RimaDima
RISK MANAGEMENT • DISASTER MANAGEMENT

Project RIMADIMA
Risk/Disaster Management and Prevention Against Natural Hazards in Mountainous/Forested Regions

CONTEMPORARY APPROACH FOR RISK/DISASTER MANAGEMENT AND PREVENTION AGAINST NATURAL HAZARDS IN MOUNTAINOUS/FORESTED REGIONS

(RIMADIMA ACHIEVEMENTS)

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Project RIMADIMA

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Prepared by:

Prof. Ivan Blinkov PhD

Design by:

Ass. Bojan Simovski

Grad. Eng. Ivan Mincev

Grad. Eng. Bozin Trendafilov

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Preface

Every year natural hazards caused not only economic damages but they endanger the human life and health too. Population in the hilly-mountain and mountain regions is permanently faced with risk of any natural hazard. The most exposed hazards in our country are those that are perceptible as wild fires, flash floods, landfalls, landslides, high temperature etc. Otherwise there are other type of hazards that are not perceptible as drought and erosion but their impact is significant.

"Danger from nuclear arm and human capability to destroy the environment are really alarming. But there are other unperceivable events – I mean on natural resources exhausting and soil erosion that are probably the most danger because when we began to feel their consequences, it will be too late."

(Dalai Lama: "Small book of peace in mind". 2002, Element Books, London)

Each partner country is obligated to edit publication related to the project. It is in accordance with the current European trends for public participation in all activities in the society. Because of the importance of natural hazard risk management, we do hope that this material, beside the expert and scientific community and decision makers will be interest for other people.

Prof. Ivan Blinkov, PhD

1. Basic information about the project RIMADIMA

Transnational project RIMADIMA (*Risk/Disaster Management and Prevention Against Natural Hazards in Mountainous/Forested Regions, web-site: www.rimadima.org)*, was launched through the European Union INTERREG IIIb CADSES Neighborhood Programme *(link: http://cadses.net).* This project is in the frame of priority 4: Environment protection, resource management and risk prevention. Beside our country, six (6) European countries participate in this project: EU (Italy, Czech Republic, Hungary, Poland, Bulgaria) and Serbia (non EU). The project consortium consists of 11 partners from all seven countries. The Faculty of Forestry – Skopje (pp7) and the Public Enterprise "Parks and Greenery" – Skopje (pp8) participates from our country. The period of implementation of the project was 1 July 2006 to 31 August 2008 on transnational level, but in our country from 22 August 2007 to 21 October 2008.

The main aim of the project is prevention from the risk of natural hazards in mountainous/forested regions through different measures.

Main objectives of the project are:

1) Planning, modernization and development of natural hazards management system in mountainous/forested regions integrated in national, regional and local entities targeting an increase of security for an enhancement of the socio-economic structures (tourism, enterprises, infrastructure, etc). *Planning activities (transnational studies and strategies, land use plans, etc.) consist: Data collection and data analysis; Strategies of protection based on international guidelines; Prognostic analysis and development hazard maps; Inclusion of ecological tourism aspects and risk management principles in sustainable planning concepts.*

2) Promotion of co-operation and exchange of experiences on European level between institutions related to this matter based on common European legislation and common approaches. *Networking is expressed through: Activities of the project co-ordination; Web portal for internal communication, exchange of data and public dissemination; Transnational co-operation on regional planning and risk prevention in co-ordination with policy strategies on all levels of government. Pilot actions are carried out on selected pilot working region and working areas through: Common data structures and common interface; Common concept for a Decision Support System (DSS); Development of a DSS Demo-Version. Several trainings were launched. Each country produces national reports. Based of them each partner is obligated to produce any transnational study, guideline for common methodology etc. Information, training, awareness raising is carried out through: Activities for information and nonscientist of the population in danger zones aimed to prevent those against natural risks; Production of information material (folder, flyer, guide, newsletter); Lectures for youth, population, scientific staff and decision makers.*

3) Elaboration and improvement of common spatial development directives, laws and procedures in risk prevention and risk management.
Recommendations for national legislation are carried out, and based on them are prepared common materials for the EU.

To simplify, the main objective of the project was a contribution to promotion of contemporary model for risk management and prevention of natural hazards in mountainous/forested regions.

The first phase of the project was aimed to comparative analyze of the current situation in the partner countries (institutional and legislation setup, factors of natural hazards, evidence for hazards etc)

Beneficiaries of the project:

- the local administration in the working region (according to the decentralization program natural hazard management has significant role),
- enterprises that prepare various plans (spatial plans, plans for regions of special purpose; forest management plans; wildfire protection plans; watershed plans),
- enterprises that manage forested or mountain regions,
- scientific community,
- all citizens.

