Developed by EU-funded Programme for the Prevention, Preparedness and Response to Man-made and Natural Disasters in the ENPI East Region (PPRD East)

PPRD east

Civil Protection and Disaster Management

A Risk/Hazard Assessment Policy for the ENPI Eastern Region

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A Risk/ Hazard Assessment Policy for the ENPI Eastern Region

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A Risk/Hazard Assessment Policy for the ENPI Eastern Region

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CONTENTS

SECTION 1

REGIONAL RISK MANAGEMENT POLICY/ STRATEGY

1 REGIONAL RISK MANAGEMENT POLICY STRATEGY

0.1 Context

0.1.1 The Prevention Preparedness and Response to Man-made and Natural Disasters in the ENPI East Region (PPRD) programme has been designed to contribute to the peace, stability, security and prosperity of the different Partner Countries. The programme has been created with the intention of strengthening the partner countries' resilience and preparedness to protect the environment, population, cultural heritage and infrastructure against the onset of man-made and natural disasters.

The programme as a whole has two specific objectives.

- To contribute to the development of the Partner Countries Civil Protection capacities for disaster prevention, preparedness and response through regional cooperation; and,
- To bring the Partner Countries progressively closer to the EU Civil Protection Mechanism and improve cooperation among themselves.

0.1.2 This policy/ strategy has been developed to implement a regional risk management framework to contribute to the wider objectives of the PPRD project. Additionally it is structured to assist the Partner Countries management of risk through the systematic identification, analysis, evaluation and treatment of these risks.

This policy has also been developed with due regard to EU best practice while also being tailored towards the realities and constraints within the different PPRD East partner countries.

Hazards can have a devastating impact on people's lives, their livelihoods and the environment. Therefore, the main philosophy of the policy is based around three key themes contributing to disaster risk reduction and aligned with the EU Civil Protection Mechanism[1]:

1. **Prevention -** It is vital not only to address the consequences of disasters, but to work on minimising the risk of disasters by investing in prevention. This policy covers three key areas of prevention:
    - Developing knowledge-based prevention policies e.g. design codes, site and selection criteria;
    - Linking stakeholders and policies throughout the disaster management cycle; and,
    - Improving the effectiveness of existing financial and legislative instruments.
2. **Preparedness –** In a number of instances prevention is either not possible or unrealistic. Preparedness to improve resilience at all levels will develop awareness of all stakeholders to anticipate, respond to, and recover from, the impact of likely, imminent or current hazard events or conditions. This policy covers five key areas of preparedness:
    - Training and exchange of key experts;
    - Preparedness exercises;
    - People centred early warning systems;

[1] European Humanitarian Aid and Civil Protection - http://ec.europa.eu/echo/policies/index_en.htm

- Developing technologies to fight disasters; and,
- Engagement of affected communities through community driven preparedness programmes.

3. **Disaster Response Mechanism** – When disasters do occur, cooperation agreements with other countries in the field of civil protection can greatly assist response capacity and improve recovery. The development of cooperation tools between the Partner Countries and the EU Civil Protection Mechanisms can greatly assist with this response. Assistance may arise in such circumstances where affected countries prevention and preparedness mechanisms for a disaster are not sufficient to provide adequate response in terms of available resources. By pooling the civil protection capabilities of the participating countries along with incorporation into the EU Civil Protection Mechanism itself, cooperative tools can be developed that ensure even better protection of people, but also of the natural and cultural environment as well as a countries assets. The EU Community Mechanism for Civil Protection has a number of tools intended to facilitate both adequate preparedness as well as effective response to disaster at community level, these include, the monitoring and information centre (MIC), the Common Emergency and Information System (CECIS), specific training programmes and civil protection modules. Each of the tools will be discussed further, later in this policy document,

This risk management policy has also been structured with due regard and attention for the strategic goals and indicators developed as part of the Hyogo Framework for Action which all the Partner Countries are enlisted.

0.2 Policy Structure

This policy/ strategy is divided into four sections as followed:

- Section One - (this section) explains the background, purpose, principles and objectives of the policy/ strategy while also providing definitions;
- Section Two - outlines the Risk Management Framework that has been adopted with details relating to the wider scope of the risk management process;
- Section Three - outlines the Risk Management Process and the specific themes for conducting a comprehensive, functional and operational risk management process including details of identification, analysis, evaluation and treatment of risks.
- Section Four - elaborates on the risk management framework and risk management process presented in section two and three. This section presents themes and components that need to be considered during implementation of each risk management framework elements. These themes are detailed specifically towards the objectives of the policy while also drawing on the realities and constraints within the different partner countries. They are also aligned with policies and strategies currently considered by the EU Civil Protection Mechanism and priorities for action set-out as part the Hyogo Framework for Action strategy.

0.2.1 Appendix A presents a matrix that considers the different elements of the risk management framework presented in section two and three, cross referenced with the specific policy themes and components presented in section four. The matrix can be used to verify which risk management framework components relates to which policy objective while also highlighting the specific themes that need to be considered when implementing a specific element of the risk management framework. Appendix G also presents a policy implementation flow chart that will assist the user to define the road map for the risk management framework and give direction to relevant sections of the policy.

0.3 Purpose of the Policy

0.3.1 The primary purpose of this policy is to assist the implementation of an efficient, functional and operational risk management framework and process. The risk management framework has been designed to assist the following:

- Facilitate a shift in culture from Response to Prevention and Mitigation;
- Assist the main beneficiaries development of a comprehensive risk management tool that considers both the needs of affected communities and the importance of regional consistencies;
- Define the various stakeholders, their responsibilities and inter relationships in the development of an effective hazard/ risk management process; and,
- Assist the Partner Countries development of current or implementation of new DRR policies and process to bring their existing structures closer to that of the EU Civil Protection Mechanism.

0.3.2 The development and implementation of a comprehensive risk management process will directly assist the following:

- Identification of hazards and there possible impact which will facilitate a priority for action;
- Identification of who is vulnerable and exposed to a particular hazard in a given situation;
- Stipulate how current development programmes can incorporate known hazard risk to facilitate disaster risk reduction;
- Encourage regional cooperation through the technical monitoring of hazards; and,
- Define institutional and legal framework requirements to facilitate the development of the risk management framework.

The risk management process will also directly facilitate the development of the Electronic Regional Risk Atlas (ERRA). The ERRA once operational will be a tool used by the various beneficiaries to monitor the onset of hazards.

0.4 Principles of this Policy

The principles of this policy are as follows:

- To assist the implementation of a top down government driven bottom up community involvement regional risk/ hazard management process;

- Develop a risk management framework to facilitate a regional consistent approach to identifying, monitoring and assessing the risks associated with earthquakes, hydro-meteorological events, chemical accidents, and forest and urban fires;
- Stipulate the importance of developing early warning systems and frameworks that not only consider institutional expertise but also the needs of communities who will benefit from the system; and,
- Assist the development of the ERRA.

0.5 Policy Objectives

- Policy Objective 1 – Promote a culture of prevention, preparedness and response at all Levels in Hazard/ Risk assessment through knowledge, innovation and education;
- Policy Objective 2 – Encourage regionally consistent hazard/ risk mitigation measures in line with current EU civil protection policies and strategies based on technology, traditional wisdom and environmental sustainability;
- Policy Objective 3 – Mainstreaming disaster management into the development process;
- Policy Objective 4 – Establish consistent Institutional, and legal frameworks to create an enabling regulatory environment and compliance regime for facilitating the conducting of hazard/ risk assessment;
- Policy Objective 5 – Implement efficient mechanisms for identification, assessment and monitoring of disaster risks and hazards to develop a regional coherent, contemporary, risk/ hazard forecasting and early warning framework backed by responsive and fail safe communication.

The five objectives stated above have been narrowed down from seven originally defined within the terms of reference developed by the European Commission.

0.6 Definition of Terms

0.6.1 Consistent terminology is essential to ensure a common understanding and approach to risk management. Below is a list of commonly used terminology to ensure consistency, the terms in black within the left hand column are taken from the "Risk Management Principles and Guidelines – BS ISO 31000"[2]. The terms in white are taken from the United Nations International Strategy for Disaster Reduction (UNISDR) "Terminology on DRR"[3]:

Capacity	The combination of all the strengths, attributes and resources available within a community, society or organisation that can be used to achieve agreed goals.
Capacity Development	The process by which people, organisations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvement of knowledge, skills, systems, and institutions.
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impact, which exceeds the ability of

[2] BS ISO 31000:2009 – Risk Management Principles and guidelines
[3] UNISDR Terminology on Disaster Risk Reduction (2009) - http://www.unisdr.org/we/inform/terminology

	the affected community or society to cope using its own resources.
Disaster Risk	The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified time period.
Disaster Risk Reduction	The concept and practise of reducing risks through systematic efforts to analyse and manage the casual factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.
Early Warning Systems	The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organisations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.
Exposure	People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.
Forecast	Definite statement or statistical estimate of the likely occurrence of a future event or condition for a specific area.
Hazard	A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Natural Hazard	Natural process or phenomenon that may cause loss of life, injury or other health impact, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impact of likely, imminent or current hazard events or conditions.
Prevention	The outright avoidance of adverse impact of hazards and related disasters.
Risk	The effect of uncertainty on objectives.
Risk Analysis	The process to comprehend the nature of **risk** and to determine the level of risk.
Risk Assessment	Overall process of **risk identification**, **risk analysis** and **risk evaluation**.
Risk Criteria	Terms of reference against which the significance of a **risk** is evaluated.
Risk Evaluation	Process of comparing the results of **risk analysis** with **risk criteria** to determine whether risk and/ or its magnitude is acceptable or tolerable.
Risk Identification	Process of finding, recognising and describing **risk.**
Risk Management	The coordination of activities to direct and control organisations with regard to **risk**.
Risk Treatment/ Mitigation	The process to modify **risk**
Risk Scenario[4]	Is a representation of one single-risk or multi-risk situation leading to significant impact, selected for the purpose of assessing in more detail a particular type of risk for which it is representative, or constitutes an informative example or illustration
Stakeholders	Person or organisation that can affect, be affected by, or perceive themselves to be affected by a decision or activity.
Technological Hazard	A hazard originating from technological or industrial conditions, including accidents, dangerous procedures, infrastructure failures or specific human activities, that may cause loss of life,

[4] European Commission, 2011. Risk Assessment and Mapping Guidelines for Disaster Management

	injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Vulnerability	The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

SECTION 2

REGIONAL RISK MANAGEMENT FRAMEWORK

REGIONAL RISK MANAGEMENT FRAMEWORK[5]

2.1 The Risk Management Framework

The success of the hazard risk management process is dependent on the management framework, it provides the foundations and arrangements that will embed it throughout the partner countries at all levels. The framework ensures information about identified risks are adequately reported and used as a basis for defining accountability and decision making at all levels. Figure 1 depicts the framework that this policy is based on.

