Deliverable 6.1

Risk communication strategy

Institutional building for natural disaster risk reduction (DRR) in Georgia

a MATRA project implemented by

Faculty of Geo-information Science and Earth Observation,
University of Twente (ITC, lead), The Netherlands
&
Caucasus Environmental NGO Network (CENN), Georgia

Contents

1. General Introduction

1.1 Introduction

It is well known that the frequency and impact of natural hazard events are growing and causing disasters with negative impacts on humans, economy and environment. Many areas in the world are prone to one or several (multi) natural hazards. Hazard events result in disasters when risk factors such as hazard, vulnerability and inadequate capacity (coping capabilities) overlaps in space and time. Avoiding or reducing the impact of disasters can be reached by reducing the disaster risk. Consequently, focusing on Disaster Risk Reduction (DRR) is an issue at stake worldwide (UN/ISDR, 2005). There are several DRR frameworks presented by different sources. One of the known DRR frameworks is developed by the UN/ISDR within the context of sustainable development known as Hyogo Framework for Action – HFA (2005-2015). It identifies five priority areas for action relating to DRR for individual nations (Georgia among them):

1. Ensure that DRR is a national and local priority;
2. Identify, assess and monitor disaster risks and enhance early warning;
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
4. Reduce underlying risk factors;
5. Strengthen disaster preparedness for effective response at all levels.

Risk information communication/early warning is one of the key priorities for risk reduction. Effective risk communicating and early warning system needs collaborative and participatory approaches within the different levels (especially local level) and actors of Disaster Risk Management (DRM) during planning and decision making related to DRR (UN/ISDR, 2005). Risk communication and early warning system needs detailed information about hazard characteristics and vulnerability for effective prognoses and preparedness. However, this kind of information is often lacking in many countries that limits the capabilities for effective DRM. During risk information communication, it is important not only the proper information distribution and communication to the citizens, but the information receiving from the public about the hazards can play an important role in disaster management and risk reduction as well. It is widely recognized that information and communications technology (ICT), plays an important role in establishing effective linkage between various actors that enables risk reduction. Participatory Geographic information System (PGIS) is one of the well-known methods that were developed from participatory approaches combined with different ICT tools to gather Local (Spatial) Knowledge (LSK) for effective communication linkages between communities at risk and higher level government in the various stages of disaster management (mitigation, preparedness, response and recovery) (Sarun, 2011).

Among other countries, Georgia as well is exposed to several natural hazards such as earthquakes, landslides, droughts, avalanches, floods and technological hazards, which causes disasters and negatively affects communities, their livelihoods, infrastructure and the environment. Natural hazards are happening all over Georgia’s territory. The majority of its settlements (70 percent of the territory) and infrastructure (motorways, oil and gas pipelines) of international importance are located in the hazard prone areas (NEA Geology, 2009). Situation in the country regarding disaster impacts got worse after Georgia broke up from the Soviet Union. The country weakened in financial, administrative and political capacity and introduced poor practice of disaster management (Risk communication among them). Georgia adopted the Hyogo Framework for Action (HFA) in 2005, thus by default effective risk commutation should become a high priority for the national government. However, currently the risk communication is still very weak in Georgia.

1.2 Problem statement

As was mentioned above, for effective risk communication it is necessary to have relevant risk information (hazards, vulnerability) available for the DRM actors, but in many countries (Georgia among them) this kind of information usually is not available. In addition to the lack of necessary risk information there is also lack of coordination, communication and information sharing between government sectors and administrative units. Therefore, this report develops and presents practical examples of risk communication that are better explained in the next section.

1.3 Objectives and questions

The main objective of the proposed report is to introduce the practical and theoretical examples of risk communication (both risk communication that focuses on the imminent threat as well as long term risk awareness example using different channels).

To rich the main objective, the following sub-objectives are defined:

1. Review the literature regarding disaster risk communication;
2. Evaluate an existing situation in Georgia regarding risk communication;
3. Introduce the general example of effective structure of early warning system (risk communication focusing on the imminent threat). The detailed framework of early warning system as well as some practical examples was not developed within this report as there was not cooperation in this regard from EMD, and further development of the early warning system framework is beyond of the Matra project;
4. Practical development of the long-term two way risk communication tool using ICT (including the workshop in two pilot areas of Georgia) and focusing on local community awareness rising and linkage between local community and higher level government institutions;
5. Practical development of long-term one way risk communication tool focusing on awareness rising for different government institutions.

The research questions to the particular sub-objectives are:

a. What is the role of risk communication in DRM?
b. What is the legislative framework for risk communication in Georgia?
c. What is the institutional framework for risk communication in Georgia?
d. What is the example of effective structure of the early warning system?
e. How the risk information could be communicated from the central level to the local community and vice versa?
f. What is another method for one way risk communication?

1.4 Methodology

The way to address the report objectives is to answer the report question. The methodology for reaching the main objective is following:

- Firstly, the literature review is performed in the chapter one to cover the question (a) and to get the main concepts and examples regarding risk communication;
- To address the question (b) and (c), firstly there was reviewed the existing articles, reports, documentation, as well the consultations were made with the key government officials related to DRM and risk communication. These issues are presented in chapter 3;
- The questions (d) are addressed by reviewing the literature regarding the early warning system. The structure can be further elaborated and implemented by respective institutions in future. Thus, objective three is addressed in chapter 4;

- The question (e) is addressed by the practical implementation of the tool for risk communication using ICT (web-atlas) between local community and government institions and is covered in chapter 5;
- The last question (f) is as well addressed by the practical implementation of one of the channel of risk communication and is presented in chapter 6.

1.5 Report outline

- Chapter 1: General introduction. This chapter represents the general introduction of the report with the statement of the problem, report objectives questions general methodology and outline of the report;
- Chapter 2: Literature review on risk communication. The chapter explains concepts regarding DRM, and risk communication and related issues
- Chapter 3: Country profile regarding DRM with particular respect to risk communication and early warning system. This chapter describes the legislative and the institutional framework regarding risk communication and early warning system;
- Chapter 4: Effective structure of the early warning system;

Chapter 5 to 8 present 4 tools for risk communication that have been developed whtin this project:

- Chapter 5: the use of the National Scale Hazard and Risk atlas as a vehicle for (one way) risk communication
- Chapter 6: the Web-based platform as a tool for two way risk communication.
- Chapter 7: the use of Participatory GIS for ciommunicating information from local people to local governments and national organizations
- Chapter 8: the use of Spatial Data Infrastructure for risk communication between different government departments concerning information on hazard and risk.
- Chapter 7: Conclusions and recommendations. The final chapter presents and summaries the major findings derived during the report writing and conclude with the key recommendations for the future.

2. Literature review on DRM and Risk communication

2.1 Disaster Risk Management

According to the internationally agreed glossary of basic terms related to disaster management, the disaster can be defined as following: “A serious disruption of the functioning of the society, causing the widespread of human, material or environmental losses which exceed the ability of the affected society to cope using only its own resources. Disasters are often classified according to their causes (natural or manmade).”(DHA, 1992). The natural disaster happens when the natural, extreme phenomenon negatively effects the exposed vulnerable population. Disaster causes humanitarian (life loss, injuries, physiological post disaster affect) economic (direct loss –damages to buildings, infrastructure such as transport, energy, water, and agricultural assets; indirect loss - resulted physical damage to firms and households; and macroeconomic – total impact on Gross Domestic Product (GDP), consumption and inflation) and ecological effects (damages to arable land, forest and ecosystem)(See Figure 2-1)(Mechler, 2004).

The disaster risk can be defined as probability or chance of losses or impacts (loss of lives, injures, property damage, etc.) due to the particular natural hazard for the particular space and time. Risk can be characterized by the probability distribution of the losses (consequences): Risk =Probability*Losses

So, the risk is a combination of probability of something negative happening and the negative consequences\loses that it does (Mechler, 2004). In other words, the degree of disaster risk is an intersection of three factors: Hazards, elements at risk and vulnerability (Glade, 2003).

Disaster Risk Management (DRM) can be seen within a broad context of Disaster Risk Reduction (DRR) that includes different activities involving public administration, strengthening organizational and institutional development, implementing policies, strategies and coping capacities of the society to reduce negative effects of hazards (UN/ISDR, 2004a). DRM as well involves mitigation measures such as structural -that are related to physical risk management measures (E.g. Construction of dams and artificial levees, flood walls, channel improvements/modifications, etc.) and non-structural - that are associated with limited uses of hazardous areas based on legal and regulatory measures (spatial planning) (van Westen & Kingma, 2009b).

Usually, DRM includes number of activities made before, during and after the disaster. In disaster management three stages can be recognized: The pre-disaster, disaster and post-disaster stages. Respectively, different activities and measures needed to deal with disaster risk or disaster impact management are farther divided into three categories: risk management that usually involves: Mitigation, prevention, preparedness, risk assessment, prediction and early warning; relief/response and rehabilitation/reconstruction that in combination is usually called a crisis management.. See Figure 2-1. Risk communication is a vital component within the whole disaster cycle, including risk and crisis management.

FIGURE** ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-**1: DISASTER CYCLE. ADAPTED FROM (WILHITE, 1999). **SOURCE: [HTTP://WWW.FAO.ORG/DOCREP/008/Y5744E/Y5744E04.HTM](http://www.fao.org/docrep/008/y5744e/y5744e04.htm)**

2.2 Risk Communication

Risk Communication (RC) is a component of risk governance and is defined as "an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management" (National Research Council, 1990).