1.1. Working region and the working areas

All partner countries select a working region and working areas within. The region of Skopje (administrative border up to 1996, spatial- functional unit of Skopje) was selected in our country because only this region was compatible to the other partners. Within the region were selected two working areas:

- Working area 1: (10x10 km) – part of the Vodno mountain and the neighborhood (municipalities of Karposh, Centar, Kisela Voda, Aerodrom, Gazi Baba, Sopishte, Studenichani),
- Working area 2: the whole park-forest Vodno and the surrounding.

In the past, the mountain Karshijak (Vodno) was affected by the unsuitable use by the local population, by forest clearing for wood and agricultural land, which resulted into turning the forest areas into bare land.

As a result of unsustainable practice during the history the Vodno mountain was bare land, erosion processes were extremely high and the citizens of Skopje were permanent endangered by the Vodno torrents. The last such torrential flood happened in 1951, when many houses were damaged; one person was killed and approximately 20 000 m^3 of silt were deposed near “Mala stanica”. Later, the city council proclaim the mountain Vodno as erosive land and according to the existing legislation in this period, different erosion control measures and activities were carried out: administrative (displace of two villages, prohibition for goat

breeding, limiting land treatment etc.), hydraulic (channels, barrages, thresholds); biotechnical (afforestation, amelioration of the shrubs and coppices, sodding etc). Later, in order to increase the protection and to accomplish the many benefits of the forest, with a decision of the city assembly this area was proclaimed as park-forest. The most of the risks for the central part of Skopje are minimized, but in the east, south-east and south part of Vodno only small part of planed activities are carried out. Afforestation was launched using even pyrophytic species at increase risk of forest fires. But according to the forecast global warming and climate changes, the situation would be worsted. The forecast drought would impact the forest (forest die-back), would destroy the soil structure, and increase risk of fires. All these combined with the forecast increase of the frequency of the high intensity rainfall would increase risk of erosion and torrential floods too. Almost all municipalities in the country are faced with the hazards that origin from the mountain region.

2. Theoretical background

2.1. Definitions

The world known literature related to this matter contain a lot of different definitions. A widely accepted definition characterizes **natural hazards** as "those elements of the physical environment, harmful to man and caused by forces extraneous to him" (Burton, 1978).

A **hazardous event** that causes unacceptably large numbers of fatalities and/or overwhelming property damage is a **natural disaster**.

A **physical event,** such as a volcanic eruption, that does not affect human beings is a **natural phenomenon** but not a natural hazard. A natural phenomenon that occurs in a populated area is a **hazardous event**.

In areas where there are no human interests, natural phenomena do not constitute hazards nor do they result in disasters. This definition is thus at odds with the perception of natural hazards as unavoidable havoc wreaked by the unrestrained forces of nature. It shifts the burden of cause from purely natural processes to the concurrent presence of human activities and natural events. Perhaps this is a very anthropocentric approach. But it should be take in consideration the fact that some hazards happened in unsettled areas, could generate hazards that would be filled in the settled areas. For example: wild fire could destroy the wild land, but because of disturbance of the ecosystem and its role, could happen hydrological disturbance and appearance of wild water that could destroy the downstream settled sections.

According to the literature, natural hazards are classified as: **atmospheric** (hailstorms, hurricanes, lightning, tornadoes, tropical storms); **seismic (**fault ruptures, ground shaking, lateral spreading, liquefaction, tsunamis); **other geologic/hydrologic** (debris avalanches, expansive soils, landslides, rock falls, submarine slides); **hydrologic** (coastal flooding, desertification, salinisation, drought, erosion and sedimentation, river flooding, storm surges); **volcanic** (tephra

gases, lava flows, mudflows, projectiles and lateral blasts, pyroclastic flows); **wildfire** (bush, forest, grass, savannah), **biogene** (epizooty, epifitoty, epidemy).

The Law on protection and rescue (Official Gazette №36/04), contain the following definition:

"Natural hazards are events caused by the uncontrolled power of the nature that endanger the human and animal life and health and cause damages to the property, cultural heritage and the environment (earthquake, flood, landslide, avalanche, sedimentation, hailstorm, dam and earth fill failure, atmospheric and other hazards).

Beside up mined, this law recognize the **technological hazards** too.