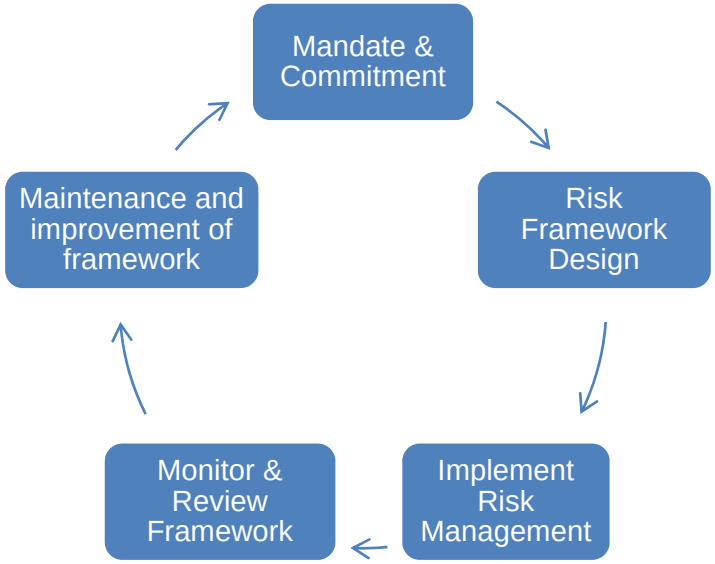

Figure 1 – Framework relationship for managing risk

2.2 Mandate and Commitment

2.2.1 Mandate and commitment of the risk management process is essential to ensure its ongoing effectiveness. The process requires strong and sustained commitment by Governments as well as strategic and rigorous planning to achieve commitment at all levels. To facilitate the risk management process the Partner Countries Governments should consider implementing laws and mandates that:

- Define and endorse the risk management policy;
- Determine hazard risk management performance indicators;
- Assign accountability and responsibility at appropriate levels;
- Ensure that the necessary resources, including finance, are allocated to the risk management process;
- Communicate the benefits of risk management to all stakeholders; and,
- Ensure that the framework for managing risk continues to remain appropriate.

[5] BS ISO 31000:2009 – Risk Management Principles and guidelines

2.2.2 Risk Management Culture, Building Capacity and Competence

2.2.2.1 Developing an effective risk management culture is a critical part of the risk management framework and results in the willingness and motivation of people to:

- Give attention and resources to risk management;
- Comply with the intent and details of risk management policies and procedures;
- Solve practical difficulties in implementing risk management policies and procedures, and do so in a way that is consistent with good risk management principles;
- Manage risk beyond compliance with formal policies and procedures; and
- Communicate about risk openly and appropriately.

2.2.2.2 The Government should attempt to monitor and develop its risk management culture through a range of activities, including but not limited to:

- Demonstrating effective risk management leadership at high government levels as an example to others;
- Monitoring and communicating the value added by risk management;
- Providing education and training in risk management including practical examples;
- Providing risk management within individual objectives and performance appraisals;
- Monitoring attitudes to risk management;
- Ensuring that formal risk management policies and procedure extend into all Government processes, including strategic planning, operational processes, development planning and programmes, project and change management; and,
- Demonstrating commitment, to continually maintaining and improving the risk management framework and process.

2.2.2.3 To build capacity and competencies, which are essential for embedding risk management throughout all levels of government and all stakeholders while also developing risk management maturity, relevant individuals should be provided with appropriate experience, skills and knowledge on:

- Current governance requirements and their sources;
- The legislative and compliance context of risk management;
- The risk policy;

- The risk management process;
- The risk appetite and escalation rules;
- How to identify, assess and manage risk;
- Risk tools and techniques and how and where they are applied including: hazard assessments, vulnerability assessments, asset characterisation and assessment, risk and exposure assessments;
- Reporting risk assessments;
- Where the countries current risk management capabilities stand (its risk management maturity);
- Roles, accountabilities and responsibilities, including the responsibilities of government officials, overseeing ministries and other relevant stakeholders; and,
- A performance assessment of each different risk management process included within the country's overall appraisal system.

The government should ensure that any employees under its control who are performing tasks that can impact on the identification, analysis and treatment of risks are competent on the basis of appropriate education, training and experience.

2.3 Risk Management Framework Design

2.3.1 **Understanding of the Partner Countries and their Current Context** is important to evaluate and understand both external and internal processes that could affect the development and implementation of the risk management framework.

Understanding internal context include:

- Your own governments current structures, roles and responsibilities in relation to:
    - Laws and their appropriateness to encouraging desired outcomes;
    - Policies, objectives and strategies that are in place to achieve them;
    - Capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, process, systems and technologies);
    - Information systems, information flows and decision-making processes.
- Standards, guidelines and modals adopted by different stakeholders;
    - Disaster management processes;
    - Hazard assessment methodologies;

- Vulnerability assessment methodologies;
- Risk evaluation methods;
- Treatment strategies;
- Institutional capacities;

- Relationships with internal stakeholders; and,
- Community involvement.

Understanding external context include:

- Situation in relation to cultural, social, political, legal, regulatory, technological, economic, natural environment within the different partner countries;
- Approaches used in the different partner countries to identify, analyse and assess risk; and
- Approaches used within other non-partner countries to identify, analyse and assess risk.

2.3.2 **Establish a Risk Management Policy** which clearly states the Government's objectives for and commitment to risk management including the appropriate communication methods.

2.3.3 **Accountability** at Government level needs to ensure that there is authority and appropriate competency for managing risk including implementation and maintaining the risk management process and ensuring the adequacy, effectiveness and efficiency of any controls. This can be facilitated by:

- Identifying who is accountable for the development, implementation and maintenance of the framework for managing risk;
- Establishing performance measurements; and
- Ensuring appropriate levels of recognition.

2.3.4 **Integration into Governmental Process,** hazard risk management process should be embedded in all the Governments country development planning in a way that it is relevant, effective and efficient. There should be a country wide inclusion of the hazard risk assessment process at all levels from community engagement, local authorities, institutions and high Government.

2.3.5 **Resources** need to be allocated appropriately so that they facilitate the undertaking of the hazard risk management process. Consideration should be given to the following:

- People, skills, experience and competences across all elements of the hazard risk management process;

- Resources both financial and technological for each step of the risk management process;
- Methods and tools to be used for managing risk;
- Documented processes and procedures;
- Information and knowledge; and,
- Training at all levels through community engagement, school curricula's and university programmes.

2.3.6 **Establishing Communication and Reporting Mechanisms** in order to support and encourage accountability and ownership of risk. The mechanisms adopted should, were appropriate, include processes to consolidate risk information from a variety of sources, and may need to consider the sensitivity of information.

2.4 Implementing Risk Management

2.4.1 In implementing the national strategy for risk management the Government should consider the following:

- Define the appropriate timing and strategy for implementing the framework;
- Identify and appoint appropriate and influential risk champions to promote and drive the process
- Apply the risk management policy and process to national development plans and process;
- Developing legal and regulatory requirements;
- Ensure that decision making, including the development of objectives are aligned with the outcomes of the risk management process;
- Hold information and training sessions; and,
- Communicate and consult with all stakeholders to ensure that its risk management framework remains appropriate.

2.4.2 The various risk assessments should be implemented by ensuring that the risk management process outlined in section 3 is applied through a risk management plan at all relevant levels. This must incorporate all stakeholders and functions of Government.

2.5 Monitoring and Review of the Framework

2.5.1 In order to ensure that the risk management framework is effective and continues to support the implementation of the hazard risk management process at the national level Governments should consider:

- Measuring risk management performance against indicators, which are periodically reviewed for appropriateness;
- Periodically measure progress against, and deviations from the risk management plan;

- Periodically review whether the risk management framework, policy and plan are still appropriate, given the countries current exposure;
- Report on risk, progress with the risk management plan and how well the risk management policy is being followed; and,
- Review the effectiveness of the risk management framework.

2.6 Continual Improvement of the Framework

2.6.1 Based on results of the monitoring and review, decisions should be made on how the risk management framework, policy and plan can be improved. These decisions should lead to improvements in the Governments management of risk and its risk management culture.

SECTION 3

THE RISK MANAGEMENT PROCESS

THE RISK MANAGEMENT PROCESS[6]

3.1 Implementing the Risk Management Process

The risk management process is an integral part of the hazard risk management framework and should be embedded in the culture and practise of the Government systems. For this policy the risk management process has been developed considering EU best practise while also tailored accordingly to the realities and constraints within the partner countries. Figure 2 depicts the hazard risk management process that this policy has adopted. The risk management process will be introduced, with further elaboration contained within section three of this report on the specific regional policy components.

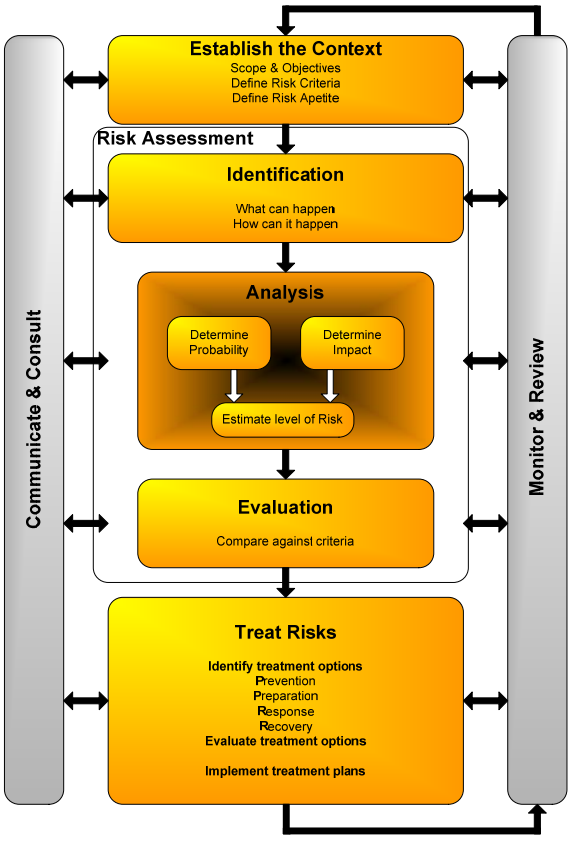

Figure 2 – Risk Management Process

3.2 Communication and Consultation

Communication and consultation with all relevant stakeholders should take place at all stages of the risk management process. This applies to relevant Government ministries and bodies, local authorities' external hazard focused institutions, international and local non-government organisations while also engaging with affected communities. Stakeholder engagement throughout the process and,

[6] BS ISO 31000:2009 – Risk Management Principles and guidelines

specifically at an early stage will assist addressing issues relating to the risk itself, its cause, its consequence and the measures being taken to treat it.

Communication and consultation with communities directly affected by disaster events is important as it is their wellbeing that is at stake. Their engagement will assist the development of any treatment strategies that need to be implemented.

Communication and consultation should facilitate truthful, relevant, accurate and understandable exchanges of information.

3.3 Establishing the Context

When establishing the context the Government can articulate its objectives, define the external and internal parameters to be taken into account when managing the risk and sets the scope and risk criteria for the remaining process.

The risk management process needs to establish a context to define the objectives, strategies, scope that are required to undertake a hazard risk assessment by all stakeholders.

Establishing the context also requires the risk criterion to be defined. This is used to evaluate the significance of a risk. The criterion needs to reflect the Governments and projects objectives, resources and exposure to historic hazardous events.

The following factors should be considered when defining the risk criteria:

- The nature and type of causes and consequences that can occur and how they are measured;
- Likelihood of an event;
- Timeframes of the likelihood and/ or consequences;
- Level of risk to be determined;
- Views of stakeholders;
- The acceptable level of risk; and,
- The possible effect of multiple risks.

3.4 The Risk Assessment Process

The risk assessment process consists of three different aspects risk identification, risk analysis and risk evaluation. Each process will be introduced in the section below with further explanation on the specific components that need to be considered during implementation presented in section four. Considering these components will allow the development of a consistent regional approach to the undertaking of risk assessments and the disaster management process.

3.4.1 **Risk Identification** is essential to identify sources of risk, areas of impact, events and their causes and their potential consequences. The aim of this process is to generate a comprehensive list of the risks posed by each of the hazards based on those events that might create, enhance, prevent, degrade or delay the achievements of the

objectives. The risk events that are considered need to be selected by a pre-determined set of criteria by considering human, political/social and economic/ environmental impact indicators. Comprehensive identification at this stage is essential, because a risk that is not identified at this stage will not be included in further analysis. Risk identification also includes an examination of the possible knock-on effects of a particular consequence. As well as identifying what might happen it is necessary to consider possible causes and scenarios that show what consequences can occur. Risks will be identified using tools and techniques that are relevant to the objectives, capabilities within the partner countries and to the risks faced. Each activity should be conducted with appropriate background information by people with appropriate knowledge and understanding of the different risks.