Communication is core to the success of disaster mitigation, preparedness, response and recovery. Communicating disasters — before, during and after they happen — is challenging. Communication systems used in disaster situation are as effective as the quality of the content they carry with them.

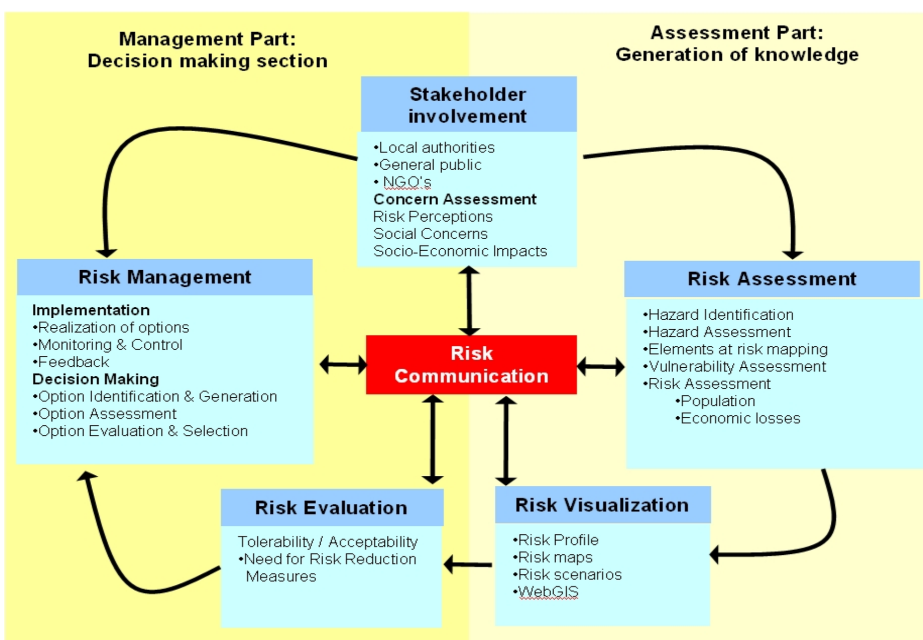


FIGURE** ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-**2: RISK COMMUNICATION AS A CORE IN RISK GOVERNANCE.

Disaster communication and early warning have strong relationship to each other. One of the major objectives of the disaster communication is to give an early warning about the disaster risk in a particular area. Early warning helps to reduce economic losses and mitigate the number of injuries or deaths from a disaster, by providing information that allows individuals and communities to protect their lives and property. This information empowers people to take action when disasters close to happening (Sarun, 2011). Risk communication focusing on the imminent threat of an extreme event is referred to as a warning and is meant to produce an appropriate emergency response (van Westen & Kingma, 2009b).

On the other hand, risk communication program can also focus on the long-term potential for such events to happen, and is then called a hazard awareness program, intended to produce long-term hazard adjustments (van Westen & Kingma, 2009b). Such awareness programs are communicating the risk information to the public not in case of imminent threat but in general, which reduces the risk in long-term perspective. Risk communication can be done in a variety of manners and at different levels. The main differentiation is between risk communication at the national level, using mass media campaigns, and risk communication at the local level, where more focused measures can be used.

Risk communication is usually aimed for:

- making people aware of the risk in their neighbourhood;
- improving their knowledge on possible disasters and how they could be prepared;
- changing their attitude towards disaster preparation, and;
- changing eventually their behaviour.

Thus, risk communication can be viewed from the different perspectives: Risk communication during early warning system and risk communication for hazard awareness. Respectively, in this report the different tools/channels will be used during different phases of risk communication. The tool/channels used for risk communication (during early warning or hazard awareness) are shown below.

Tools/Channels	Risk Communication	
	Early warning	Hazard Awareness
Mass Media (TV, Radio, newspaper)	x	x
Electronic Media (WWW, SMS, MMS)	x	x
Audio-visual (video, audio, multi-media, animation, photographs, model, map, slide show, artwork, graph, curves,)	x	x
Postal (direct mailing)		x
Stand-Alone print (billboard, poster, banner, warning sign, flood water level)		x
Face-to face (meeting, seminar, workshop, conference, march, exhibition, demonstration, training, exchange visit, planning)		x
Distributor print (leaflet, pamphlet, brochure, booklet, guideline, case study, newsletter, journal, research paper, report)		x
Folk Media (story, drama, dance, song, puppet, music, street entertainment)		x
People (community leader, volunteer, project worker, head of women's group)	x	x

Table 2.1: Several tools or channels that are used in risks communication. Adapted from (van Westen & Kingma, 2009b).

In this report, there is used the combination of tools (e.g. electronic media and audio-visual), such as web-GIS, particularly concentrating on geo-information. A web-GIS application allows the user to combine different types of information, and display information such as: Hazard maps of individual hazard types, elements at risk information, multi-hazard risk, provide recommendations per administrative unit about behaving before, during and after the different type of disaster, etc. Mentioned application can be use not only for one way risk communication (to public) but for two way communication (from public), for warning and hazard risk reporting, that will be used for early warning as well as for hazard data gathering leading to better risk assessment and better risk reduction measurement (including risk awareness). The two way risk communication is able not only via web-GIS but via mobile phones as well, that will not be covered in this report.

2.3 Risk communication tools

In addition to the radio and mobile phones, the internet has an increasing popularity (for the ones who has access to the electricity and computer) for disaster risk information communication, because of its potential of information management. In the field of disaster management, among others, the web based technologies (Web 2.0, Google Earth, OpenStreetMap) and other social networks (Twitter, YouTube, Blogs, Wikipedia, Facebook) are already widely used for communication the risk information (Lagmay, 2009; Subedi, 2010; White et al., 2010).

The examples of collecting and using the community information is increasing due to the ICT development that makes it easier to collect, store, retrieve and disseminate the local information from grass-root level. One of the important tools for risk information communication is web-GIS. The Web-GIS is a tool not only for communicating the information to the community (using different tools and visualisation methods) but to gather and communication the information from the community itself. The mentioned tool is developed and used as practical example in chapter 5.

Some other ways of risk communication are: volunteered geographic information (VGI) that emerged from areas such as PGIS. PGIS approaches however differ from VGI in a number of respects. VGI is a new and rapidly growing resource. Its near real-time capability has been utilized in the emergency and disaster management environments to broadcast the conditions and situation on the ground. VGI is same as participatory sensing. Expect VGI there are other similar methods of LSK collection such as, opportunistic sensing that is semi-voluntary and uses communication technology (Internet, phones, Bluetooth apps, etc.) to receive, extract or generate information; or Web 2.0 that has opportunity to interact live, including voice and images. As well it includes web-based communities such as social-networking sites, video sharing sites, wikis, and blogs. Based on this new ICT the H2.0 – Human Sensor Web- project was initiated that is aimed at using the power of information and technology to address global challenges, such as climate change, poverty and disaster management. The mentioned methods were not developed in the framework of MATRA projects as internet network is not available wildly in rural areas.

In addition to internet, the scope and reach of mobile phones are increasing and it is currently the leading medium for personal communication in day to day life. Mobile phones have been used successfully even in the emergency situation and it has shown demonstrated potentiality as tool for emergency two way risk communication. The infrastructure damage will have minimal effect in mobile phones as they can receive signals from towers in peripheral areas and disturbed towers can be repaired quickly compared to other infrastructures. Another advantage of mobile phone is its potential for informing the public especially through the use of text-based features. Mobile phone services are now available with internet services or they can be used as mobile modem to connect to internet. This feature has added advantages for its wider application in pre and post disaster situation as information management tool. Usually the major communication tool in many countries (Georgia as well) is mobile phone and are widely used and accessible to broad population (villages). Mobile phones can be used to collect data through voice or text services. As technology is getting advanced and cheaper, in near future, can be assumed that all mobile phone owners will possess smart phones that can offer wide variety of interactive data collection methods. The mentioned methods has wide potential to be used in Georgia in future.

3. DRM and risk communication in Georgia

3.1 Introduction

As was mentioned in the first chapter, during the transition period, Georgia experienced economic difficulties that were reflected on DRM. The shortage in finances, personnel and the technology are still limiting the adequate monitoring programs of different hazard, river gauging, hydro-meteorological observations and other risk communication methods. This chapter will introduce the general institutional and legislative background of Georgia regarding DRM and risk communication.

3.2 DRM in Georgia

Since 2004, as a new government was elected in Georgia, a number of reforms were implemented at different sectors and levels of government, resulting in legal and institutional changes. The most significant changes in the DRM field were the development of an Emergency Management Department (EMD) under the Ministry of Internal Affairs (MIA) in 2005 and the establishment of the Centre of Monitoring and Prognosis in 2006 that in 2008 became the National Environmental Agency (NEA) under the Ministry of Environmental (MoE)(United Nations, 2010a).

In the DRM sphere Georgia cooperates with several countries with bilateral agreements(United Nations, 2010a). Additionally, the International community in cooperation with the government and non-government institutions helps the government of Georgia to make a progress in the field of natural DRM (GNCDRR et al., 2010). Georgia adopted the HFA in 2005.

Other changes in DRM are: Since 2009 the Rescue Preparedness and Response Centre (Division) was created as one of the divisions of EMD for better protection and rescuing people during emergency situation throughout the country at different levels(MIA, 2011); and since September 2010 civil defence and safety lessons were introduced in the educational institutions(MES, 2010). Despite the changes made within the last years, disaster management activities in Georgia are still concentrated on emergency response.

