tsunamis ☐ Flooding ☐ Landslides ☐ Pest / plant diseases ☐ Other: ______________
Hazard Types to be Considered	☐ Hazards that may directly impact project activities ☐ Secondary hazards, such as earthquake-induced landslides ☐ Risks that inadvertently induced or exacerbated by project activities, e.g., ☐ Offsite hazards / risk factors that may impact the project
Hazard Data Sources	☐ Local government ☐ Relief agencies and NGOs ☐ Local communities

Category	Assessment and risk reduction checklist – Agricultural Improvement Activities
	☐ Sharing of information amongst LEDP components ☐ Observations and local measurements (soil type, topography/slope, proximity to streams, high water marks, vegetation cover, etc.) ☐ Are there any significant data quality issues or data gaps that need to be resolved?
Vulnerability and Resilience Factors	☐ Location / extent ☐ Frequency / probability ☐ Intensity / severity – Consider both catastrophic and everyday impacts ☐ Duration / timing ☐ Predictability ☐ Sensitive receptors ☐ Existing coping mechanisms
Site selection, design and construction	☐ Site selection: Nurseries, demonstration fields and other agricultural sites should avoid hazard prone areas, if feasible. Relevant hazards for cacao and rubber are landslides, although tree planting tends to reduce landslide risk. Rice fields can be prone to damages from tsunamis and flooding. ☐ Drainage facilities associated with agricultural sites should be adequately designed and maintained to prevent localized flooding ☐ Hazard-tolerant varieties should be considered (such as salt-tolerant or flood-tolerant rice varieties as contingency plan for tsunamis) ☐ Removal of understory vegetation in rubber/cacao plantations should be minimized to prevent soil erosion.
Early warning systems	☐ If collection of meteorological data is included as part of the agricultural support program, utilization of such data for hazard warning should be considered.
Contingency and continuity planning	☐ Physical security and evacuation of people working in the fields ☐ Alternatives for utilities, transportation/access to materials and people and other inputs critical to the operation of the nursery/field ☐ Considerations should be given to establishing agricultural plots that may serve as emergency food supply or protected storage for seeds ☐ Contingency for tsunamis on agricultural sites should include salinity and water logging impacts. Salinity avoidance/mitigation measures include: soil salinity assessments and avoidance of saline land for cropping until the salt concentration is reduced to an acceptable level; enhanced drainage and through-flow irrigation to leach out salts; improve soil chemical and physical fertility using organic and inorganic amendments; and interim use of salt-tolerant varieties until salt levels return to normal. ☐

Table 5.4 Checklist for Civil Engineering Components

Category	Assessment and risk reduction checklist – Civil Engineering Components
Procedural	☐ Designation of person(s) with DRM responsibilities ☐ DRM is incorporated into consultants and contractors' requirements ☐ Allocation of budget for DRM ☐ Monitoring and evaluation plan for DRM ☐ Documentation and filing system for DRM
Relevant	☐ Ground shaking (from earthquakes)

Category	Assessment and risk reduction checklist – Civil Engineering Components
Hazards	☐ Liquefaction ☐ Tsunamis (if roads/bridges are planned in coastal areas) ☐ Flooding ☐ Landslides ☐ Other: _______________
Hazard Types to be Considered	☐ Hazards that may directly impact project facilities ☐ Secondary hazards, such as earthquake-induced landslides ☐ Risks that inadvertently induced or exacerbated by project (including: 1) dependence on improved access and resulting disruptions if pathways become impassable after earthquakes/landslides; and 2) dependence on improved engineered facilities for sanitation and water supply and resulting disruptions in critical services if facilities (such as pipelines) become damaged after earthquakes, landslides or flooding). ☐ Offsite hazards / risk factors that may impact the project
Hazard Data Sources	☐ Local government ☐ Relief agencies and NGOs ☐ Local communities ☐ Sharing of information amongst LEDP components ☐ Observations and local measurements (soil type, topography/slope, proximity to streams, high water marks, vegetation cover, etc.) ☐ Are there any significant data quality issues or data gaps that need to be resolved?
Vulnerability and Resilience Factors	☐ Location / extent ☐ Frequency / probability ☐ Intensity / severity – Consider both catastrophic and everyday impacts ☐ Duration / timing ☐ Predictability ☐ Sensitive receptors ☐ Existing coping mechanisms
Facility site selection, design and construction	☐ Alignment selection – avoid hazard prone areas as priority ☐ Select alignments that involve the minimum feasible number of channel crossings, as they are vulnerable to earthquakes and flooding and can become constrictions in the system in the event of damage. ☐ Choice between bridges and low stream crossings: Bridges are less vulnerable to flooding, but higher engineering requirements and more vulnerable to earthquakes; if not adequately designed, bridges could lead to flooding upstream and also downstream if structure subsequently collapsed. Low stream crossing may not be passable during heavy rainfall, but less vulnerable to structural damage from earthquakes or flooding; need to consider the acceptable flood frequency for which the stream crossings will be designed. ☐ Consider alignments that can also improve access to safe areas, e.g., for tsunamis and flooding ☐ Refer to Section 5.3, Guidelines on Road / Trail Design and Construction of ERM's report, *Review of Ecological and Habitat Aspects of Project Proposals*, August 2008, for soil erosion prevention measures, which would contribute to prevention/mitigation of landslide hazards. ☐ Involvement of engineering expert in design and construction