3.4.2 **Risk Analysis** involves developing an understanding of the risk through specific hazard, vulnerability and asset assessments. The specifics of these assessments are discussed further in section four and within relevant appendixes. The results of the risk analysis provide an input to the risk evaluation and to decisions on whether the risks need to be treated and the most appropriate risk treatment strategies and methods. The risk analysis also provides input to decision makers where choices must be made on the most applicable and appropriate risks to treat. The risk analysis stage will consider the cause, source, and underlying risk factors and the likelihood that those consequences can occur. Factors that affect the consequences and likelihood of occurrence also need to be identified. When considering an event the impact of multiple consequences can have on multiple objects need to be considered. The confidence in determining the level of risk and its sensitivities to preconditions and assumptions should be considered and communicated effectively to decision makers and other relevant stakeholders. Factors such as divergence of expert opinion, uncertainty, data availability, quality, quantity and ongoing relevance of information or limitation on modelling should be stated and highlighted. Consequences and their likelihood can be determined by modelling the outcomes of an event or set of events, or by extrapolation from experimental studies including all available data.

3.4.3 **Risk Evaluation** is undertaken to assist in making decisions, based on the outcomes of risk analysis. Evaluation of the risk analysis process is undertaken to assess which risks warrant greater consideration, this allows for a priority list for treatment strategy implementation to be developed. Risk evaluation involves considering and comparing the level of risk identified during the analysis stage against the risk criteria originally established, this helps to understand the specific level of treatment required. The risk evaluation stage, in some circumstances can lead to a decision to undertake further analysis.

3.5 Risk Treatment

Risk treatment involves the selecting of one or more options for modifying the risks to acceptable levels. The risk treatment involves a cyclical process covering: assessing the treatment, deciding whether residual risk levels are tolerable, if not generate a new risk treatment method and then assess the effectiveness of that treatment. Selecting the most appropriate risk treatment options involves balancing the costs and efforts of implementation against benefits derived with regard to the prescribed outcomes including social responsibility and the protection of the natural environment. Risk treatment itself can induce risk monitoring needs to be an integral part of the risk treatment plan to give assurance that the measures remain effective. Specific international recognised risk treatments strategies given the objectives of the project have been presented in section four and appropriate appendixes, these include social intervention and physical protection measures.

3.6 Monitoring and Review

It is essential that monitoring and review of every aspect of the risk assessment process is a planned activity throughout which involves regular checking and surveillance. The process should be developed for the purpose of:

- Ensuring controls are effective and efficient in both design and operation;
- Obtain additional information to improve the risk assessment;
- Analysis and learn lessons from events, changes, trends and successes and failures;
- Detecting changes to risk criteria which may require alteration to risk treatment and priorities;
- Identify emerging risks.

SECTION 4

REGIONAL RISK MANAGEMENT POLICY THEMES AND COMPONENTS

REGIONAL RISK MANAGEMENT POLISY THEMES AND COMPONENTS

4.1 Introduction

4.1.1 This section of the policy, documents a number of specific themes and process that can be used to assist the implementation of the risk management framework and risk management process. Each topic sets out what should be considered when implementing the specific aspect of the risk management framework. The different points presented below were developed through researching current the hazard risk management contexts within each of the different partner countries and EU/ international best practise regarding both risk management and disaster risk reduction. The themes below also cover concerns and issues discussed during the Risk Assessment Workshop held in Tbilisi, Georgia in April 2012.

4.2 Laws and Regulations

4.2.1 Laws and regulations are to be developed that cover all risk management activities including the risk assessment process itself while also addressing disaster management. Mandates need to be backed by laws that support the development and incorporation of risk management.

4.2.2 The laws are primarily required to define accountability to the roles and responsibilities of the different stakeholders. While also facilitating financial resources for training, new technologies, research centres and continuous development.

4.2.3 A number of current active laws are evident within the partner countries that cover elements of disaster management. Where existing laws were identified as being appropriate regulation could be developed to incorporate additional risk management activities.

4.3 Financial Mechanisms

4.3.1 Financial mechanisms are required to facilitate all aspects of risk management at all levels. Financial resources are required to be available so they not only consider the setting up of the risk management process but also to consider the dynamic nature disaster risk management and disaster risk reduction.

4.3.2 The availability of funding is considered to be the major constraint when Governments are considering the implementation of rick management activities. Governments need to consider the financial advantages of a functional and operational risk management framework. Incorporating Cost-benefit analysis into the risk management process is beneficial at any stage especially when considering risk mitigation and treatment methods. This analysis method can substantially justify the methods being proposed.

4.3.3 Cost-benefit analysis is a major decision-supporting tool commonly used for appraising projects. The process can be used to organise, appraise and present the costs and benefits of projects taken by public sector authorities and local, regional and central Governments. Two different approaches for measuring the net benefits of disaster risk management were outlined in a cost-benefit analysis manual[7]. The two approaches documented include:

[7] Cost-benefit Analysis of Natural Disaster Risk Management in Developing Countries – Reinhard Mechler, 2005, GTZ

- A risk-based forward looking approach building on a detailed assessment of hazard, vulnerability (fragility and exposure) finally leading to risk and risk reduction; and
- An impact-based, backward looking approach relying on information on past damages.

4.3.4 The major benefits of cost-benefit analysis in the context of risk management relate to the increased reduction to the impact from disasters and the comprehension of financial saving that can be realised from implementing mitigation measures. The results from cost-benefit analysis make a convincing case for risk reduction[8].

- The world bank and US Geological Survey calculated that economic losses worldwide from natural disasters in the 1990's could be reduced by $280bn if $40 were invested in preparedness, mitigation and prevention strategies;
- In China $3.15bn invested over 40 years in measures to control floods is estimated to have prevented potential losses of $12bn;
- A World Bank team working in La Paz, Bolivia, Calculated that disaster prevention and preparedness would cost $2.50 per capita, whereas annual losses from property damage alone resulting from natural disasters were estimated at $8 per capita; and,
- According to Oxfam, the value of cattle saved on a flood shelter covering approximately four acres in Bangladesh during 1998 floods was Tk4m, against a construction cost of Tk700,000.

4.4 Gap Analysis

4.4.1 Conducting a gap analysis is an important aspect of the risk management framework. The technique will assist with determining the steps required to be taken to move from the current risk management process to a fully functional and operational risk management framework.

4.4.2 The gap analysis process consists of identifying and listing risk management process that are currently operational within the Government structure. This information is then required to be cross referenced with the processes that are required to deliver the stated national risk management objectives. A number of the key aspects are discussed within this policy. The gap-analysis will highlight what is required to fill the gaps that are evident from current practise and to realise objectives.

4.5 Risk Assessment Process

4.5.1 Introduction

4.5.1.1 The risk assessment methods that are presented within this policy are an integral element of the risk management process, most notably risk identification, risk analysis and risk evaluation.

4.5.1.2 The risk assessment process is undertaken through the development of a number of different methods. Risk can be defined a number of ways but for the purpose of this policy risk will be expressed as.

[8] Disk Risk Reduction, Mitigation and preparedness in development and emergency planning – John Twigg, 2004, Humanitarian Practice Network

Risk = Hazard x Vulnerability x Exposure

4.5.1.3 The Risk Matrix approach as described in Appendix B can be used at national level to assist risk identification. It can define a recordable disaster while also developing an understanding of where additional analysis is required. The identification of risks needs to be undertaken in a step-wise approach consisting of four components: scenario building, extent of quantitative analysis (the extent of hazard that determines a risk), number of risk and risk scenarios considered (amount deemed as requiring attention) and temporal horizons (likely return period in the short term)[9]. Three key elements need to be recorded when identifying a hazard these include: location (co-ordinates/ area), probability of occurrence and intensity. Consistent recording of hazards throughout the identification phase is essential to ensure separate hazard can be compared equally. Probability of occurrence can be considered as a percentage of a probable return period over a set length of time. Intensity otherwise known as impacts can be characterised in a number of different of ways, these include but are not restricted to:

- Cost – relating to the acceptable financial impact from a disaster in USD;
- Casualties – related to the total number of very significant injuries or human deaths as a result of a disaster may include:
  - Effected people – relates to number of people reported as being injured and ill requiring hospital assistance;
  - Displaced people – relates to the number of people displaced from their homes as a result of a disaster;
- Environmental impact – related to the scale/ size (km) of a disaster, degree of environmental /ecological damage (e.g. (1). slight up catastrophic), (e.g. (2). Slight short term toxicity to totally uninhabitable for several years –requiring significant clean up); and
- Political/ social considering various levels of impact that include the following criteria: public outrage/ anxiety, international involvement, impact on public order and safety, loss of finical system, loss of medical systems, loss of ability for government to communicate;
- Security – loss of territory, impact on territory of others, ability to govern own territory.

It is the understanding of the level of intensity and probability of occurrence that define a recordable hazard.

The consideration of the impact of a hazard must be undertaken in accordance to a minimum degree of common understanding throughout the partner countries. This process known as “Scenario Building” sets criteria at a national level when identifying risks ensuring at least all significant hazards that meet these parameters are considered. The EU risk assessment guidelines recommends that for national risk identification at least all significant hazards that would on average occur once or more in 100 years and for consequences that represent potential impact where greater than 50 people effected, economic and environmental costs above €100 million, and political/ social impact considered significant or very serious. The criteria levels need to be defined by the different partner countries. However it is recommended that this is where the financial implications exceed a threshold of 0.6% of gross national income (GNI).

[9] European Commission, 2011. Risk Assessment and Mapping Guidelines for Disaster Management

4.5.1.4 As previously discussed the risk analysis process is undertaken to comprehend the nature of risks identified and too determine the extent of that risk. For all risks identified within this process the identifier is required to carry out a detailed estimation of the probability of its occurrence and severity of its potential impact.

4.5.1.5 On the completion of the risk analysis stage, risk evaluation needs to be undertaken to compare the results against the risk criteria (as defined in section 3.3). The risk matrix can again be used during risk evaluation to allow comparison of different risks and assist decision making on the significance of a risk and whether each risk needs to be treated.

4.5.1.6 The identification, analysis, and evaluation of hazard data is known to be problematic. The UNDP through a Global Risk Identification Platform have initiated with assistance from national Governments, a sustainable institutional model for the systematic collection, analysis and interpretation of disaster data. The concept known as a National Disaster Observatory (NDO) is designed to engage with Governments to improve the evidence base on disaster related losses, by promoting and supporting the systematic organisation of disaster data into a national database for analysis and use, institutionalising these efforts at a national level. The establishment of an NDO enhances and develops capacity for disaster analysis at both national and local levels, and strengthens the national disaster risk reduction system[10]. Figure 3 presents an idealised hazard risk assessment framework highlighting the different stakeholders, how their involvement is interlinked and the need to adopt a top down bottom up approach to undertaking a risk assessment.

4.5.2 Asset Characterisation/ Exposure

4.5.2.1 Definitions

Asset - Any item of value or importance. These may include physical / tangible items (property, infrastructure, utilities), cyber and information (communications or financial systems), or human and living elements (functions and critical knowledge). Critical assets are a sub-set of these, and are identified as assets whose unavailability or loss would have a major impact. Concept applicable at varying scales; at a specific organisational / plant level. a regional or 'Sector-Specific' (e.g. power generation, food processing & distribution), and National (e.g. agriculture).

Asset Characterisation - The process that identifies and gathers details of assets are critical to a nation, region or organisation.