3.3 DRM Legal Framework

The First legislative documentation in Georgia regarding DRR/DRM dates back after the World War II, and it was mainly oriented on technological hazards like nuclear exposure. However, as there were no technological hazards afterwards but damages caused by the natural hazards were increasing worldwide, in many developed countries various national programs regarding natural DRM were implemented and Georgia joined in this process in 1995.

Disaster management activities in Georgia are led by the legal and regulatory acts supported by several normative acts adopted in different years. These main legal acts are:

- “The law of Georgia on State of Emergency” (1997) concentrating on post disaster phases only;
- Martial Law of Georgia (1997);

- “The law of Georgia on the protection of the territory and population from emergency situations caused by natural and technological disasters” (2007). This law is also oriented on disaster response and gives minor attention to pre disaster phases;
- Presidential Decree(#415)on the National Response Plan for Natural and Manmade Emergency Situations (2008) (United Nations, 2010a).

Above mentioned laws defines the main government institutions (non-government institution as well, such as Red Cross) that are involved in different DRM activities: risk assessment, monitoring, prediction, emergency preparedness, response and information dissemination and warnings (DRR Consultancy Report, 2010). In addition to these laws, elaborating early warning systems for civil protection is considered as one of the priorities under the Flagship initiatives of the Eastern Partnership (2010-2014); However, in the above mentioned laws the existence of the early warning system is not defined, as well their standards or parameters are not clear (VFL_RECC).

3.4 Institutional Framework

The institutional framework of natural DRM in Georgia is very complicated and creates obstacles for effective DRM. Institutions are scattered through several government sectors. Nowadays, there is no institution that would be involved in the whole DRM cycle. Various agencies and institutions participate at different stages. The main institution in DRM which is responsible for policy making and advising the President is the National Security Council (NSC). According to the legislation, at different DRM phases different sectors of the government, individuals and legal entities are participating. The EMD MIA is responsible for the emergency management during natural or manmade disasters and in the short term of the post disaster period. The functions of monitoring, forecasting and the prevention of natural disasters are allocated to the MoE (that is a national focal point in implementation of the HFA 2005-2015), different legal entities of the public law in subordination of the Ministry, other legal entities and commission at different levels(Gogitidze, et al., 2008).

According to the Presidential Decree (#415) on the National Response Plan for Natural and Manmade Emergency Situations the main the main bodies involved for risk communication during early warning are listed below in the table 3.1.

Function 2 : Ensuring network and warning activity	– Coordination of the development and implementation the main networking and warning activities; – Ensuring the readiness of the electronic communication, postal communication and broadcasting facilities; – Protection of the information technology resources, its restoration and continuous maintenance.	Main utilities: -Department of Communications, Informational Technologies and Innovation of Ministry of Economy and Sustainable Development; Assisting utility: -Department of Emergency Management of Ministry of Internal Affairs; - Patrol police department of Ministry of Internal Affairs; - Ministry of Defence; - Ministry of Energy and Natural Resources; - Legal entity of Public Law – public and private broadcasting; - Electronic communications and postal network operational companies; - Georgian national commission of communication.

TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.-1: ENSURING NETWORK AND WARNING ACTIVITY DURING EMERGENCY SITUATION (SOURCE: DECREE #415, 2008)

The main government institutions involved in risk communication (warning and awareness) are listed below:

3.4.1 National Environmental Agency

NEA – is the legal entity of the public law under the MoE of Georgia. NEA is an independent organisation and operates under the state control.

Up to 2011 NEA had the following departments:

- **Environmental Pollution Monitoring Department** (Head of Dep. Mrs. Marina Arabidze). They have modern lab facilities, recently installed, to measure water, soil and air samples..
- **Weather Forecasting Department** (head Mr. Ramaz Chitanava). Georgia has no own satellite ground station for weather forecasting. They have hard- and software through a project with Meteo France. At this department there was an initiative with the Netherlands Deltares to install a system for flood early warning (Paolo Reggiani). Delft-FEWS has evolved into an open shell platform that accepts a variety of data sources and is compatible with a host of special application models. Delft-FEWS is the accepted standard in Europe. It was used as a pilot study for one of the rivers in the West of Georgia, but the project was stopped due to a lack of data and trained personnel at NEA.
- **Spatial Information Centre** (head Mr. Levan Javkhi Shvili). They have GIS software, mainly to map and monitor mining licensing and other natural resources. There is little data sharing with other departments of NEA.
- **GeoHazards Department** (head Emil Tserrteli). Focus on all kind of hazards but mostly on flooding and landslides. They have a huge data archive built up from more than 100 years ago, but nothing digitalized, and mostly in Russian. Availability of data is not the problem, structuring, organizing and analyzing these data is a problem.
- **Coastal protection Department**
- **Department of Hydrometerology** (head Mr. Irakli Megrelidze). They have done some work on digitally mapping of snow Avalanches, but are managing now only a fragment of the stations that were available before.
- **International Projects Coordination and Relations Department** (head George Kordzakhia).

During the project implementation period, there was a major reorganisation of the Ministry of Environmental Protection and Natural Resources of Georgia (MoE) by the national government. The activities related to Disaster Risk Management (DRM) were transferred to the different ministries. The responsibilities and functions of the ministries changed during the reorganisation period significantly slowing down the negotiation and communication processes with the Ministry related to the activities of the project. Throughout the restructuring of the Ministry, CENN and other NGOs were actively lobbying the Ministry with the parliamentary committee to prevent the abolishment of the MoE and actions related to DRM.

In March 8 of 2011, there was a major restructuring of the MoE. Several responsibilities and functions of MoE were transferred to different Ministries. NEA (as a one of the key actors in DRM) and its departments were restructured as well. Only 2 main departments remained in NEA: **Department of Geological Hazards and Geological Environment Management** and

Hydrometeorology (the coastal protection department was moved in MRDI). The Spatial Information Centre was moved to the Ministry of Justice.

In general, the main tasks of NEA are: Identification and assessment of risks of different hazards (floods, flash floods, landslides, mudflows, erosion, heavy rains, droughts, snow avalanches, hail, strong winds, etc.); Damage assessment; Planning and implementing of protection and mitigation measures; Monitoring and forecasting of natural disasters; Zoning of the country regarding dangerous disaster risks; Collecting and analysing disaster risk data and providing spatial maps; Implementing optimal international practices and taking into account the local conditions (social, geological, etc.); Issuing annual reference books, bulletins and guidance regarding dangerous hazards; Distribution of warnings and recommendations for preventive measures to the Parliament of Georgia, national and local authorities, ministries and mass media(GNCDRR, et al., 2010).According to the legislation and tasks assigned, NEA is mostly involved in the pre-disaster phases of DRM. The lack of adequate equipment's, finances and is an obstacle for availability of reliable and timely natural disaster risk information. There is a low priority given to the risk assessment nowadays.

3.4.2 Emergency Management Department

EMD is a subsection of the MIA (Ministry of Internal Affairs) that coordinates activities during emergency situations caused by natural or technological disasters (EMD MIA, 2011). EMD department has three divisions: Civil Security Division, Fire Fighting Division, Rescue Preparedness and Response Centre. The main functions of EMD are: coordinating and planning of processes during the emergency response; allocation of humanitarian aid and rescuers during emergency; training and preparedness of fire-fighters/rescuers at different administrative levels; developing information banks for effective disaster management; forecast and monitoring of emergency situations, risk notification and provision of recommendations for action on-site(GNCDRR, et al., 2010).

3.4.3 Ministry of Regional Development and Infrastructure

Activities related to DRM are not a direct responsibility for MRDI, but it has some supporting functions during emergency situations, such as support during the recovery process, coordination of transportation in emergency situations, recovery of transportation after the disaster, etc. The Ministry of Finances cooperates with MRDI for regional budget allocation that is afterwards transferred to local administrations to be used for the disaster management activities among others (Aleksandre Movsesiani, personal communication). Finances and reserve funds in local administration for disaster management activities are so limited (2% of budget) that it is mainly oriented for the reconstructions in post disaster phases, thus not enough to use for preventive measures (Giorgi Datusani, personal communication).

3.4.4 Universities and research centres

In Georgia there are also a number of Universities and research centers that play a role in the research on Disaster Risk Management, and some also in the management of crucial data for disaster risk assessment and management. Among them the following organizations can be mentioned:

Ilia State University, in particularly the College of Engineering (dean, Zurab Javakishvili), and the Department of Earth Sciences (Mikheil Elashvili). They are managing the seismic network for the country and have their own website: http://seismo.iliauni.edu.ge/eqs/eqs.php

Ivane Javakhishvili Tbilisi State University. Tbilisi State University is the largest and oldest university of Georgia. Tbilisi State University is going through several changes, re-organizing their faculties and departments, formulating new programs for international collaboration and seeking new funding sources. Some relevant for DRR are:

- GIS and Ecology: they are in the process of developing a new curriculum (BSc and MSc) in ecology
- Land administration: they are in the process of formulating a new PhD program in land administration, including one stream on GIS for land administration.
- Geology and geography; they want to strengthen the GIS component in their BSc and MSc programs.