2.2. The Nature of the Hazard

Although humans can do little or nothing to change the incidence or intensity of most natural phenomena, they have an important role to play in ensuring that natural events are not converted into disasters by their own actions. It is important to understand that human intervention can increase the frequency and severity of natural hazards. Human intervention may also cause natural hazards where none existed before.

For example: sustainable planning (spatial planning, urban planning, planning in forestry, water economy etc), implementation and monitoring of these plans is perhaps the most important thing for mitigation or avoidance of risk of any natural hazard. Good example for this is comparison of floods happened in Negotino (1995) and Sarno (Italy - 1998). The Negotinska River flood resulted in a large material damages but without a dead human. Behind the river have wider belt of streets and park and the flood wave passed through this "open" area. Otherwise because of Mediterranean style of urbanism, the flood wave destroyed everything along the bad and result in 147 dead. According to the Italian experts, as a result of high intensive rainfall, land vulnerability and perhaps unsustainable forest activities, happened landfalls and landslides, that enlarge the volume of flood wave with solid material ant it covered the area along the stream.

An extreme case of destruction of the ecosystem in arid and semiarid areas is desertification (*note: large part of our country belongs to the region vulnerable to desertification).* Drought is a very danger phenomenon. Different way of hazard management activities should be carried related to it as long-term planning mitigation of consequences of drought in agriculture, forestry and water economy as the most vulnerable sectors.

All this is the key to developing effective vulnerability reduction measures: if human activities can cause or aggravate the destructive effects of natural phenomena, they can also eliminate or reduce them. Natural hazards are linked and chained. Risk of wild fires increase during the dry period. After forest fire, erosion intensity is higher and risk of torrent floods in the downstream sections increase.

2.2.1. Rapid Onset vs. Slow Onset

The speed of onset of a hazard is an important variable since it conditions warning time. At one extremely event as flash floods or landslide give virtually no warning. Less extreme are regional floods where the likelihood of occurrence is known for several hours or days in advance. Other hazards such as drought and desertification act slowly over a period of months or years. Hazards such as erosion/sedimentation have varying lead times: damage may occur suddenly as the result of a storm or may develop over many years.

2.2.2. Controllable Events vs. Immutable Events

For some types of hazards the actual dimensions of the occurrence may be altered if appropriate measures are taken. For others, no known technology can effectively alter the occurrence itself. For example, afforestation of the bare land on the catchments and canalizing a stream bed can reduce the area extent of inundations, but nothing will moderate the ground shaking produced by an earthquake.

2.2.3. Frequency vs. Severity

Where flooding occurs every year or every few years, the hazard becomes part of the landscape, and projects are sited and designed with this constraint in mind. Rare or low-probability events of great severity are the most difficult to mitigate, and vulnerability reduction may demand risk-aversion measures beyond those justified by economic analysis. Sometime any event have higher frequency but lower intensity then any event with low frequency but higher intensity. The total damages from the frequent event could be much higher then the rare event. Typical example in our country is drought. There were a lot of dry year in last two decades. During all this period, drought caused large damages especially in agriculture sector (where consequence can be easily felt in the same year), but drought damaged the forest too (several subsequent dry years are condition for higher disturbance of the forest ecosystems).

2.2.4. Mitigation Measures to Withstand Impact vs. Mitigation Measures to Avoid Impact

Mitigation measures are usually different constructions that withstand the natural hazard power. Earthquake-resistant construction and flood-proofing of buildings are examples of measures that can increase the capacity of facilities to withstand the impact of a natural hazard. In this group belong measures for drought mitigation as: planting dry resistant cultures (agricultures), planting dry resistant tress and shrubs (forestry), different measures for optimization water use during the dry period.

3. Forest role in reduction of the vulnerability to natural hazards

Forests can play a very significant role in protection against natural hazards and risks in mountain lands, especially against erosion, landfalls, shallow landslides, torrential flash floods, rock falls etc. The current research, realized at national level or with international exchanges, lead to improve knowledge about the interactions between forests and hazards, in order to enhance the management of mountain ecosystems and in particular to guarantee the people safety by the mean of prevention.

The connection between deforestation (as a consequences of illegal cut, bad management practices, accelerated forest fires and environmental disasters), is not well documented, but it is likely that they are strongly related.