[10] Global Risk Identification Platform – National Disaster Observatory
http://www.gripweb.org/gripweb/?q=search/node/National%20Disaster%20Observatory

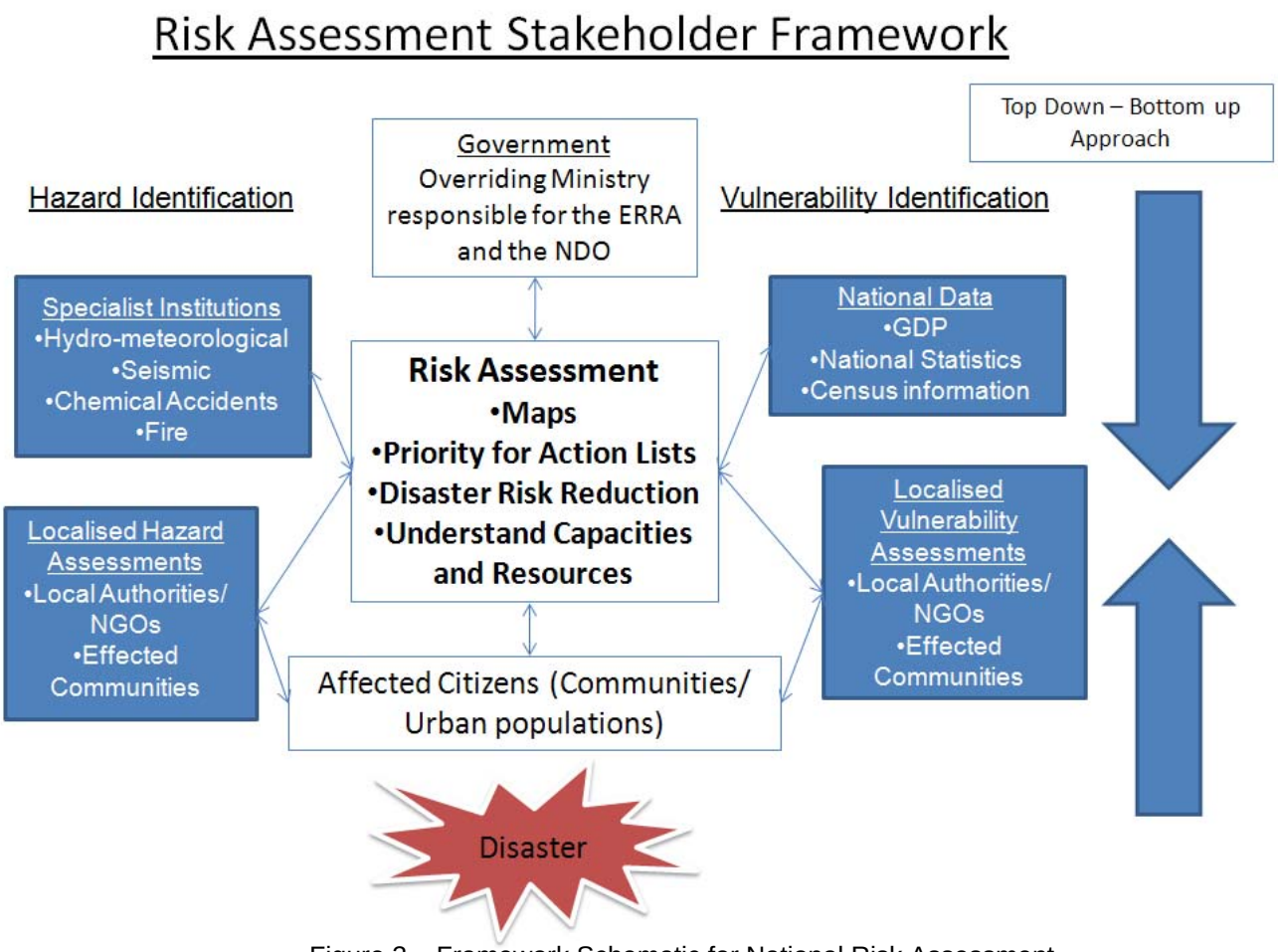

Figure 3 – Framework Schematic for National Risk Assessment

4.5.2.2 Asset characterisation typically occurs at an early stage in a security or natural hazard assessment as it seeks to identify and rank assets which if damaged would diminish, either at the organisation or regional level the ability to meet objectives. Objectives in this case might include the provision of transport, food, power, healthcare etc.

This can be a large task, especially in populated and significantly industrialised regions. Therefore in order to make the process efficient it is to address things in two stages:

- The top screening stage where the importance of the asset is assessed;
- The secondary stage where assets are selected examined in more detail and used in analysis.

It is important to recognise the effect of scale, but also to be aware that the boundary between regional, national and local / organisation level can vary, and elements in each can be interdependent. For example loss of an organisation or facility appears to be a local effect, which may have been impacted at the local level (e.g. flooding or fire) but also by a regional event (e.g.loss of power or transport). It is also possible that a local organisation, possibly due to providing a critical component or action in a supply chain can have a regional impact (e.g. a gas pumping station or a water retaining / electrical generating reservoir.

Considering the complexity above it is important to collect sufficient data regarding individual assets at a local and sector specific / regional level, such that an accurate understanding is arrived at.

4.5.2.3 Top screening stage (1)

Gathering basic data for all assets including size, location, structure, age, purpose of the facility / asset, initial estimation of importance / consequence if it were to be diminished / fail. Additional data matched to the hazard risk assessment, assuming the worst case – for example types of material stored (toxicity), maximum fatalities, and serious injuries, financial and economic losses. Great precision is not required at this stage as it is merely used to exclude low consequence items from further assessment, but retain their record in the event that changes are recognised or the asset is required as part of a disaster recovery plan.

4.5.2.4 Asset Selection stage (2)

The next stage is important in taking the remaining assets forward to a full characterisation process so that they can be used in subsequent threat, vulnerability and consequence analyses. To do this the steps in Table 01 below should be followed and data coming out of each step recorded. It should be noted that there will be a significant degree of re-iteration between steps 1 to 3, and that step 3 is in particular dependent on the scale/ level being adopted (e.g. specific organisation / operation, local or regional) of the assessment. These 3 structured stages enable the characterisation of the various physical, logical and resource factors that may be required in subsequent analyses. Step 5) can be defining step since if the consequence isn't high the view may be taken that further analysis isn't warranted.

Step	Task	Details
1	Identify critical functions	Identify critical functions of the asset at the appropriate level (local / regional)
2	Identify critical assets	Identify critical assets / components of that enable 1) above
3	Identify critical infrastructures	Identify critical internal and external infrastructures (scale dependent) and any dependencies
4	Identify existing countermeasures	Identify what protects the functions and assets in 1) -2) against the hazards / threats envisioned (e.g. building codes, contingency plans, redundancy)
5	Identify potential consequences	Identify the potential (worst) consequences / impacts to the assets and functions from disruption and total loss
6	Select assets for next stages in analysis	From 4) and 5) develop a ranked list of critical functions and assets which will be used in further risk and resilience analysis

Table1 - Asset Characterisation Steps

4.5.2.5 Once captured this data from the selected assets can be taken forward to the vulnerability and consequence analysis stages of the hazard risk assessment.

4.5.3 **Hazard Risk Assessment**

4.5.3.1 The development of hazard maps is an essential element of the hazard risk management process. The hazard assessment is required to be undertaken

considering all primary and secondary hazards, while also considering the implications of multi-hazard events. Appendix C outlines international developed methodologies used to assess the hazards that are relevant to the PPRD project.

4.5.3.2 Hazard risk assessments are typically undertaken by specific hazard focused institutions, Government ministries and other entities. The maps are developed through the interpretation of historical data/ reports, current recording techniques and expert opinion.

4.5.3.3 When considering the scope of this project the development of hazard maps are particularly relevant when determining the risk associated with the possible occurrence of seismic events, flooding, drought, forest fires and chemical accidents. Assessment and presentation methods covering all types of hazards adopted by the different Partner Countries need to be consistent regarding their data output.

4.5.4 Vulnerability Assessments

4.5.4.1 Vulnerability assessments are known to be the most complicated component of a risk assessment. This is primarily because the concept of vulnerability has wide ranging interpretations and multiple definitions. Vulnerability within this policy is defined as the conditions determined by physical, social, economic and environmental factors or processes that increase the susceptibility of a community/ settlement to the impact of hazards. The definition with respect to this project also covers the lack of resilience that influences the capacity to anticipate, cope with, resist, respond to, and recover from the impact of a hazardous event.

4.5.4.2 The assessment of vulnerability can be categorised by considering physical and social vulnerability. Physical vulnerability relates to the built environment around us comprising of the buildings we occupy and infrastructure we use. Understanding the impact hazards have on the physical environment around us can greatly assist the identification of vulnerable groups. Physical vulnerability is discussed in greater detail in the Asset Characterisation section of this report. Appendix D also outlines and describes a multi-spatial approach for defining and assessing physical vulnerability. Social vulnerability in contrast considers issues that define an individual's/ communities current situation through and how this impacts their exposure to hazards. Social vulnerability is discussed further below; Appendix D also presents indicators used as part of the "The Prevalent Vulnerability Index" tool, these indicators assist with the understanding of social-economic and social resilience to allow different groups/ areas/ regions to be compared.

4.5.4.3 Vulnerability is a complex and multi-dimensional circumstance, its appraisal is not easy as its issues are fully enmeshed in the structure and evolution of contemporary societies. The Pressure and Release framework developed in the classic book "At Risk" provides a progression analysis of vulnerability that traces unsafe locations and fragile livelihoods through dynamic pressures to root causes. It ties vulnerability to access, marginalisation, capacity and recovery through an original suit of integrated diagrams[11].

4.5.4.4 Vulnerability assessments are also an essential element of local community preparedness. By understanding local vulnerabilities measures can be implemented to reduce their exposure to the possible onset of a disaster. Community participation is known to assist their own development by empowering affected individuals to

[11] The Routledge Handbook of Hazards and Disaster Risk Reduction – Wisner et al, 2011, Routledge

improve their own capacity to anticipate, cope, resist and recover to the onset of disasters.

4.6 Education

4.6.1 Educational programmes at all levels considering all risk management activities represent a commitment to developing a risk management process that can be incorporated into relevant stakeholders day to day activities. It is imperative to ensure the rights of people to education and to produce education that sustains life.

4.6.2 A number of educational relevant course were evident both within primary and secondary school curricular but also as part of university programmes. However, Governments need to develop educational courses that cover the following.

- Community level preparedness programmes, so that those who are directly affected by disasters can be empowered to anticipate, cope, resist and recover;
- School curricular at all levels to develop awareness of how hazards affect them along with life safety courses; and,
- University programmes that cover all aspects of Disaster Risk Reduction:
    - Vulnerability assessments incorporating the use of GIS technology;
    - Hazard assessment by applicable hazard focused institutions incorporating the use of GIS technology;
    - Treatment methods;
    - Civil protection;
    - Modern technological monitoring, forecasting and early warnings;
    - Asset exposure characterisation;
    - Building and infrastructure design.

4.6.3 Educational programmes also need to be delivered within communities that are the most exposed to disasters. These programmes would focus on such issues as home safety, the impact of localised hazards and what can be put in place to improve recovery.

4.6.4 Universities also need to develop academic research programmes that are relevant to the policy and wider disaster risk reduction practise of the country. Disaster risk reduction analysis is sensitive and is a very complex subject that requires specialised research. Research programmes need to be developed to have a greater focus on interdisciplinary activities not just between different academic study areas but also with policy makers in Government and practitioners working in the field and along with the representative from the different partner countries. Research programmes should look to incorporate policy and decision makers from different local and national Government ministries, practitioners working in the field and institutions who specialise in social, political, geo-physical and engineering studies.

4.7 Communication

4.7.1 Communication across all Government sectors and applicable stakeholders is essential not just to report the possible occurrence of disasters but to also facilitate the identification, analysis, evaluation and treatment of risk.

4.7.2 Government mandates and policies need to be developed that assist the development of a cross cutting disaster risk reduction platform that incorporates representatives from all the different stakeholder groups. Covering the various Government ministries, hazard focused institutions, overseeing organisations, practitioners, and representatives from effected communities.