Nodia institute of Geophysics. This is a research center of the Ivane Javakhishvili Tbilisi State University. They have scientific departments but the one relevant for DRR is the Department of Seismology and experimental geophysics (under the guidance of T. Chelidze). They have been working a lot on seismic hazard assessments. Recently they also produced a study on multi-hazard risk assessment , lead by Dr. Nino Tsereteli.

Ilia Chavchavadze State University. Faculty of Earth Sciences (Dean Dr. Zurab Javakhishvili). This university was established some 10 years ago and is considered as one of the most modern and progressive university of Georgia, breaking away from the old Soviet style of education.
The Faculty of Earth Sciences is recently established. It only has Masters programs. They offer master programs in Seismology and Geophysics. They are dependent on the quality of bachelor programs of other universities with respect to the intake of their students, which is a problem, so they are planning to also develop their own bachelor education in earth sciences.

Georgian Technical University. Faculty of Mining and Geology (Dean Anzor Abshilava). They teach a course dealing with natural hazards.

4. Effective structure of the early warning system

4.1 Introduction

The chapter 4 presents one of the effective structures for early warning system. This chapter can be further elaborated by the respective authorities beyond the framework of MATRA project and make practical implementation of it.

4.2 Integrated Early warning system

The main goal of the early warning system is to take an action to protect or reduce loss of life or to mitigate damage and economic loss before the disaster occurs. Well-functioning early warning system needs an effective communication system. Early warning disaster communication system are made of two main components (1) communication infrastructure hardware that must be reliable, especially during the natural disasters: and (2) appropriate and effective interaction among the main actors of the early warning process such as the scientific community, stakeholders, decision makers, the public and the media. The effective application of emerging communication technologies can be realized only if they form part of a sound early warning system based on a well-established basic principle.

Institutional cooperation framework is required for channelling information across reliable communication systems and cascades of interfaces for better response during disaster situations. Prediction, communication, and use of the information are necessary factors in effective decision making within the early warning processes. Prediction efforts by the scientific community alone are insufficient for decision making. A miscommunicated or misused prediction can result in costs to the society. The lack of clear and easy-to-use information can sometimes confuse people and undermine their confidence in public officials. In any case, clear and balanced information is critical. Redundancy of communication system is essential for disaster management, while emergency power supplies and backup system are critical in order to avoid the collapse of communication system after disaster occurs. Information Communication Technology (ICT) tools enables us to be smart and strategic in gathering and dissemination of information. Packaging of disaster information in various modes of communication such as personalized devices (e.g. mobile, telephone, email etc.), mass media (newspaper, radio, television) and community media (loudspeaker, hooter, alarm etc.) is necessary to ensure that desired objective is met (Sarun, 2011).

A warning system is intended to get information about an imminent emergency, communicate that information to those in need, and facilitate good decisions and timely response of society in danger. Contemporary warning systems are complex in both organizational structure and work process. The structure of warning systems has been researched several times. The researchers agreed that most effective structure for a warning system is that of an integrated system that has two qualities:

- to ensure preparedness, the warning system is composed of three relatively separate subsystems, the detection, management, and response subsystems;

- and integration requires that sound relationships among these subsystems be developed and maintained (Mileti & Sorensen, 1990).

4.2.1 The detection subsystem

The detection subsystem focuses on the relatively routine monitoring of the natural, technological, and civil environments that could induce an emergency. It collects, collates, assesses, and analyzes information about those environments and, when warranted, makes a prediction about the potential occurrence of an emergency. The prediction is then communicated from the detection subsystem to the management subsystem. This typically means that scientists inform emergency management officials about impending natural emergencies. Military, police, or intelligence organizations typically inform civilian officials about civil emergencies. The detection subsystem is largely the domain of scientific organizations for natural hazards.

Monitoring and Detection - collect data about the presence of hazards. This is done both systematically that involves regular observation, measurement, and recording (For example, fro the flood hazard, recognition may be based on observing rainfall and rising river levels) and serendipitously that involves non-systematic observation of factors which may occur by chance or by intuition. Detection may be made by a member of the public, or it may be performed by a specialized monitoring organization, through the use of sophisticated technological equipment. Both approaches produce data that can be used to predict emergencies.

Data Assessment and Analysis - use data to understand the behaviour of the hazard system being monitored. The methods of data assessment range from simple computations to complex modelling efforts. Data analysis in warning systems is limited by the factors that bound inquiry: adequacy of available data, level of development in relevant theory, experience of personnel, limited resources, and legitimacy of the analysis.

Prediction - to forecast the behaviour of the hazard that includes information on five factors: time, location, magnitude, probability, consequences. Prediction is limited by many of the same factors which limit data analysis (e.g. data, theory, experience, resources, and expertise). Prediction is complicated by the issues of confidence (uncertainty) and uniqueness.

Informing – Communicating (informing) detected hazards to emergency management officials. Informing can rely on formally established procedures, which provide guidelines on when, how, who, and what to inform. Effective communication of prediction from detectors to emergency managers is constrained by several factors: scientific or technical terms are not always understandable, inadequate communication hardware, being wrong that disaster will not occur, it is not clear to the detector to whom address the communication (Mileti & Sorensen, 1990).

4.2.2 The Management Subsystem

The second subsystem is focused on integrating the risk information received from the detection subsystem and warning the public when warranted. This subsystem is composed largely of local emergency management officials. But warning can also be issued by people whose warning roles emerged during the emergency. After receiving information from the detection subsystem, these managers must interpret that information in terms of potential losses (e.g., loss of life and property) and then decide if the risk warrants a public warning. One part of this subsystem often overlooked is the monitoring of public response once warnings are issued, so that subsequent warnings can be refined or changed if people are not responding in a way that would minimize their exposure to risk.

Interpretation - Sometimes emergency mangers can have a difficult time understanding hazard predictions, particularly if they are offered by scientists. More interpretive information is usually necessary because uncertainty and confusion produced by misunderstood information can lead to inappropriate decisions.

Better interpretation of risk information by the emergency managers or by the public (both during early warning or long –term risk awareness programs) also depends on risk visualization. Visualization of risk is a one of the important processes in risk governance. Since risk is a spatially varying phenomenon, Geographic Information Systems (GIS) technology is now the standard tool for the production and presentation of risk information. The several forms of risk visualization can be seen the figure 2.3

Statistical information per administrative unit (country, province, municipality, or neighborhood), such as: A Risk Index value resulting from qualitative risk assessment (e.g. Spatial Multi Criteria Evaluation); The Probable Maximum Loss (PML) or Average Annual Loss.

Risk curves, such as: Loss Exceedance curve for economic risk or; F-N curves for societal population risk;

Maps which shows the spatial variation of risk over an area: A hazard map with an overlay of the elements at risk; Qualitative classification of risk classes in high, moderate and low; Quantitative estimations of building-, economic or population losses per unit;

Web-GIS applications that allow the user to combine different types of information, and display information such as: Hazard maps of individual hazard types; Elements at risk information; Maps of individual risk types, for instance for different return periods; Multi-hazard risk;

Spatial Data Infrastructure / Clearinghouses, where through internet basic GIS data can be shared among different technical and scientific organizations involved in hazard and risk assessment.

Animations showing the spatial and temporal distribution of hazards and risk, such as: Flood animations showing the development of a flood over time, where the flood height, and water velocity are shown per time step as a movie file, overlain with elements at risk information; Fly-through, three dimensional displays of risk information over a high resolution satellite image. For instance, Google Earth now offers great opportunities to make such animations, as one can export the risk maps from GIS and KML files that can be directly overlain in Google Earth.

Figure 2.3: Several forms of risk visualization (van Westen & Kingma, 2009b).

Decision to warn - decision to warn the public is one of the least understood aspects of warning systems. One major issue concerns specifying who makes the decision to warn the public. Previous experience with warning decisions make clear that the person or group making the decision should be identified and recognized before the decision of warning.

Method and Content of Warning- alert the public to the likelihood, nature, and consequences of an impending disaster and outline appropriate protective actions. People who are not at risk as well need to be informed, as it is important to know that one is safe from an impending threat. The method and content of warning consists of the warning message itself, the source of that message, the channels by which it is communicated, and the frequency with which it is repeated. Good messages contain consistent, accurate, and clear information; guidance on what to do; risk locations; and confidence or certainty in tone. In general, messages must come from sources that the public view as credible. Because different people have different, views of credibility, it is usually desirable for messages to come from multiple channels and sources. A single warning is not sufficient to get people to believe and respond

Redundancy of communication system is essential for disaster management, while emergency power supplies and backup system are critical in order to avoid the collapse of communication system after disaster occurs. Information Communication Technology (ICT) tools enables us to be smart and strategic in gathering and dissemination of information (Sarun, 2011).

Monitoring Response - One of the most neglected aspects of the emergency management component of warning systems is the monitoring of public response to warnings issued. It is important that those issuing public warnings have some notion of what effects the warnings are having, how the public is interpreting the information, and what additional information is being generated outside the official warning channels. The results of monitoring can be used to adjust the warning method or content on the basis of what the public is and is not doing and to dispel inaccurate warning information (Mileti & Sorensen, 1990).