Category	Assessment and risk reduction checklist – Civil Engineering Components
	☐ Training of construction contractors ☐ Supervision to ensure construction is carried out according to design specifications ☐ Ensure that changes in drainage patterns associated with pathway construction do not result in landslide or flooding inducement ☐ Routine and post-hazard event inspection and preventative maintenance program to 1) remove debris and sediments from stream crossings and bridges to prevent flooding, 2) detect and repair minor damages for roadways and bridge/stream crossings (including signs of landslides for roadways), and 3) remove debris from drainage channels for roadways to prevent flooding
Early warning systems	☐ Consider installing water level gages at stream crossings / bridges to provide flood hazard warning data
Contingency and continuity planning	☐ Consider providing signage to safe areas along roadways, including directional and distance markers ☐ Awareness raising and provision of warning signs at entry points and along pathways when pathways / stream crossings are not safe for passage due to flooding/landslides ☐ Explore opportunities for use of specialized emergency vehicles tailored for 1.5-m pathways. ☐ Contingency planning / alternatives in case of disruptions to use of pathways, channel crossings and water/sanitation facilities due to earthquakes, landslides or flooding (both temporary disruptions from flooding, and longer-term disruptions from structural damages or large debris accumulation requiring removal/repair). ☐ Assessment and decision-making procedures for re-starting use of stream crossings and bridges if damage may have been sustained from earthquakes, landslides or flooding

In addition, training and capacity building for farmer groups, women's groups and government personnel are a key focus of LEDP across the components, and should be used to mainstream DRM into the program, potentially including the following:

- DRM training for field-based technical consultants, who will be in close contact with the target community members. "Training of Trainers" could be provided to the consultants so that they can in turn provide simple DRM training to the farmer groups or women's groups in addition to or as part of the training and capacity building they would provide in their core expertise area.
- DRM training for government personnel could include:
  - development of capabilities for meteorological and hydrologic data collection and analysis
  - dissemination of hazard warnings
  - land use controls to prevent building in hazard prone areas and land uses that can induce hazards such as landslides
  - technical capabilities for design, construction, retrofit and maintenance of hazard-resistant structures

- DRM training for farmer and women's groups could include:
  - basic emergency response / evacuation for life safety
  - reporting on observed hazard incidents (particularly landslides and flooding, including events that do not result in damage but may provide useful data for predicting future events)
  - contingency planning specific to agriculture sector (use of hazard-tolerant varieties, pests/plant diseases management, protected storage of seeds, etc.)

Notes on Food Security Issues: Rice is an important stable food for Nias, yet a large portion of the demand is met by imports from outside of the island. In general, the LEDP would be expected to have beneficial impacts on food security (and associated resilience to disasters) by increasing the productivity of rice.

However, one potential secondary impact of LEDP as a whole is that shift in agricultural practices or types of crops planted (e.g., towards monoculture of rubber or a shift from growing food to cash crops) may decrease capacity to cope with disasters (e.g., increased reliance on food imported from other villages or other islands, which may be cut off in the event of infrastructure damage from earthquakes.). LEDP should therefore incorporate measures to ensure that promotion of cash crops does not have adverse effects on local sources of food supply. Periodic (e.g., annual) assessments should be conducted to ensure that changes in agricultural practices resulting from the program would not have unintended adverse effects on food security. This assessment should be conducted both at the regional (island or district level) as well as at the village levels.

6 NEXT STEPS

As presented above, LEDP facilities and activities may be susceptible to various types of hazards, including earthquakes, tsunamis, flooding and landslides. Although some hazard-coping capacities have been developed as part of the post-disaster relief programs in the last several years, the overall DRM capacities of Nias government and communities remain low because recovery and reconstruction have been the main focus of the relief activities to date.

This report presents the results of a high-level hazard assessment and identifies the risk reduction approaches by hazard type as well as by the general type of LEDP activity. In addition to protecting people and assets involved in the LEDP from potential hazards, DRM is also critical for ensuring that the program does not inadvertently increase hazard risks, both small and catastrophic. Furthermore, where feasible, LEDP should seek to develop the overall DRM capabilities of the Nias government and people, such as through hazard data collection and mapping and awareness raising.

The suggested next steps for incorporating DRM into LEDP are as follows:

- Identify bodies responsible and funding for DRM during both planning and implementation phases for specific program components. For example:
    - LEDP Project Management Unit (PMU): Staff within the PMU should be designated to have the overall responsibility for:
        (1) checking that DRM is integrated into LEDP activities during planning and execution (including for sub-contracted work);
        (2) providing DRM training to the field-based consultants, so that the consultants develop the ability to incorporate DRM into the livelihoods training and capacity building programs conducted as part of LEDP;
        (3) providing DRM training and capacity building for government personnel (as part of Component 1); and
        (4) monitoring of positive and adverse effects on DRM resulting from LEDP activities.
    - LEDP Field-based Consultants: The field-based consultants will have the best access to the community members targeted by LEDP. Therefore, they should have the primary hands-on responsibility for increasing DRM awareness and capacities. They should be responsible for integrating DRM into the individual program activities, for example through use of the checklists presented in this report. (See Section 4 for resources for community-based DRM activities in Indonesia).

- Develop LEDP-wide engineering design and construction standards/guidelines and a contractor training program for habitable structures, roads and stream crossings, and water supply/sanitation facilities. This work should be conducted in coordination with people that have prior experience in Nias (e.g., ILO and AusAID for roads and stream crossings; NGOs such as the Spanish Red Cross for water supply/sanitation projects).
- Apply the assessment and risk reduction framework presented in this report to each specific program activity / community, including:
  - Collection and evaluation of site- or community-specific information necessary for the hazard assessment
  - Identify site- or community specific vulnerability and resilience factors
  - Prepare a risk reduction plan (including personnel, budget and a monitoring and evaluation component to check the implementation status of the plan) tailored to the program activity / geography
- Identify significant information gaps, equipment or other resource needs based on the above application of the framework to various activities / geographies, and determine which resource needs should be filled as part of LEDP
- Develop templates for contingency plans that can be used across different LEDP activities/facilities

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