4.7.3 The communication of results both negative and positive to stakeholders will assist the development of the risk management process by streamlining its effectiveness. Early warning systems also need to be developed to consider the most appropriate automotive fail safe communication frameworks. These need to consider links from appropriate monitoring to decision maker and then onto the population who could be affected.

4.7.4 Productive and proactive partnerships with the media can greatly assist the development of the disaster management process and specifically the dissemination and communication of information. Media have developed process and methods (radio, television and social media) to disseminate vast quantities of information to the public. These mechanisms can be particularly useful for disseminating warning information regarding an impending hazard. Media can also assist with the preparedness of the population in the face of disasters; educational information can be disseminated through popular television shows, radio programmes and editorial newspapers. For media to become an effective tool within the risk management framework media workers should make more of an effort to inform themselves about resources available to make disaster risk reduction an exciting and engaging topic for their audience.

Where appropriate journalist should interact and cooperate with scientists, Government officials and disaster risk reduction practitioners to assist with the communication and dissemination of disaster related information. Where partnerships can be developed a real improvement can be realised.

4.8 Treatment/ Mitigation Measures

4.8.1 Electronic Regional Risk Atlas (ERRA)

This risk management policy has been developed to facilitate the creation and design of the ERRA. The ERRA at a national level will give an indicative visual representation of the projected hazards and the impact these hazards could cause. At a local and regional level the ERRA will include general information showing where key infrastructures (roads, railways, dams, and airports – asset characterisation) are located and how they interact with specific hazards while also considering the vulnerability of the population.

The ERRA at national level can be used to facilitate a general understanding of how each hazard and general understanding of vulnerability could impacts on a region/ area. At a local level the ERRA will be developed so Governments can visualise the level of risk associated with a certain location. The localised risk will consider the likely occurrence of a hazard along with the vulnerability of the population within the

footprint of that hazard. This information can then be used to assist decision making regarding treatment strategies to reduce the risk of the identified hazard.

The ERRA will also incorporate facilities to monitor and then forecast the occurrence of slow on-set hazards such as floods, droughts and possible forest fire triggers.

4.8.2 **Early Warnings** linked to monitoring systems of hazards can greatly improve the chances of survival from the onset of disasters. This risk assessment policy has documented methods that facilitate the identification, analysis and evaluation of risk. Once the extent of a risk is known, forecasting and early warning systems can be developed primarily based around the setting of trigger levels incorporated into current monitoring systems of a particular hazard. It is essential that these forecasting and warning systems are backed by responsive, fail safe communication mechanisms incorporating appropriate information technology. Any early warning system needs to be developed to incorporate technically appropriate forecasting methods but also participatory driven by those who would be affected by and first to respond to a disaster. Figure 4 below presents an idealised early warning system framework highlighting the different stakeholders and how there involvement is interlinked. An early warning system will be evaluated by its capacity to save lives and reduce losses rather than on how quickly it issues a warning, the involvement of affected communities will give this the best chance. Further details on developing early warning systems (EWC) are documented in the EC working document –Towards Better Protecting Citizens against Disaster Risks: Strengthening Early Warning Systems in Europe[12].

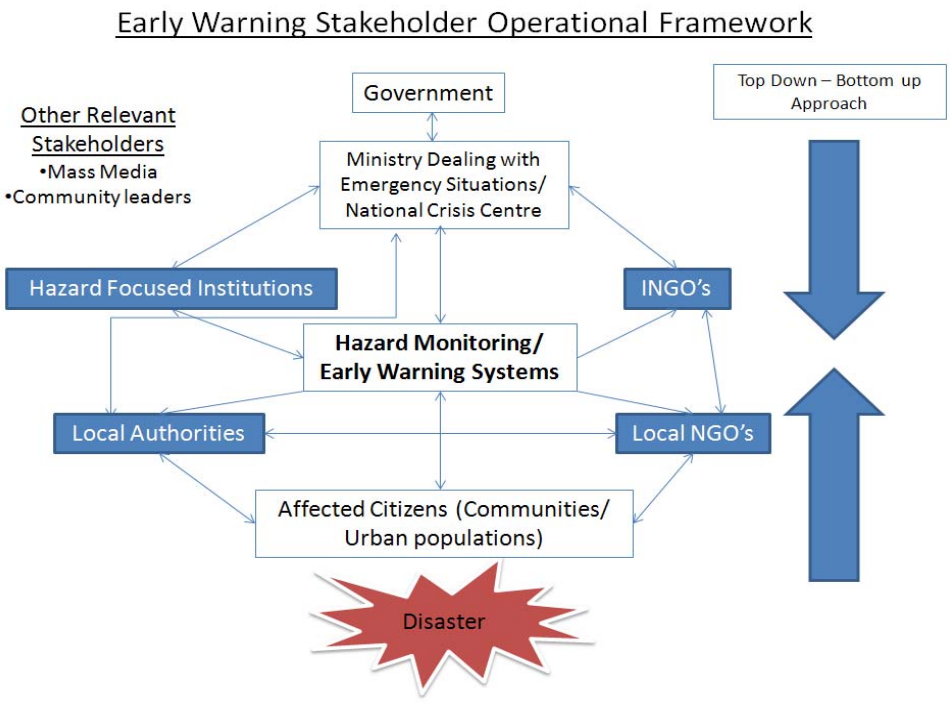

Figure 4 – Framework Schematic for Early Warning Stakeholder involvement

[12] European Commission – Strengthening Early Warning Systems in Europe, 2007. Available at: http://ec.europa.eu/echo/policies/prevention_preparedness/preparedness_en.htm

4.8.2.1 Early warning systems can vary significantly depending on the type of hazard being monitored. Monitoring of river levels along with interpretation of weather forecasting linked to trigger levels are used to develop early warnings for possible flood events. The development of early warnings for drought events incorporates and understanding of abnormal weather patterns, agricultural indicators such as reduced crop production and animal mortalities while also consideration of hydrological conditions. The initial monitoring of forest fires concerns weather conditions, warning are only disseminated in the event a forest fire could possibly interacting with human activity. Early warnings in the event of an earthquake have been developed but they can be very expensive to implement and give only minimal warning. Research has shown that if individuals are educated to understand when they are in an earthquake and what to do their chance of survival is greatly increased, as document in an IFRC Guidelines on preparing, responding and recovering to earthquakes[13].

4.8.3 **Community Preparedness** is an essential mitigation measure; once the extent of a known hazard has been identified preparing communities is the most effective method for reducing the risk of that hazard. Their involvement throughout the risk assessment process can significantly reduce the consequences of a hazard and improve their resilience to recovery after a disaster has occurred.

Disaster preparedness can be defined as measures taken to prepare for and reduce the effects of disasters. Generally this includes the ability to predict and where possible prevent or mitigate their impact on vulnerable population, as well as improve response to and effectively cope with their consequences. Community preparedness covers a number of activities including: maintaining appropriate early warning systems, gaining political support, agency mandates, acquiring resources, developing personal skills, expertise and knowledge, managing information, and managing linkages with networks of relevant stakeholders.

Community preparedness can appear to be difficult and complex. It is more manageable if it is taken based on everyday life and dealt with as community safety, health and well being along with adequate education, gender equality and sustainable livelihoods improvement. Learning from and advising communities of the risks they face, their vulnerabilities and capacities is the first step in preparedness primarily through awareness, training and educational programmes.

A number of programmes have been developed by international Non-Government Organisations to assist with community preparedness:

- IFRC – Vulnerability and Capacity Analysis (VCA)[14];
- UNDP – Community Based Approaches to Local Development;
- UNDP – Local Level Climate and Risk Assessments.

4.8.4 **Technology**

4.8.4.1 Technology plays an important part in the development of a functional and operational disaster risk management framework. The monitoring of hazards needs to use technology that has the capacity to capture data that can be manipulated to develop useable hazard maps. The data capture methods also need to facilitate the setting up

[13] IFRC – Earthquakes, Guidelines on preparing, responding and recovering, 2012
[14] IFRC VCA Web site - http://www.ifrc.org/en/what-we-do/disaster-management/preparing-for-disaster/disaster-preparedness-tools/disaster-preparedness-tools/

and dissemination of appropriate forecasting and early warning information in the occurrence of hazardous events.

4.8.4.2 Appropriate technology also needs to be considered when developing hazard assessment methodologies. Using internationally recognised methodologies will assist with the risk analysis and evaluation stages across the partner countries.

4.8.5 **Traditional Wisdom**

4.8.5.1 The exposure of communities to natural hazards is not new and people have been living in hazard-prone areas for centuries in some cases for thousands of years. They have inevitably developed methods and techniques for defending themselves and their livelihoods.

4.8.5.2 The application of indigenous knowledge in the face of hazards and other threats is referred to as a coping mechanism or coping strategy. The choice of skills and resources to be applied varies according to the nature of the threat, the capacities available to deal with it, and a variety of community and individual priorities.

4.8.5.3 Local communities have developed a number of coping mechanisms and when developing treatment strategies the following should be considered[15]:

- People in hazard prone areas have acquired considerable knowledge and technical expertise for managing risk;
- Indigenous knowledge and coping strategies are often overlooked and undervalued;
- Coping strategies are very diverse comprising of economic, technological, social and cultural;
- It is important to look objectively at all forms of knowledge – indigenous and external, to identify the most suitable approach for each situation; and,
- Indigenous knowledge is affected by changes in economy and society at large and often undermined by these changes.

4.8.6 The identification of traditional wisdom or coping strategies can only be realised by engaging with the communities that are directly affected by these hazards. A number of tools have been developed that can assist with the identification of such coping strategies most notably the VCA. **Preparedness through the EU Civil Protection Mechanism**

4.8.6.1 Through five different approaches, the EU Civil Protection Mechanism actively prepares member states for the on-set of both natural and man-made disasters. These approaches cover[16]:

- **Training and Exchange of Experts**, that aims to reinforce and facilitate European co-operation in civil protection assistance intervention. Experts who have trained together can interact better in the field and will posses similar skills to assist coordination and assessments. The Civil Protection

[15] Disk Risk Reduction, Mitigation and preparedness in development and emergency planning – John Twigg, 2004, Humanitarian Practice Network

[16] EU Civil Protection – Preparedness - http://ec.europa.eu/echo/policies/prevention_preparedness/preparedness_en.htm

Mechanism also facilitates the secondment of national civil protection experts into other participating states departments on all aspects of emergency intervention.

- **National Expert Tabloids,** are distributed to share experiences, advertise training and report on exercises.

- **Exercises**, organised by the EU are designed as field test aiming to establish a common understanding of co-operation in civil protection intervention and to assist the response during disasters.

- **Early Warnings Systems and Other Technologies,** are of particular importance to the EU Civil Protection Mechanism, it is seen as being one of the most effective methods for reducing the impact of disasters when they cannot be prevented. The EU promote a number of systems that provide early warning information regarding the onset of natural disasters, these include:

    - Meteoalarm is an internet-based alert platform, established by the European meteorological services, which issues European weather warnings through a multilingual interface;

    - The Global Disaster Alerts and Coordination System (GDACS) developed jointly by the EU and UN is fully automatic alert system which gathers data about natural events (earthquakes, tsunamis, tropical storms, floods and volcanoes);

    - European Flood Alter System (EFAS) financed through the European Commission alerts the Monitoring and Information Centre (MIC) on the most server flood events 3-10 days before the event;

    - European Forest Fire Information System (EFFIS) also developed by the European Commission provides daily meteorological fire danger maps and forecasts up to 6 days before;

    - The European Mediterranean Seismology Centre (EMSC) provide continuous up to date monitoring of seismic activity around the Mediterranean and throughout Europe; and,

    - Intergovernmental Oceanographic Commission cooperate with the European Commission on the establishment of early warning systems for the North Atlantic and Mediterranean region.

- **Developing Technologies to Fight Disasters,** is a priority of the European Commission thus they have invested heavily in there development. Their involvement cover three specific initiatives: research, information society and the Joint Research Centre (JRC) all setup to facilitate the development of disaster forecasting and disaster management.