4.2.3 The Response Subsystem

Public response constitutes the third warning subsystem. People respond to warnings received from the management subsystem on the basis of their own interpretations of those warnings, and public interpretation can differ from that of detectors or managers. Moreover, the public response subsystem contains an additional warning element, in that people generate unofficial warnings for others. Unofficial warnings can come from members of the management subsystem, for example individual fire and policemen who choose to go house-to-house or from members of the warned public who inform others. People also confirm and alter warnings according to their own perception of the events and their own social realities. This facet of a warning system can be overlooked in preparedness. The ideal response subsystem has particular structural characteristics in an integrated warning system. First, comprehensive and multiple channels of communication to the public have been prepared. Second, warning messages are comprehensive and provide the public with all that it needs to know. Third, public response is monitored as it occurs and feed back into the management subsystem so that adjustments in warnings can be made as needed. Fourth, the ability of the environment to bypass the detection and management subsystems and directly influence public response is taken into account in planning. Finally, the possibility that detection-system personnel may informally give to the public direct information, which supports or contradicts official warnings, is recognized and managed.

Interpretation - In an emergency, this means that even though everyone may be listening to the same warning information message, different people can reach different conclusion about what they hear. These different perceived "realities" about the emergency lead to differing public responses to the same warning message. The goals of any public warning system are: everyone who should hear a warning message hear it; all members of the public understand what is being said, the public believe what is being said, people at risk personalize the warning information and those not at risk not do so, people act or respond on the basis of those decisions in a timely manner.

Response - What people do in response to emergency warnings varies. Unfortunately, it is not always clear what are the best steps to take in response to emergency warnings. The adequacy of responses might be measured in several ways, for example, the extent to which people react in ways consistent with the emergency information that they were provided or the number of deaths and injuries avoided.

Informal Warnings - There is an informal dimension to emergency public warnings. People who are the targets of formal warnings also participate in warning others. These informal warnings can serve a useful purpose. Sometimes informal warnings are correct and help to reinforce official warnings. Other times informal warnings can be incorrect. This is more likely when there are strong pre-emergency misperceptions about the hazard. Informal warnings can contribute to confusion in these cases, particularly if formal warnings are weak in substance or form. The role of informal notification in providing first warnings would probably decrease dramatically as the speed of the formal alert and notification system increases. Informal notification also appears to increase as the urgency of the situation increases (Mileti & Sorensen, 1990).

5. Tools for risk communication 1: The National Hazard and Risk Atlas of Georgia

Risk Communication (RC) is a component of risk governance, and is defined as “an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management” (National Research Council, 1990).

Communication is core to the success of disaster mitigation, preparedness, response and recovery. Communicating information on hazard, vulnerability and risk is challenging, as it is the custom human behaviour not to be worried about events that might happen in the future but that do not cause immediate cause for concern. During a crisis situation this changes dramatically and then the citizens need to be informed instantaneously by local authorities. Media also play an important role in this.

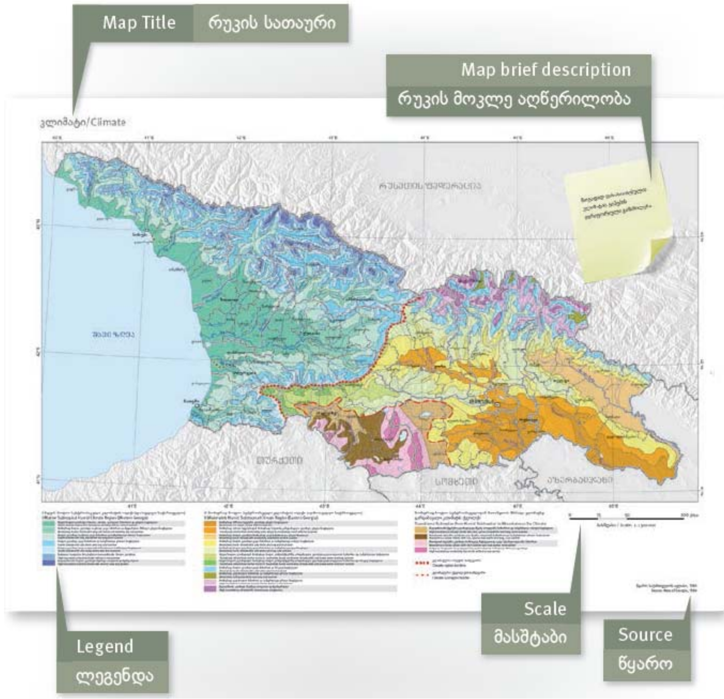
Risk communication focusing on the imminent threat of an extreme event is referred to as a warning and is meant to produce an appropriate emergency response. On the other hand, risk communication programs can also focus on the long-term potential for such events to happen, and is then called a hazard awareness program.

Risk communication in the form of this risk atlas is aimed to:

- make citizens, media, local and national authorities aware of risks in the country;
- improve their knowledge of possible disasters, and their possible impacts;
- improve their knowledge how they could be prepared for;
- change their attitude towards disaster prevention and preparedness, and
- eventually change their behaviour (van Westen & Kingma, 2009b).

Better interpretation of risk information by emergency managers or by the public depends considerably on risk visualization. Visualization of risk is one of the important processes in risk governance. Since risk is a spatially varying phenomenon, Geographic Information Systems (GIS) technology has become a standard tool for the production and presentation of risk information (e.g. maps).

Maps make the comprehension of messages easier for wider user. Thus, maps are one of the effective tools for risk communication. Two main instruments were developed within the project (paper risk atlas, and web-based risk atlas), where the maps (interactive, static) are the main component.



The risk atlas includes texts, graphs, figures, tables and maps that communicate to the user information regarding the hazards, exposure, vulnerability and risks. All the maps contain information regarding the map title, legend, sources of the data, scale, projection and a brief description regarding the contents of the map. Besides the map content, each map has additional information giving an overview about how the map was produced or processed before visualising them on the maps.
The risk atlas was prepared with the aim of communicating risk to different stakeholders in Georgia (Government organizations, local authorities, NGO's, communities and the general public). More than 500 copies of atlas have been distributed over these stakeholders in Georgia. We expect this atlas to increase awareness of the risk to natural hazards, and the willingness to adapt measures to reduce the risk.

6. Tools for risk communication 2: The Web-based platform

Nowadays, the internet is an increasingly popular tool for the communication of disaster risk information, because of its capacity for information management. In the field of disaster management, among others, internet based technologies are already widely used for the communication of risk information. As was mentioned above, within the project a web-based risk atlas was developed along with a risk communication tool (See figure 1.6). Web-based risk atlas allow the user to combine different types of information, and display information such as: hazard maps of individual hazard types; elements at risk information; exposure maps; vulnerability maps and maps of individual risk types.

The main functions of the web-atlas are as follows:

- **Disaster reporting**: where users (general public, local authorities, universities, experts, media, etc.) can report about disasters/hazardous events in their own area. Firstly, the users have to be registered to be able to make a report, after the process of registration a user can locate the hazardous event as a point, line or area on the map;
- **Disaster Database**: where users can query different hazards by types (e.g. landslide, rockfall, mudflow, flood/flash flood, wildfire, snow avalanche, etc.) date, location, etc. The database includes hazardous events recorded in the past that was gathered during the project's implementation and presented by administrative units. Newly reported events will be added to the existing database and updated continuously.
- **Hazard and risk maps**: where users can view different hazard and risk maps. The user can retrieve the reports regarding hazards, exposure, vulnerability and risks presented for any place of interest at different administrative levels.
- **Community profile**: where short information regarding the different administrative units (region, municipality, community) can be generated. Those information are: number of recorded natural hazardous events present as graph and table; hazard maps (with high, moderate and low classes); exposure of elements at risk (buildings, population, GDP, transportation, forest, crops) in percentages for each hazard type.

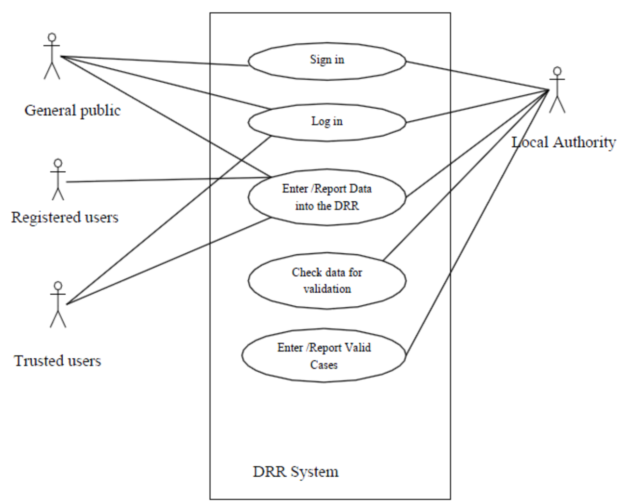
* **Natural hazards**: where background information regarding different types of hazards can be found. A range of different maps covering different interests (pdf format) can also be downloaded in this section.
* **Local case studies**: where case studies that were carried out within the project can be downloaded in both languages.
* **Disaster Risk Reduction**: where all the training materials carried out within the project can be downloaded. All the information relevant to DRR can also be uploaded/placed, etc. here.
* **Paper atlas**: where presented atlas' will be available in pdf format and can be downloaded by the user.

The Web-based platform and its design have been presented in detail in Deliverable 4.1.1. It can also be consulted at http://drm.cenn.org . Therefore we will not repeat the details here, but will focus on one of the important components for risk communication: reporting of disaster events by the public and its verification.

In reporting disaster, it has been observed that human observations can be integrated with the Web technology and one of the challenges is that not every piece of information obtained is useful.