The impact from erosion can be divided in two groups:

-Damages occurring on the place where the erosion occurs: "on-site effects":

- Loss of soil and nutrients;
- Loss of water;
- Land degradation because of the devastation of the eroded site;

-Damages which occur far away of the place where the erosion occurs: "of-site effects":

- Torrential floods which occur as a result of intensive erosion; Processes in the catchments and evoke large damages on the agriculture, inhabited areas, industrial infrastructure etc;
- Filling up with sediment: accumulations, fertile arable land, roads, riverbeds in the downstream regions;
- Creating swamps on the fertile soils;
- Damages which are affecting the environment and they are represented with mechanical pollution of the water with sediment and chemical pollution with fertilizers, pesticides and other dangerous substances.

The impact of wildfires to the human could be direct and indirect.

The direct impact is when fire directly affects human lives and human constructions. Usually this is recognized as damage of wildfire. In the methodologies for estimation damages are recognized damages of burned wood mass.

Indirect damages are:

- Air pollution that lead to endangering of the human health;

- Soil destroying, disturbance of the forest-water relation that lead to decrease of available fresh water or increase risk of erosion, torrential flash floods, landslides;
- Air pollution form toxic plumes as: carbon monoxide, particulate matter, ozone, nitrogen oxide, lead, sulfur dioxide which lead towards endangering human health;
- Increased premature deaths;
- Aggravation of respiratory or cardiovascular illness;
- Lung function decrements;
- Increased work loss;
- Changes in lung function/structure/natural defense.

The forest plays a crucial role in the soil stabilization and water storage. When the forest ecosystem is stable then the soil is protected from erosion and landslides and the water infiltrates in the soil and the surface flow, which poses a threat, is eliminated. This results in increase of infiltration surface and decrease of erosion and further degradation. The soil erosion causes loss of fertility and productivity therefore increasing the risk of landslides on the slopes and hills.

It is very difficult to notice soil erosion and because of that the degradation continues, slowly but continuously. The inhabitants of the hilly, mountainous-hilly and mountain regions after some time abandon their homes because the arable land which they work on becomes not suitable for production and therefore their existence becomes under question. This cruel cycle is amplified by the intensive rainfall and the extreme climate change which have large destructive power.

In the past, especially 50's and 60's of the XX century contributed in large migration processes in the country. This process not only devastated the hilly-mountain region but also increased the pressure in the cities which contributed an increase of socio-economic problems and also the environment was largely affected.

It is real to expect that the extreme climatic disasters will increase proportionally to the accumulation of methane and CO_2 in the atmosphere. To decrease the vulnerability of the area, the awareness should be set on a higher level towards the factors which contribute in appearance, development and intensity of the natural disasters. For example, unsuitable agricultural, forestry and animal husbandry practices in the higher regions can result with significant consequences in the lower regions - if the mountain ecosystem is disturbed then large consequences will be felt in the sub-mountain and the plains. Therefore, to mitigate the flooding of the torrential streams it is necessary to undertake measures for protection of the mountainous and above all, forest ecosystems.

Sedimentation of the reservoirs in the country is a large problem too. On average, annually around 300 000 m^3 of sediment (which is a result of the erosion in the catchments) is discharged in the accumulations. The effects are long term, because the damage is abided by the water economy (decrease of space for accumulation of the water) and indirectly the agriculture is affected (80% of the water resources in the country are used for irrigation), consequently the state economy is covering the loss. With the foreseen climate change this problem will be

even more intensified. The accumulations are built on the best sites and the future of each one is to be filled with sediment and to become useless waterfall.

Many villages and cities were and they still are attacked by the torrential floods. This is due to the disturbed ecosystem in the catchments.

In the past, Skopje was also vulnerable to such events (torrential floods from the Vodno torrents), but luckily with minor intensity, contributing with large material damage and one human casualty.

Because of the large hazardous events from the past, in the period until 1990, especially in the period of 1971-1990 when the afforestation of bare lands fund existed, there were over 100 000 ha bare eroded lands were reforested. Unfortunately, these erosion/torrent control activities are largely reduced after the independence of the country. The danger is lurking and with the anticipated climate change it will increase even more.

On the basis of the aforementioned, it can be said that ecosystems, especially the forest ecosystem, have leading role in decreasing the vulnerability of the area to natural disasters: erosion, sedimentation, landslide, torrential floods, etc. The forest ecosystems cannot stop earthquakes, meteorological disasters such as hurricanes, droughts, but they can significantly diminish the risk from torrential floods and can affect the microclimate. Because of this, appropriate and sustainable forest activities are crucial for good functioning of the forest ecosystem.