4.9 Prevention

4.9.1 Introduction

4.9.1.1 Prevention measures can be implemented in a number of approaches and there intervention goes far beyond the physical treatment of potential hazards. Preventing the impact from disasters must also incorporate reducing the vulnerability and enhancing capacities of affected communities. Capacities can be built on and vulnerabilities reduced so some hazards are morphed into resources. Listed below are a number of preventative measures that need consideration and incorporated into national planning.

4.9.1.2 The preventative measures presented below are enshrined within the policies and strategies developed by the EU Civil Protection community.

4.9.2 DRR and the National Development Planning Process

The national development planning process will not necessarily reduce vulnerability to natural hazards instead it can unwittingly create new forms of vulnerability or exacerbate existing ones. Solutions for securing sustainable development, reducing poverty and increasing hazard resilience need to be explicitly and actively sought. Such solutions are best derived by integrating disaster risk reduction strategies and measures into the overall national development planning process, thus viewing disaster risk reduction as an integral component of the development process rather than its own entity. Within the sections below a number of approaches are presented that can assist with adaptation of disaster risk reduction into the national development planning process, the methods presented are further elaborated in a Guidance Notes titled “Tools for Mainstreaming Disaster Risk Reduction” developed by J Twigg and C Benson[17].

4.9.3 **Poverty Reduction Strategies** have become the principle objective of many developing countries including within all the members of the partner countries. Each country has actively submitted Poverty Reduction Strategy Papers (PRSP). Each PRSP outlines a countries macroeconomic, structural and social policy and programmes to reduce poverty and promote pro-poor growth. Disasters are known to have a direct impact on the poor and it is widely acknowledged that poverty increases an individual’s exposure to risks and income shocks. Four essential actions have been devised that are integral to the preparation of PRSP to ensure that disaster risks are adequately assessed and managed:

- An early assessment of vulnerability to natural hazards should be undertaken in hazard prone areas;
- Rational, informed and explicit decisions should be taken on whether and how to address significant risk;
- The role of disasters and associated risks in contributing to other characteristics of poverty and their potential implications for the achievement of related strategic objectives should be carefully explored; and
- Post disaster support should be planned ahead of time to support both rapid recovery and enhanced resilience to future events, particularly of the poor.

[17] Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations – C Benson and J Twigg, 2007, Provention Consortium

4.9.4 **Country Planning** within each of the partner countries is applied in some form through which problems, needs and interests are analysed, sectoral and thematic areas of focus are identified and broad levels of assistance planned. Considering hazards and their related risks in country programming is critical in securing sustainable long-term development and ensuring the effectiveness of current developed national strategies. There are three essential actions that are required as part of national planning to ensure disaster risks are adequately assessed and managed:

- Disaster risks should be explicitly examined as part of the preliminary country analysis undertaken at the start of the planning process;
- Rational, informed and explicit decisions, linked to transportation assignments of accountability and responsibility, should be taken on whether and how to address significant risk; and,
- The contribution of disasters and related risks to other development challenges and their potential implications for the achievement of country programme strategic objectives should be carefully explored.

4.9.5 **Environmental Sustainability** and assessment of projects and programmes is considered as established good practise. Other international governments have adopted environmental reviews as a key component of the project appraisal process. The basic purpose of environmental assessments that covers hazards and related risk is to examine the potential environmental consequences of a project and to ensure that they are adequately considered during the design phase. The state of the environment is a major factor determining vulnerability to natural hazards. Environmental degradation is widely recognised as one of the key factors contributing to increasing human, physical and financial hazard related losses. These essential actions are required as part of an environmental assessment process to ensure that natural hazards and related factors are adequately assessed and managed:

- The environmental assessment process should include collection of data on natural hazards and analysed to determine if further examination is required on other components of the project appraisal process;
- Systematic analysis of the potential disaster consequences on a project via its impact on the environment; and,
- Environmental issues should be carefully considered in the design and implementation of post disaster relief and rehabilitation activities.

4.9.6 **Country Planning, Development and Environmental Sustainability** has significant overlaps between their implementation and consideration. Inappropriate development can cause climate change, climate change impacts poor people, and the health of ecosystems and availability of environmental resources shapes economic growth and well-being. Management of these multiple and often contradictory priorities is of critical importance to the future health of the plant and the quality of life it provides. A background note produced by the Overseas Development Institute sets out a roadmap to bring development in line with environmental issues and assist with individual policy development[18].

4.9.7 **Infrastructure** projects contribute to a significant amount of financial resourcing used to assist national development. These investments and development gains can be

[18] Overseas Development Institute – Background Note, Separated at birth reunited in Rio? A roadmap to bring environment and development back together, May 2012

lost in seconds in the event of a hazardous event. The majority of human and direct economic losses from a natural hazardous event primarily occur as a direct result of damage on the built environment. This negative impact caused by hazards can be limited by taking into consideration when selecting sites, designing new infrastructure and from the strengthening existing infrastructure.

4.9.7.1 Certain infrastructure by its nature is more critical than other. The operational and life safety stability of schools and hospitals during and after a hazardous event is essential. The design of storage facilities such as chemical sites and dams need to have been developed to consider the possible failure mechanisms along with plausible outcomes.

4.9.7.2 A number of international treatment methods have been designed over the last decade to assist with the prevention of hazards. Appendix E presents a number of approaches that can be considered in the event of selecting an appropriate treatment method for the hazards that are considered by the PPRD project.

4.9.7.3 Within the European Union specific prevention standards known as the Eurocodes are used to reduce the impact of hazards, these are listed in the table below[19]:

Type of Disaster	Technical/ normative framework
Forest Fires	Eurocode 1 (actions on structures) defines proective design measures against fire. Covers a number of building materials.
Ground Movement	Eurocode 7 defines calculations and design rules for stability of buildings according to Geotechnical conditions at a construction site
Earthquakes	Eurocode 8 defines calculations and design rules for the stability of different buildings in seismically known locations
Storms, Hurricanes	Eurocode 1 covers the design of structure to wind loading
Heat wave, drought	Eurocode 1 covers the design of structure to resist heat waves
Industrial and Technological Hazards	Eurocode 1 defines building design rules against explosion
Maine pollution and port spills	EC Regulation 1726/2002 banning single-hull tankers from European ports EC regulation 1406/2002 and 2038/2006 entrusting the European Maritime Safety Agency response to ships causing

[19] European Commission, 2011. Risk Assessment and Mapping Guidelines for Disaster Management

	pollution Direction 2005/35/EC of 7/9/2005 on ship source pollution
Environmental Issues	Directive 85/337/EEC on Environmental Impact Assessments Directive 2001/42/EC on Strategic Environmental Assessments
Flooding	Directive 2007/60/EC on the Assessment and Management of Flood Risk
Chemical Accidents	The Seveso Directives I and II

4.10 National Platforms for Disaster Risk Reduction

4.10.1 Hazard mitigation and prevention measures in their nature require the interface from numerous stakeholders. Through the United Nations International Strategy for Disaster Reduction (ISDR) a programme titled "National Platforms for Disaster Risk Reduction" has been developed and implemented with commitment from Governments in a number of countries. The program is nationally owned and led by either a forum or committee of multi-stakeholders requiring legal commitment, public understanding, scientific knowledge, careful development planning, public understanding, people-centred early warning systems, and effective disaster preparedness and response mechanisms. The platform serves as an advocate of disaster risk reduction at different levels and provides coordination, analysis and advice on areas of priority requiring concentrated action through coordination and participatory processes[20].

4.11 Disaster Response

4.11.1 Each of the Partner Countries has a well developed and integrated disaster response framework that incorporates a number of relevant stakeholders including local authorities, Governments and emergency services. Governments across the Partner Countries should however consider the implementation of regional based tools to facilitate preparedness as well as effective response mechanisms to disaster at a community level through regional cooperation. The tools presented below are aligned with policies prepared by the European Commission as part of the Community Mechanism for Civil Protection. The tools have been developed to enable and ensure an effective delivery of assistance, team work during emergencies and rapid mobilisation[21].

Monitoring and Information Centre (MIC) is the operational heart of the civil protection mechanism. It is operated by DG ECHO of the European Commission and accessible 24 hours a day. It gives countries access to a

[20] International Strategy for Disaster Reduction – Guidelines, National Platforms for Disaster Risk Reduction, 2007

[21] European Commission Community Mechanisms for Civil Protection wed site - http://ec.europa.eu/echo/policies/disaster_response/mechanism_en.htm

platform, one-stop-shop of civil protection means available amongst all the participating states. Any country inside or outside the Union affected by a major disaster can make an appeal for assistance through the MIC. It acts a communication hub at headquarters level between participanting states, the effected country and despatched field experts. It also provides useful and update information on the actual status of an ongoing emergency. The MIC plays a important role in co-ordinating offers of assistance put forward by participating states the needs of the disaster-stricken country. **Common Emergency and Information System (CECIS)** is a reliable web-based alert and notification application created with the intention of facilitating emergency communication among the participating states. It provides an integrated platform to send and receive alerts, details of assistance required, to make offers of help and to view the development of the ongoing emergency as they happen in an online logbook. **Training Programmes** has also been set up with a view to improving the co-ordination of civil protection assistance interventions by ensuring compatibility and complementarity between the intervention teams from the participating states. It also enhances the skills of experts involved in civil protection assistance operations through the sharing of best practices. This programme involves training courses, the organisation of joint exercises and a system of exchange of experts of the participating states.

- **Civil Protection Modules assistance** often consists of highly specialised equipment and teams for tasks such as search and rescue, high capacity pumping, or aerial forest fire fighting. The civil protection response thus makes a vital contribution in the immediate post-disaster phase. A number of such specialised emergency response units have been set up under the Mechanism to respond more quickly to emergencies. Known as 'modules', these operational units are prepared by one or more countries. They can be used for interventions both within and outside the EU. They have to be available at short notice (max. 12 hours) and be able to work independently. Using modules ensures that the European response is quick and that European teams are experienced in working together. Examples of European modules include high capacity pumping, advanced medical posts or urban search and rescue.

4.12 Regional Consistent Approach

4.12.1 A number of bilateral agreements are already active between the different Partner Countries; these primarily concern assistance during emergency situation but also concerning the elimination of disaster events. The current bilateral agreements or new initiatives need to be developed to assist mitigation and prevention across the region. Bilateral agreements need to be sought in the following areas:

- Monitoring and forecasting to assist the potential impact from cross boarder hazards;
- Development of hazard assessment criteria to assist the identification and recording of a hazard event;
- Vulnerability assessment to produce a consistence understanding to assess an areas exposure to hazards;
- Preparedness and mitigation plans through media cooperation, educational programmes; and

- The setting up of regional response centres to improve assistance across the partner countries during disaster situations.

For the development of the regional risk management approach to be as functional and appropriate as possible cooperation between the partner countries at Government level and hazard focused institution is essential.

4.12.2 Governments need to consider regional consistent approaches during the implementation of all themes and components in relation to the risk management framework and process.

4.13 Roles and Responsibilities

The roles and responsibilities are an essential aspect of the policy as they define which stakeholders within each individual partner country as responsible for which aspect of the hazard risk management process. For each of the stakeholders identified their responsibilities have been discussed in relation to the risk management framework components and themes presented throughout this section. The Gap Analysis detailed during section 4.4 requires consideration from all the stakeholders presented below, understanding the current situation is essential to develop a comprehensive risk management process.

4.13.1 **Government** – develop and implement legislation that covers all aspects of developing the hazard risk management framework; including financial frameworks and definition of accountability. Initiate the mandate and commitment through laws and delegation of responsibilities, along with the monitoring and review aspects of the hazard risk management process. The Government specifically need to consider themes and components set out in section 4.2 and 4.3 of the policy ensuring the facilitation of all the other themes and components that were discussed.