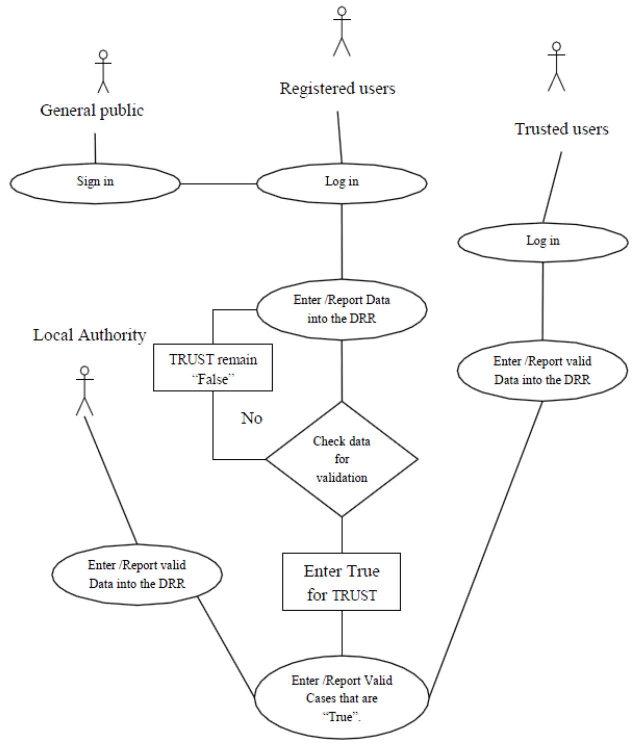
Information content may vary with respect to a number of information quality criteria (e.g. accuracy, relevance, usability, etc.). The Quality of data is a major concern, since information entered by the public are not always reliable and that may lead to mistrust in the officially created data. This has being a major issue affecting the way National Environmental Agency (NEA) communicate to the public information on disaster. Often the quality and format of data do not respond to modern requirements and can not be applied by other state agencies. In some cases it has also lead to waste of national resources where unreliable information had being used.

Therefore, the National Environmental Agency (NEA) and the Emergency Management Department (EMD) needs a verification mechanism to validate incoming observations. In a broad sense, an authentication process is required in the Disaster Risk Reduction and management System (DRR) to make sure that the data entered into the system is valid, complete, fit for use and correct. In other words a verification mechanism is required as part of a security architecture that would check user profile and bind attributes entered into the system with their user identity.



Therefore a study was made with the objective to design and implement a verification mechanism as part of a security architecture that would help in evaluating data entry and data quality issues based on certain procedural rules implemented within the system. How can the quality of this information be assessed and validated? This verification mechanism would be the base for a Risk communication strategy and a framework for communicating hazard information to the Disaster Risk Reduction and management System (DRR).

The Authentication Service for this system provides a standardized means to authenticate users (or more generally speaking: clients). With this service users are able to subscribe to the system and their detail checked on every login attempt. After a successful authentication of a user, they are guaranteed access to a protected service every time they login to the system.



Public User Access

Once a user subscribes to the system as specified above in the user requirement and his details are registered within the system. All he/she needs to do is login with the username and password and access would be granted.

Local Authority Access

The unique criteria here is that the local authority subscribe to the system using his staff ID (identification number) which would be stored in the database and checked during login process.

One of the basic requirements for trust is proof of identity, because authentication provides a means on checking users and a crucial part of the verification mechanism. Following the proposed system design, a user has to obtain an account by subscribing to the system through a form on the interface. After a user gets authenticated access is granted to the user and information specific to that user is made available. This is fostered by the use of Active server pages that communicate with the server and database containing details of the user. Each operation is invoked by HTTP GET operation. In both cases parameter names and values have to be parsed to the server as defined by the application together with the content type. The resulting query string is appended to the service's URL (HTTP GET) or part of the HTTP POST body. In most cases HTTP POST is the best choice, as you don't run into URL length limitation problems. But sometimes it is more convenient to perform an HTTP GET.

The details of the procedure can be found in Deliverable D 6.1.3.

7. Tools for risk communication 3: Participatory GIS using Cybertracker

PGIS used in a participatory risk assessment process brings together the spatial information components of disaster risk reduction management (DRRM) with local spatial knowledge. By making use of formalised systematic mapping and analysis of local spatial knowledge relevant to hazards, vulnerability and risk, PGIS provides the added value of digital data in a GIS environment to local capacities. Participatory GIS contributes to risk management by helping to build local capacity, improve the community's relationships with those in power, promote learning among the actors and improves risk communication for instance of local concerns and capacities to the 'higher ups'.

Participatory mapping and PGIS elicit, represent and validate local spatial knowledge, which is rarely available on official maps; this may be considered the most significant and valuable contribution of PGIS. The information is spatially specific, implying that it concerns local priorities, values and perceptions; the process itself is driven by local interests and priorities. It is socially inclusive, representative of interests and values of communities as well as individuals; feelings of 'ownership' and legitimacy of actions can be strengthened at community and municipality level. It is capacityenhancing as communities and groups can be empowered by involvement in PGIS processes, thereby improving self–confidence and technical and political capacities. By building communicability between outsiders and insiders, it not only legitimises the value of endogenous knowledge, but also makes the technical GIS tools and instruments more acceptable to local users.

Participatory mapping and PGIS Integrate local and external knowledge - local, indigenous knowledge, sacred knowledge, gendered knowledge; this is knowledge that doesn't necessarilyconform to state visions of place. It is integrated with scientific knowledge of e.g. implications of global climate change, globalisation and urbanisation.

- Visual images as "spatial narratives". Pictures are rich in information and shared understanding, not just a quantitative increase in information, but also qualitative. Visual images often provide the 'conviction' factor, though this may have negative as well as positive implications.
- Multi-sourcing: involves multiple processes of people's participation in knowledge identification and selection. There are many opportunities for X-checking and alternative validations.
- Using functionalities of GIS
    - spatial analysis of e.g. proximity, buffer zones, threshold distances, efficient routes and networks (e.g. people, roads). Overlaying is a 'value-adding' functionality where GIS is superior to paper or mapping with plastic sheets.
    - ability to work across multiple scales and topologies Spatial scaling (multi-scaling, zoomingin). Moving/ jumping scale (landscape view),
    - ability to handle multiple data layers for analysis and presentation; ease in overlayingmultiple data sets ('what is where?').
    - handling spatial Queries (where is ?, what is there ?). Simple (calculating areas, drawing boundaries), and complex (geo-coding, dynamic simulations) analyses.

- Accessible and user-friendly, ease in mapping, portability (laptops, Tablets. mobile GIS like CyberTracker), for determining locations (using GPS); and numerous types of output not just maps;
- P-mapping and PGIS are assumed to have superior effects in terms of relevance, usefulness, sustainability, empowerment, and meeting good governance objectives, due to their stress on participation and on utilising local knowledge.
- Furthermore, the local actors can achieve lower costs in their disaster risk assessments and disaster management.

These factors are particularly important in developing countries where much of the crucial spatial and non-spatial information and the technical and financial resources for risk assessments are not otherwise available to local authorities and planners.

SUITABLE APPLICATIONS / TOOLS	Community mapping	Environmental Hazard history	Land use planning	Location of hazards	Vulnerability assessment	Risk mapping	Safety & security mapping
RRA & PRA methods (for spatial info)		o	o		o	o	o
P-mapping with: Sketch mapping			o		o	o	o
P-mapping with: Topographic maps	o		o	o	o		
P-mapping with: aerial photos, satellite images or Virtual Globes	o	o	o	o	o	o	o
P3DM	o	o	o	o	o		
Mobile GIS, GPS	o	o	o	o	o	o	
Cyber Tracker	o	o		o	o	o	o
Visualisation, Graphics software		o	o		o	o	o
Digital camera, Video, Multi Media		o			o	o	o

There is more than enough evidence from environmental management that the combination of local knowledge with modern spatial information systems (GPS, GIS), participatory GIS (PGIS) and earth observation (satellite imagery, aerial photography) enhances planning and policy decisions by providing more reliable, empirical, detailed and convincing information (McCall, 2003; Rambaldi et al., 2006; Chambers 2006). A map created participatorily can become a platform on which local issues can be discussed, both within the community and with outsiders. The power even of simple sketch maps in participatory rural appraisal (PRA) exercises is widely recognised (e.g. Chambers, 2006); the application of modern information technology for mapping in participatory settings has the potential to be even more empowering. Partly this is simply because maps in digital form look beautiful and are intrinsically impressive, giving gravitas and status to information which might be easily dismissed by educated outsiders as amateurish and unsound, were it to be produced as rough sketches on flip-over sheets. The technology puts local knowledge on a technical par with outsider knowledge.

The **CyberTracker** programme usually operates on a hand-held computer (PDA) such as a Palm OS handheld computer or an iPaq, connected by Bluetooth to a GPS unit; CT also functions withSmartphones. (cf. Bey 2009, Helveta 2009, Peters-Guarin & McCall 2011; Ansell & Koenig 2011) CyberTracker (CT) was originally developed by Louis Liebenberg for wildlife tracking and monitoring in Southern Africa (www.Cybertracker.org). The software allows the design of screens to collect field data in a systematic way. The data entry can be programmed by clicking on icons or text following a sequence which is predefined by the user. The software was originally designed to be especially user-friendly for people unfamiliar with computers, even illiterates and innumerates. The interface is relatively straightforward to use, as its front end has been designed for ease of understanding, e.g. with a wide range of existing icons, thus relatively little need for programming skills. Data initially captured on the PDA or Smartphone can later be transferred easily to a Windows-based PC.