4.13.2 **Overseeing Ministry** – coordinate development of the risk assessment framework through interface with institutions, ministry bodies, local authorities and INGOs and other relevant stakeholders. Initiate prevention and mitigation measures across each hazard at all levels. Implementation of the risk management framework including: defining the context, overseeing the risk management process, deciphering risk treatment strategies while also ensure continuous communication and consultation with relevant stakeholders. Initiate the development of a National Disaster Observatory and the National Platform for Disaster Risk Reduction while also facilitating within own department or specifying accountability for the Electronic Regional Risk Atlas (ERRA) to be used as an everyday tool. The overseeing ministry need to consider all themes and components described between sections 4.4 and 4.12 during the implementation of the risk management framework.

4.13.3 **Other Government Ministries Involved with the Following**:

- **Construction** – develop building codes to consider, seismic loads, flooding consideration and fire protection, consider DRR during planning. The ministry involved with construction needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.
- **Environmental** – develop Chemical Accident risk assessments as set out below, coordinate with other ministries and institutes concerning possible environmental impacts from hazards. Consideration of DRR within policies. Initiate prevention and mitigation measures. Assist overseeing ministry with hazard risk identification, analysis, evaluation and risk treatment strategies. The ministry involved with environmental issues needs to consider the

themes and components described in sections between 4.5 and 4.10 and section 4.12.

- **Infrastructure** – consider all aspects of DRR during consultation, design and construction of infrastructure, consult risk assessments. The ministry involved with infrastructure needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.
- **Development** – consider DRR during planning of livelihood, economic, environmental impact policies. The ministry involved with development needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.
- **Forestry** – develop forest fire risk assessments as set out below, coordinate with other ministries. Initiate prevention and mitigation measures. Assist overseeing ministry with hazard risk identification, analysis, evaluation and risk treatment strategies. The ministry involved with protection of forests needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.
- **Education** – develop DRR education material across all hazards to be implemented at all levels, including; school curricular, university programmes, home safety kits and community workshops. The ministry involved with education needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.
- **Emergency services** – development of preparedness plans and strategies to initiated during an emergency situation. Sharing of the hazard assessment results to comprehend possible extent of a hazard. The ministry involved with preparation of Emergency Services needs to consider the themes and components described in sections between 4.6, 4.7 and 4.8.
- **Health care & hospitals** – ensure that hospitals are prepared in the event of a hazard to deal with possible outcomes. Interface required at all stages of the hazard assessment to fully understand the impact on the health system and hospitals. The ministry involved with preparation of Emergency Services needs to consider the themes and components described in sections between 4.5, 4.8 and 4.9.
- **Telecommunications** – communication is essential at all stages of the risk management process. From the initial stages of indentifying stakeholders through to the dissemination of risks information and the communication hazard data and early warning alarms. The ministry involved with use of telecommunications needs to consider the themes and components described in sections between 4.8 and 4.9.

4.13.4 **Seismic Institutions** – develop regional consistent seismic hazard and risk assessment methodologies to assist the development of seismic hazard maps. Develop appropriate monitoring and early warning systems. Assist overseeing ministry with hazard risk identification, analysis, evaluation and risk treatment strategies. Seismic institutions needs to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.

4.13.5 **Hydro-meteorological** – develop regional consistent flood and drought risk assessment methodologies to assist the development of hazard maps. Develop regional consistent forecasting and monitoring systems to facilitate appropriate early warning systems. Assist overseeing ministry with hazard risk identification, analysis, evaluation and risk treatment strategies. Hydro-meteorological institutes need to consider the themes and components described in sections between 4.5 and 4.10 and section 4.12.

4.13.6 **Local Authorities** – facilitation of community driven activities, including; local level vulnerability and hazard assessment, initiation of community early warning systems. Initiation of prevention and mitigation measures specified by the overseeing ministries. Assist overseeing ministry with hazard risk identification, analysis, evaluation and risk treatment strategies. Local authority's need to consider the themes and components described in sections between 4.5 and 4.11.

4.13.7 **Communities** – highlight their own vulnerabilities and capacities needs. Define the extent of exposure to each hazard. Develop community based prevention and mitigation plans. Involvement with the development of community run early warning systems. Affected community's need to consider the themes and components described in sections between 4.5, 4.8, 4.9 and 4.11.

4.13.8 **International Non-Government Organisation** – Work directly with the government to facilitate the development of risk assessments and implementation of required prevention and mitigation measures. Work with the worst affected communities to implement the prevention and mitigation measures. International non-government organisations need to consider the themes and components described in sections between 4.5 and 4.12.

4.13.9 **Non-Government Organisations** – Work with affected communities to improve resilience and mitigate their exposure to hazards. Assist with the implementation of community based development programmes that consider DRR. Non- government organisations need to consider the themes and components described in sections between 4.5 and 4.11.

APPENDIX A – RISK MANAGEMENT FRAMEWORK ALIGNMENT WITH POLICY OBJECTIVES

	Regional Risk Management Policy Objective				
Policy Components	1- Culture of PPRD at all levels of the Risk Assessment Process	2- Regional consistent mitigation measures	3- Mainstreaming DRR into the development planning process	4- Institutional, technological and legal frameworks to facilitate hazard risk assessments	5- Coherent, contemporary risk/ hazard forecasting through identification, assessment and monitoring to facilitate fail safe early warning systems
Risk management Framework					
2.2 – Mandate and Commitment	✓ 4.2, 4.3	✓ 4.2, 4.3	✓ 4.2, 4.3	✓ 4.2, 4.3	✓ 4.2, 4.3
2.3 – Risk Management Framework Design	✓ 4.4, 4.5, 4.6, 4.13		✓ 4.8, 4.9, 4.10	✓ 4.5	
2.5 – Monitoring and Review	✓ 4.2, 4.3, 4.5, 4.7, 4.13			✓ 4.2,4.3, 4.7, 4.10	✓ 4.5, 4.8, 4.9, 4.10
2.6 – Continual Improvement	✓ 4.4, 4.5, 4.6, 4.7, 4.13	✓ 4.6	✓ 4.6	✓ 4.4, 4.6, 4.7, 4.10	✓ 4.6
Implementation of the Risk Management Framework					
3.2 – Communication and Consultation	✓ 4.5, 4.11, 4.13	✓ 4.7	✓ 4.7, 4.10	✓ 4.3, 4.5, 4.10	✓ 4.7, 4.10
3.3 – Establishing the Context	✓ 4.4, 4.5, 4.13			✓ 4.4, 4.5	
The Risk Management Process					
3.4.1 – Risk Identification	✓ 4.5, 4.13			✓ 4.5, 4.12	✓ 4.5, 4.8
3.4.2 – Risk Analysis	✓ 4.5, 4.13			✓ 4.5, 4.12	
3.4.3 – Risk Evaluation	✓ 4.5, 4.13			✓ 4.5	
3.5 – Risk Treatment	✓ 4.11	✓ 4.8, 4.9	✓ 4.9		✓ 4.8
3.6 – Monitoring and Review	✓ 4.5, 4.13	✓ 4.7, 4.10	✓ 4.7, 4.10	✓ 4.7, 4.10	✓ 4.4, 4.7, 4.10

APPENDIX B - RISK IDENTIFICATION/ RISK MATRIX

Appendix B - Risk Identification/ Risk Matrix

Risk Identification

During the risk identification stage to develop further the understanding of the risks considered by the PPRD project and the impact they present at a regional and national level the risk matrix can be used. The risk method has presented below can be used to further develop an understanding to identify locations were further more complex investigations are required, which will ultimately assist decision making in the implementation of appropriate treatment strategies. Using the risk matrix tool also allows different risk situations to be compared quantitatively by considering the various ensuring consistency to assessing the impact and likelihood of an event.

Where additional risk investigations measures have been identified through the risk matrix approach, specific hazard, vulnerability and exposure analysis can be undertaken. These methods are also document within the risk analysis section of this policy.

At the risk identification stage it is important to consider all hazards, how they interact, their probability of occurrence and their possible impact. Analysis on this scale is referred to as considering "risk scenarios". Risk scenarios are a plausible description of how the future may develop. Scenario building is mainly based on experience from past events, risk matrixes can be used to develop the scenarios when considering the different plausible outcomes.

Page 24 of the EC "Risk Assessment and Mapping Guidelines for Disaster Management" sets out criteria for undertaking scenario building at a national level. The process sets out the need to undertake the task to a minimum degree of common understanding[22].

Risk Matrix Hazard Analysis

The risk matrix is a visualisation tool that relates the two dimensions of a disaster, notably likelihood and impact. They are represented in a graphical format to facilitate the quantitative comparison of different risks. Within each category both impact and likelihood the relative importance should be graded using a qualitative process of considering the impact from previous disasters, acceptable impact levels and information from key experts. A single set of criteria to score the relative likelihoods and impacts to the different hazard risk scenarios originally identified is required to be set, this criterion must be considered consistently across all the different hazards that are being assessed.

An assessment of the "Likelihood" of the consequence is established. The likelihood is the probability that an event will occur and is given a likelihood number.

The explanation of likelihood of the consequences or probability that a hazardous event will occur is given in table 1 below. The table has been developed from understanding the context and realities within the different partner countries.

	Likelihood		**Chance per location**
	DESCRIPTION	**GUIDELINES**	
5	**Almost Certain**	This is a significant threat that could occur at any time. Immediate remedial action is required to remove or reduce the risk.	70%
4	**Probable**	The threat exists and it indicates high probability. Action is required to reduce this risk.	50 – 70%

[22] European Commission, 2011. Risk Assessment and Mapping Guidelines for Disaster Management

3	**Likely**	The threat exists but the history or expectation of this type of situation indicates occurrence is moderately probable. Action could be taken to reduce this risk but it is unlikely to be cost beneficial.	30 – 50%
2	**Unlikely**	A slight threat is perceived from this source but the situation is unlikely to occur. No action is required to reduce this risk, unless the business demands minimal risks.	10 – 30%
1	**Negligible**	No perceived threat exists from this source. No action is required to reduce the risk.	<10%

Table 1 "likelihood"

Following this the "Impact" of the consequence of an undesired event is established. The impact is the result of an event occurring and is given an event number.

In order to give some indication of the potential impact of various types of risks, use will be made of the internationally recognised measures presented in table 2 below.

Impact (I)	**Minor - 1**	**Significant - 2**	**Severe - 3**	**Major – 4**	**Catastrophic - 5**
Human					
Economic					
Environmental					
Social					
Political					

Table 2 Indicative impact measures

This information can then be used to develop a risk rating for all of the individual hazards risks identified, this is based on the ratings presented in table 3. For the purpose of this policy the comparison of several risks in one risk matrix is not called a multi risk analysis.

	Relative Likelihood				
Relative Hazard Impact	1.Negligible	2.Unlikely	3.Likely	4.Probable	5.Almost Certain
5.Catastrophic	Medium	High	Very High	Very High	Very High
4.Major	Medium	High	Very High	Very High	Very High
3.Severe	Medium	High	High	High	High
2.Significant	Low	Medium	Medium	Medium	Medium
1.Minor	Low	Low	Low	Low	Low

Table 3 Risk Ratings (R)

APPENDIX C - HAZARD ASSESSMENT METHODS

Appendix C - Hazard Assessment Methods

Hazard Assessments

The PPRD east project considers four primary hazards including: seismic events, hydro-meteorological events, forest and urban fires and chemical accidents. Listed below for each of the hazards is a brief description of internationally recognised hazard assessment techniques. A number of the techniques presented below are similar to and based on approaches used by the MATRA Atlas for Natural Hazards in Georgia project[23].

Earthquakes Hazard Assessment

Earthquakes are considered to be among the most devastating hazards that can cause huge economic damage and human loss of life. They are considers as one the major hazards to effect the ENPI east region particularly the South Caucasus Moldova and southern Ukraine.