CyberTracker is open source, and may be adapted by users for their own purposes; it can be obtained gratis. When combined with free satellite imagery from Virtual Earth or Google Earth and open source free GIS software (such as ILWIS5), there are considerable financial advantages over relying on expensive (Ikonos, SPOT) or low resolution (e.g. Landsat) remote sensing products and on standard GIS software such as ArcPad or ArcView.

CyberTracker applied to DRR Management in Mleta, Caucasus Mountains. A method was developed to collect DRRM information mainly on vulnerability, but also on awareness and preparedness, in a mountainous rural area in Georgia in October 2010. The participants in the CT exercise and trainees in this workshop were mainly people with higher education backgrounds, about half in technical fields. They were mainly from outside the fieldwork area, employed in national agencies and ministries, such as NEA (5), NGOs (5), and district or municipal level staff (6).

The workshop participants utilised PGIS procedures to acquire local spatial knowledge using the CT programme installed in iPaq hand-held PDA devices and connected with a separate GPS via Bluetooth. Many places and communities located in the Caucasus Mountains, close to the border with Russia, suffer problems of mudflows and landslides, especially when the rainy season starts at the beginning of autumn. The village of Mleta in Mtskheta-Mtianeti region was the study area, and the survey was carried out over two days after previous reconnaissance visits. The tool was used to collect information from local inhabitants about a severe mud flow that devastated this area in 2009. (Tatashidze et al. 2006).

The permanent inhabitants of Mleta, plus a few family members visiting from Tbilisi or elsewhere, and some key informants including a resident Orthodox monk, provided the local knowledge on the hazards, vulnerability and coping.

The main advantages of CyberTracker are:

- CT itself is a free programme. Furthermore, it incorporates free Virtual Earth or Google Earth or OpenStreetMap images, and the data can be transferred and used in free GIS software such as ILWIS. Therefore it is very relevant in Georgia, especially for NGOs or small local authorities where financial limitations are significant.
- However, although the software and images are free, the hardware, that is, the IPAQs and Smartphones or GPS devices are not, although they are getting cheaper and potentially more affordable in future.
- The spatial data are geo-referenced.
- Entering data in the interview sequence is easier than using paper and pen, especially when the field data values are already pre-defined; therefore the participants stated that is easier to transfer the collected local knowledge to the data base, Cross-checking and checking the validity of the written record in the field was felt as a positive experience in the Mleta case.

CyberTracker has the potential to be a usable, useful and understandable tool for many members of local communities to utilise for community-based disaster risk management; like it is already utilised in other community-based mapping, measuring and monitoring of natural resources, or social and environmental problems. CT is relatively user-friendly and effective for field application even by non-technical people.

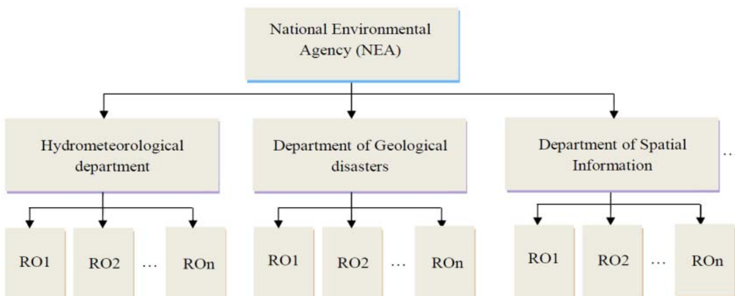
Unhappily this is countered by the relative complexity and obscurity of some of the steps needed to prepare the sequences for use. The basic strength of the CT system is its relative ease of application in the field by users, with its combination of the navigation / location function and the recording of selective geo-referenced information by script, photo, recording or image. The ability for users to work with just icons and images is part of its strong advantage.

The primary drawback is the complexity of initially setting it up for use for any particular application: in creating the many screens for the navigation and recording sequences. As shown in this guide, there are a large number of steps involved, and all too frequently the programmed instructions are not clear enough, and the terminology and some of the essential steps are non-intuitive. In its current format, it is easy to go wrong in the setting-up of the sequences. The simplicity and user-friendliness in the field needs to be complemented by a more user-friendly and intuitive programming procedure.

Deliverable 6.1.2 presents a guide to the use of CyberTracker as a tool for risk communication in Georgia.

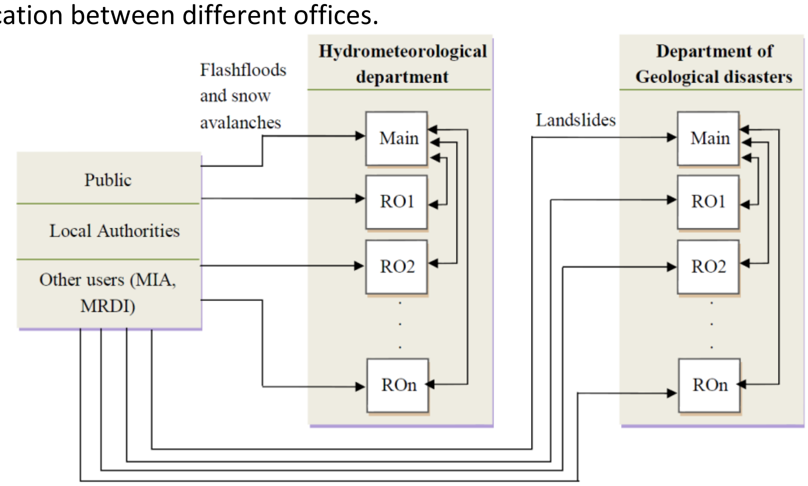
8. Tools for risk communication 4: SDI portal as a tool for cross-agency communication

This topic is part of the risk communication tools that are designed for the project "Institutional Building for Natural Disaster Risk Reduction (DRR) in Georgia". The National Environment Agency (NEA) is the main governmental body in Georgia responsible for the monitoring of hydro-meteorological disasters and the distribution of such information to the interested parties. Spatial Data Infrastructure (SDI) portal is constructed that can be used as a tool for cross-agency communication in NEA. This deals with three departments of the NEA: (Hydrometeorology, Geological Hazards & Geological Environment Management and Spatial Information) departments.



Simplified structure of the Department in NEA and their regional offices

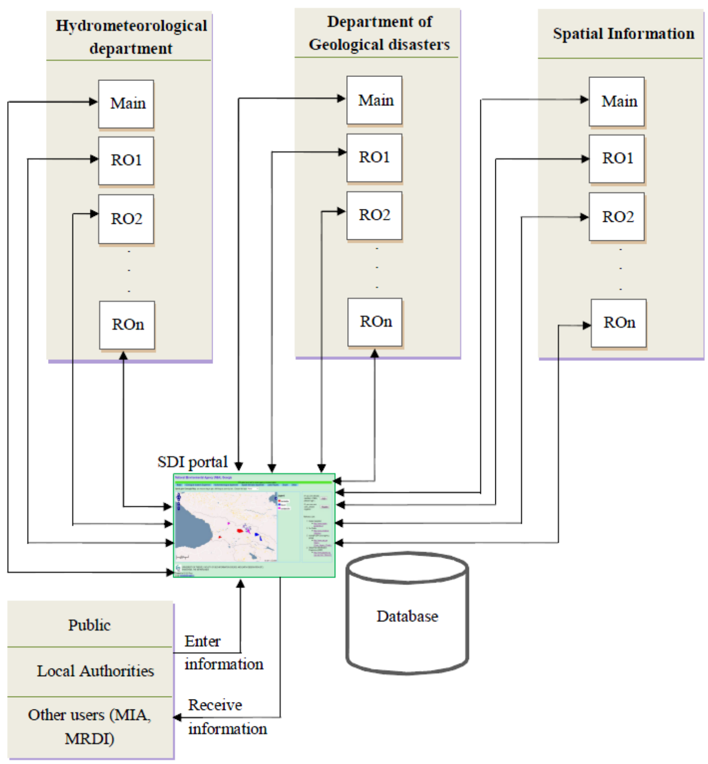
Each department has its own role for a specific disaster type. Therefore, the designed system mainly focuses on three types of disasters: landslides, avalanches and flashfloods in Georgia.
Each department of NEA has a main office and a number of regional offices. The disaster reports are submitted to either main office or regional offices. Moreover, each department knows only its responsible disaster information. Currently methods of disaster inventory used by NEA, disaster events are reported independently to the main office as well as to regional offices by different users such as public, local authorities and other users (MIA and MRDI). The Figure below shows the structure of how disaster information is reported by users into the NEA and the communication between different offices.



Disaster reporting and communication without SDI portal

Each department deals with specific disasters. For example, Department of Geological disasters have the responsibilities for monitoring landslides, Hydrometeorological department deals with flashfloods and snow avalanches. Each department knows only their correspondence disaster information and sharing disaster information is only taken place between main office and regional offices. Therefore, other departments cannot know all disaster information

The proposal is that an SDI portal can be used both for sharing disaster information between different departments (horizontal communication) and for making easily exchange of information between main office and regional offices of NEA (vertical communication). The design structure for cross-agency communication via SDI portal is shown in the Figure below. By using SDI portal, communication between various departments and offices might become simplified and easy. Moreover, SDI portal can inform each other of developments in projects, cases, monitoring and so on.



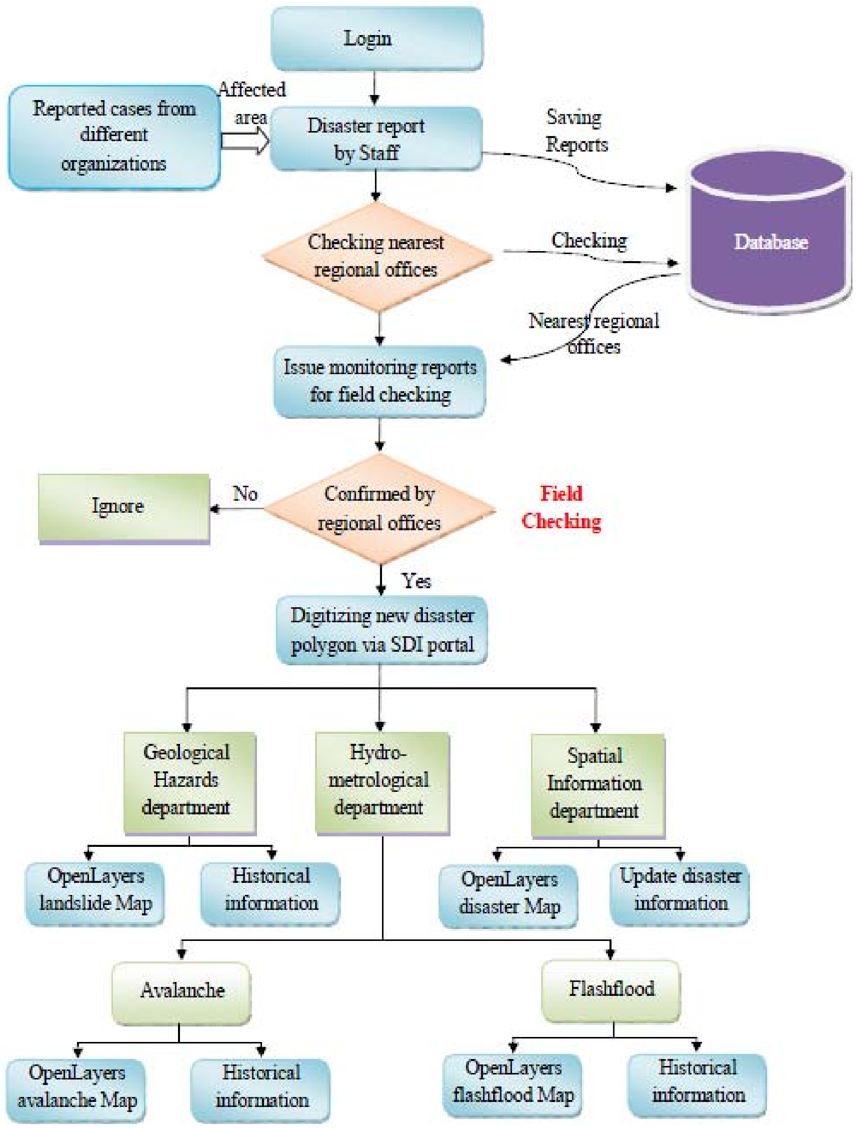
System architecture for cross-agency communication via SDI

Therefore, this proposal is to implement an SDI portal for both horizontal (between different departments) and vertical (between main and regional offices) communications.

Three department profiles are designed based on their responsible disaster type. All historical information about the disasters can be accessed via this SDI portal. These disasters information is entered by public, local authorities, Ministry of Internal Affairs (MIA) and Ministry of Regional Development & Infrastructure (MRDI). As soon as the disaster reports are submitted by the staff, these reports are stored into the database and published via the portal. Then, the nearest regional offices of NEA can be calculated using various buffer distances for a field checking. After the disaster areas are checked and confirmed by the regional offices of NEA, these new disasters are digitized by Spatial Information department via OpenLayers Map and the digitized polygons are saved into the original disaster database.

Because of the evolution of modern Open Geospatial Consortium (OGC) web services and Spatial Data Infrastructure (SDI) technologies, dissemination and sharing disasters information

via Geo Portal become possible in reality. For example, the INSPIRE Geoportal provide searching spatial data sets and spatial data services, and subject to access restrictions, view and download spatial data sets from the European Union (EU) Member States within the framework of the Infrastructure for Spatial Information in the European Community (INSPIRE) Directive.
The conceptual diagram is shown in the figure below.



Conceptual diagram

Deliverable D 6.1.4 presents the details of the SDI for risk communication between the various departments of NEA. Unfortunately, due to the change in NEA that occurred in 2011, the spatial information department was moved out of NEA, which made it impossible to implement the design. However, a lot of the components have been integrated within the Web-Platform designed within this project: http://drm.cenn.org

9. Conclusions

The objective of Area 6 of the project was to the elaboration of a Risk communication strategy involving local stakeholders and a framework of early warning system for DRR is developed and introduced.

Early warning systems are still a step too far.

Throughout the project it has become clear that it is too early in Georgia to develop a national Early Warning system, focusing on hydro-meteorological hazards, like floods, landslides, mudflows, and snow avalanches. The historical information available at NEA was not in digital form and it has taken a considerable effort to digitize part of this data. As described in Deliverable D 4.1.1 we have been successful in generating a fairly large database of historical events. However, for most of these the exact data of occurrence is missing, which doesn't allow the correlation with the meteorological triggers like daily rainfall and temperature changes. These are required in order to be able to correlate the number of events with the intensity of the trigger and to develop threshold equations that are used as the basis for Early Warning Systems. In Georgia the data is simply not enough to be able to develop such systems at the moment. Also the number of telemetric meteorological and hydrological stations is far too less to be able to come up with real time warning. Therefore Early warning systems are still a step too far, as was also demonstrated by the failure of the Flood Early Warning system that was attempted with the help of Deltares, but which had to be discontinued due to a lack of data and trained personnel. The reorganization of NEA and the removal of the Spatial Information Department (which was supposed to be the host of the Web-based platform) to the Ministry of Justice, complicated the implementation even more.

Having said that, there are certainly possibilities for local early warning systems based on community participation. As has been demonstrated in this project the use of Participatory GIS has proven to be a very good tool for linking local information from communities to national and local authorities. This can be extended further in future. CENN is also heavily involved in community-based project realted to Disster Risk Reduction. The role of our main beneficiary NEA, however, is expected to be limited in this field.

Risk communication

For the reasons given above we have concentrated the risk communication efforts in this project mainly to the development of a national atlas for hazard & risks in Georgia, of which more than 500 copies have been distributed to many stakeholders throughout Georgia. This is basically a one-direction form of risk communication.

A two-directional risk communication strategy has been implemented through the development of the Web-based platform, which allows reporting of events, querying information and the generation of hazard, exposure and risk profiles for all administrative levels. This tools is aimed at the public, at local authorities of different administrative levels, at NGO's, the media, and expert organizations that can use the tool to exchange risk related data. The web-based platform should be further updated and maintained. It should also be transferred to the EMD as key organization. It has the potential to become a very important tool for risk communication in Georgia, but the success of it depends on the commitment of the various stakeholders, and the political support for disaster Risk Reduction in Georgia.

10. References

Kheladze, N. (2011). *Assessing the feasibility of using local spatial knowledge in disaster risk reduction in Georgia.* Enschede.

Lagmay, M. A. (2009). Citizen-based interactive flood map Retrieved 10.01, 2011, from http://opinion.inquirer.net/inquireropinion/talkofthetown/view/20091010-229407/Citizen-based-interactive-flood-map

McCall, K. M. (2010). Local Participation in Mapping, Measuring and Monitoring for Community Carbon Forestry. In M. Skutsch (Ed.), *Community Forest Monitoring for the Carbon Market: Opportunities Under REDD*.

Mileti, S. D., & Sorensen, H. J. (1990). Communication of emergency public warnings: A Social Science perspective and state of theart assessment. Washington, D.C.: FederalEmergency Management Agency.

NEA Geology. (2009). Bulletin of The Results Geo- Hazardous Events for 2008 and their Forecast for 2009 Year: Georgia Tbilisi: MoE.

Rambaldi, G., Kwaku Kyem, A. P., McCall, M., & Weiner, D. (2006). Participatory Spatial Information Management and Communication in Developing Countries. *The Electronic Journal of Information Systems in Developing Countries, 25*(1), 1-9.

Sarun, S. (2011). *Disaster risk communication over early warning technologies - A case study of coastal Kerala*. Paper presented at the Disaster, Risk and Vulnerablity Conference, Trivandrum, India.

Subedi, J. (2010). Disaster Informatics: Information Management as a Tool for Effective Disaster Risk Reduction. In E. Asimakopoulou & N. Bessis (Eds.), *Advanced ICTs for Disaster Management and Threat Detection: Collaborative and Distributed Frameworks* (pp. 415): IGI Global.

UN/ISDR. (2005). *Hyogo Framework for 2005-2015: Building the Resilience of Nations and Communities to Disasters.* Paper presented at the World Conference on Disaster Reduction, Kobe, Hyogo, Japan.

van Westen, C., & Kingma, N. (2009b). Disaster Risk Management. In C. van Westen (Ed.), *Multi-hazard risk assessment: Distance education course/Guide book*: United Nations University – ITC School on Disaster Geoinformation Management.

White, I., Kingston, R., & Barker, A. (2010). Participatory geographic information systems and public engagement within food risk management. *Flood Risk Management, 3*, 337–346.