Though the short term prediction of earthquakes remains an unsolved task, however long term probabilistic approaches in terms of seismic hazard and risk are well developed. Understanding the possible effects of a seismic event allows pre disaster activities (education, training, preparedness plans) and management of the consequences (recovery and reconstruction) possible. There is a broad understanding that it is extremely important to ensure disaster preparedness through reducing of vulnerability to an earthquakes impact.

The catalogue of earthquake events within the ENPI East region consists of two parts: historical data typical extracted from historic annuals and reports, and instrumental recordings initiated in the region around the beginning of the 20th century.

Modern approaches are reliant on probabilistic hazard assessments and are based on the identification of possible earthquake sources and their parameterisation. The probability that the predicted level of seismic effect will be exceeded at a certain point during a fixed period of time is defined.

Carrying out probabilistic seismic hazard assessments typically consist of four stages:

- **Identification and Parameterisation of Earthquake Source Zones** is based on the analysis of active faults which are compared to observed and historical seismicity as well as to other geophysical fields.
- **Earthquake Reoccurrence Rates for the Earthquake Source Zones** relates to data captured through instrumentation and applying a distribution relationship for each source which allows the frequency of occurrence for a specific magnitude earthquake to be estimated.
- **Earthquake Surface Effect Attenuation Law** relates to the application of attenuation relationships applied for a given area.
- **Calculation of Integral Seismic Effects** using the probability of exceeding a certain level of seismic event for a fixed period of time can be calculated. Probability seismic maps can then be produced utilising GIS technology with design return periods for 10%, 5%, 2% and 1% of exceedance.

Flooding Hazard Assessment

[23] MATRA Project, 2012. ATLAS of Natural Hazards and Risks of Georgia

Flooding and flash flooding have been defined as posing the greatest and most frequent threat to the countries within the ENPI east region. Flood assessments can be defined by understanding the discharge rate of a river and topographical data.

Flood discharge analysis can be calculated from reviewing discharge data recorded by hydrological stations. Yearly maximum water levels and discharge rates are required to be stored in a database for each of the stations. For each station an analysis of data needs to be conducted to calculate the magnitude-frequency relationship. Using this relationship the discharge and water levels can be predicted for a given return period event.

The flood hazard assessment can then be determined using a GIS based approach. The process requires heights above a river to be mapped based on a digital terrain model, the understanding of workflow based on methods developed by the EU joint research council for potential flood hazard and risk mapping at pan-European scale, together with the discharge analysis. This process requires validation and correction based on expert local knowledge on the occurrence of floods within a particular country.

Droughts Hazard Assessment

As a result of global climate change, changes in temperature regimes have caused a growth in the drought hazardous events throughout the world.

Droughts damage typically occurs in areas of arid, semi-arid and semi-humid lands through the increased consumption of water by plants coinciding with phases of reduced precipitation. Days can be assessed as droughty when precipitation is less than 5mm, the relative humidity is less than 30% and the average temperature is more than 25°C. The quality of aridity can be defined on the basis of the difference between the precipitation and water consumption by plants and the index of humidity within the plant vegetation period.

Wild Forest Fires Hazard Assessment

Wildfires have become a major environmental concern in many world ecosystems as they play a critical role in aspects such as soil formation, hydrological cycle, nutrient cycle, biodiversity stability and plant growth. Wild fires in their nature are a natural aspect of a forests ecosystem and there suppression should only be considered where they interact with human activity.

The development of wildfire hazard maps can be produced using a weighted indictor approach. Typically five individual risk factors that share similar characteristics are used to produce static models. The five indicators include: fuel risk, ignition risk, weather risk, detection risk and response risk. A final risk output is produced by combining these indicators using a weighted approach.

The static maps can be developed by conducting surveys to gain expert judgement on the indicators presented above. The formation and evaluation of all models consisted of a pairwise comparison based on analytical hierarchy process and knowledge of previous fire patterns. Each indicator can be determined as following: fuel risk – location of forest areas, ignition risk – location of human interaction, weather risk – comprehension of drought conditions, detection risk – road and rail networks and response risk – known response mechanisms.

Chemical Accident Hazard Assessments[24]

The assessment for chemical accidents relate to a four step process.

- **Identification** of site locations, this includes both old and new storage facilities.

[24] A Lgnatowski and I Rosenthal – The Chemical Accident Risk Assessment Thesaurus

- **Possible Event Sequences** relating to how the storage facility could fail considering a number of different scenarios. Along with the impact that the chemicals being stored could cause.
- **Plausible Outcomes** concerns the implications to both the eco-systems and human activity if a storage facility failed.
- **Comparable Outcomes** ensuring the methodologies that have been developed allow different identified sites to be assessed against each other.

APPENIDX D - VULNERABILITY ASSESSMENTS

Appendix D - Vulnerability Assessments

Vulnerability Risk Analysis

Two methods have been presented within this appendix as appropriate method to assess vulnerability at different levels. The first method "Spatial Multi-Criteria Evaluation" has been presented as a method for the analysis of vulnerability[25] at a localised level. This approach can be used on a case by case bases where a hazard has been identified as impacting on a specific community and is similar to the approach adopted by the MATRA project for assessing vulnerability. The second approach "The Prevalent Vulnerability Index" uses composite indicators to provide an understanding of a countries pattern or current situation and allow a quantitative comparison at a regional and national level.

Spatial Multi-Criteria Evaluation

The output is dependent on a number of spatial representations that cover physical, social, economic, environmental, institutional, and human factors of vulnerability. It is important to understand that the indicators have different measurement scales, cartographic representation and favourable or unfavourable objects all requiring standardisation. On selection of the indicators defining their standardisation and hierarchical structure, weighting values can be assigned. For the purpose of this method four different aspects of vulnerability have been presented these include physical, social, economic and environmental vulnerability. Each of these different aspects are presented below, a number of the techniques presented are approaches used by the MATRA Atlas for Natural Hazards in Georgia project[26].

Physical Vulnerability is the potential for physical impact on the built environment and population. It is defined as the degree of potential loss to a given element from the occurrence of a hazard, expressed on a scale 0 (no damage) to 1 (total damage). Physical vulnerability is determined by the spatial overlay of exposed elements at risk and a hazards footprint. Four groups of indicators are used to assess physical vulnerability:

- **Building Vulnerability Assessment** is based on an understanding of the following: location of built up areas, number of buildings per administrative unit, building size and typology. Three indicators are used to construct the building vulnerability map: building density, building type and building vulnerability classes defined by the European Macroseismic Scale (EMS 98).

- **Transportation Vulnerability Assessment** is carried out by weighting the importance of airports, railroads and roads. Three different road vulnerability indicators can be used, highways density, paved road density and unpaved road density.

- **Essential Facilities** that provide services to the communities and should be functional after a disaster. Indicators can include hospitals, police stations, fire stations and school and are assessed on the distance to them from settlements via the road network.

- **Lifeline Vulnerability** that provide basic services to the population. Indicators can include access to water supply, electricity supply, gas supply, telecommunications, mobile telephone network and a sewage system.

[25] Methods for the Improvement of Vulnerability Assessment in Europe (MOVE), 2011. Assessing vulnerability to natural hazards in Europe: From Principles to Practice, A manual on concept, methodology and tools

[26] MATRA Project, 2012. ATLAS of Natural Hazards and Risks of Georgia

The four sub groups related to physical vulnerability are required to be combined with appropriate weighting of the different groups by importance.

Social Vulnerability is the potential impact of events on vulnerable groups within a society. Vulnerable groups include poor, unemployed, single parent households, pregnant women, young mothers, the handicapped, children and the elderly. Impact factors typically consider public awareness of risk, ability of self-cope skills, and the status of institutional structures designed to help. A number of social vulnerability indicators can be used:

- Population density;
- Healthcare;
- Distance to hospital;
- Number of hospital beds per number of population;
- Numbers of doctors per number of population;
- Education;
- The number of school children per administrative unit;
- The number of teachers per administrative unit;
- Distance to school following the road network;
- Disadvantaged groups;
- Unemployed;
- Disabled persons;
- Elderly;
- Single parent households.

Environmental Vulnerability is defined as the potential impact of a hazardous event on the environment. Environmental vulnerability indicators include the following:

- Protected areas;
- Cultural heritage;
- Water bodies proximity to urban areas;
- Landscape uniqueness; and,
- Land cover type.

Economic Vulnerability is defined as the potential impact of hazardous events on economic assets and processes.

- Agricultural sector;
- Forestry sector
- Tourism sector;
- Educational sector;
- Industry; and,
- Services.

The overall vulnerability can then be defined by aggregated and combining the level of physical, economic, social and environmental value indicators to calculate and produce an overall vulnerability map.

The Prevalent Vulnerability Index[27]

Allows an estimate predominant vulnerability conditions by measuring levels of exposure in prone areas, socioeconomic fragility and lack of social resilience. These indicators provide a measure of the direct as well as indirect and intangible impacts of hazard events.

Indicators of Exposure and Susceptibility

[27] Inter-American Development Bank – Indicators of Disaster Risk and Risk Management, The Prevalent Vulnerability Index

- Population growth, average annual rate (%)
- Urban growth, average annual rate (%)
- Population density, people/5 Km2
- Poverty-population living on less than US$ 1 per day PPP
- Capital stock in millions US$ dollar/1000 km2
- Imports and exports of goods and services, % GDP
- Gross domestic fixed investment, % of GDP
- Arable land and permanent crops, % land area

Indicators of Socioeconomic Fragility

- Human Poverty Index, HPI-1
- Dependents as proportion of working age population
- Inequality as measured by the Gini coefficient.
- Unemployment, as % of the total labor force
- Annual increase in food prices %
- Share of agricullture in total GDP growth (annual %)
- Debt service burden as a % of GDP
- Soil degradation resulting from human activities (GLASOD)

Indicators of (lack of) Social Resilience

- Human Development Index, HDI [Inv]
- Gender-related Development Index, GDI [Inv]
- Social expenditures on pensions, health and education, % of GDP [Inv]
- Governance Index (Kaufmann) [Inv]
- Infrastructure and housing insurance, % of GDP [Inv]
- Television sets per 1000 people [Inv]
- Hospital beds per 1000 people [Inv]
- Environmental Sustainability Index, ESI [Inv]

APPENDIX E – PHYSICAL PREVENTION MEASURES

Appendix E – Physical Prevention Measures

Earthquake

- Seismic design of new buildings and infrastructure using design codes;
- Site selection/ land planning considerations for new buildings and infrastructure;
- Retrofitting of existing buildings and infrastructure;
- Shut down of sensitive plant (gas and oil pipelines).

Flooding

- Development of construction codes to consider the impact from flood events on both new and existing buildings and infrastructure;
- Site selection/ land planning considerations;
- Physical barriers:
  - Breakwaters;
  - Dams;
  - Dredging;
  - Embankments;
  - Levees and Dykes;
  - Floating screens.

Droughts

- Crop protection;
- Crop adaption;
- Special farming techniques;
- Rainwater harvesting;
- Water cellars.

Forest Fires

- Prescribed burning;
- Property protection;
  - Accessible driveways;
  - 9m grass exclusion zone around house;
  - 30m Vegetation exclusion zone around house;
  - 30m garden hose attached to house;
  - Fuel moved 9m away from house;
  - Localised trees thinned;
- Construction design codes to improve the resilience of the structure;
- Initiation of community based prevention programmes;
- Restriction of activities in certain weather conditions.

Urban Fires

- Construction design codes to incorporate fire protection;
- Home safety and prevention kits;
- Smoke and fire alarms.

Chemical Accidents

- Appropriate design consideration of the storage facility, including possible impact from seismic and flood events;
- Retrofitting of existing storage facilities where appropriate;
- Site selection/ land planning specifically considering the impact from both seismic and flood events;
- Regular monitoring of know facilities to determine possible failure.

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APPENDIX G – PPRD EAST RISK MANAGEMENT POLICY IMPLEMENTATION FLOW CHART

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