The changes in composition, structure and function of the forest ecosystem are called ecosystem development. The human activities can change the structure of the forest ecosystem. The different activities such as: reforestation, cleaning, thinning, cutting, reconstruction, building forest road network, transport of wood are affecting the ecosystem. If a certain unsuitable forest activity is implemented in the forestry it can increase the risks of natural disasters. Therefore, strengthening the capacities of the forest service should be primary goal.

Planning of the land use and natural resource management, especially water and forest management plays a crucial goal towards mitigating the risks from natural disasters everywhere in the risky regions, not only in the mountainous regions but also in the riverbeds and in the valleys. To accomplish economy in the reduction different tools, methods or variants should be implemented. The regulatory protection and control of the sustainable use of the land and the resources is done by the appropriate inspection units of the state.

4. Natural hazards in mountainous/forested regions in the country and the other participants in the project

In the mountainous/forested regions in the country, the most actual disaster is forest fires. On the basis of the records for the last 9 years (1999-2007), in the country on average annually are registered about 220 fires, and annually 10 750 ha of forest are on fire, in which burns 163 742 m^3 of wood, and the average damage is 5 803 492 euros. In the recent past, the biggest damages were made in 2000 and in 2007.

Other different disaster in the mountainous/forested regions is the erosion accompanied with the torrential floods. This is a totally different disaster. Its effect

is not expansive and wild as the fires. The negative effects of the erosion are long term. As a result of the erosion processes the forest ecosystem is disturbed and the largest affected areas are in the downstream area where torrential floods attack the inhabited areas, common infrastructure and water economy infrastructure. These disasters are very frequent, they show up suddenly and they end as quick also, therefore the reaction time is limited. Many of these disasters are not recorded and therefore the data for the damages are not real.

Landfall and landslides in the mountainous regions show up everywhere. Usually they are minor events, except few more significant (Germo, Rostushe, Moklishte, Jelovjane). The damages from these types of disasters originate on the place of the event and the most affected is the infrastructure which is in direct contact with the disaster. But it should mention that in some cases the removed material is discharged in some water flow which can create flooding disasters in the downstream regions (Germo-Dzhepchishki torrent, Moklishte-Luda Mara).

The meteorological disasters such as storms or strong winds are occurring in the mountainous regions. The direct damages are minor, but also in this case the role of the ecosystem can be disturbed and occurrence of other disasters.

According to the opinion of several experts, among them the experts of this project, the most dangerous natural disaster which will be intensified because of the climate change, is the drought. There is no direct endangerment of the human life as in the case of earthquakes, floods or fires and because of this the drought is largely neglected. The damages from the drought are incomprehensible. To a point they can be recorded with the decreased yield in the agriculture (in the Tikvesh region in 1993 the yield has been diminished from 30 to 70% depending on the crop). The drought is a generator of other disasters. In dry conditions, the level of available water table is decreased and this leads to insufficient nutrition of the plants, physiological weakening and drying. In these conditions the plants are susceptible to sicknesses and pests which can lead to death. Further on, a large amount of dry, burnable material is deposited. With the fires and the forest dieback the land cover is decreased. The prognostic models indicate of increase of the frequencies of the intensive rains. This is followed by intensification of the erosion processes and finally they lead to desertification.

According to the prognostic climate models developed in the frames of the EU project “Prudence”-IPPC SRES scenario A2 for the last quartile of this century our country is in the zone which will have an increase of the average temperature for 4-4,5^{o}C and decrease of average annual rainfall for 20-25%. Therefore, in the future, the attention should be focused on the drought and the risk of desertification.

In the frames of the working region and in the working areas, there have been recorded some disasters of minor scales compared with our country. But because of the importance of the city of Skopje, the preventive measures of these disasters are in main focus and several structural and non-structural measures are undertaken for minimizing the risks.

In the countries which participate in this project, the most frequent disasters are as follows: Poland (torrential floods, forest fires and storms), Czech Republic (torrential floods and landslides), Hungary (landslides, torrential floods), Bulgaria (torrential floods, landslides and wildfires), Italy (torrential floods and

landslides), and Serbia (torrential floods and landslides). Generally, most of the countries have recorded similar disasters.

5. Preparation of risk maps

The estimation of the risk which is crucial for the development of risk maps it is done using 2 parameters: probability of occurrence of certain event (hazard) and severity of the outcome when the hazard or associated event occurs (damage). Some types of events might be permanently monitored, such as: rainfall intensity, water discharges, intensity of the earthquakes, etc. For these types of hazards it is easy to estimate the probability of occurrence using mathematical models. For other types of hazards, it is difficult to estimate the probability because of absence of data series about the relevant event (erosion, torrential flood, landslides). Some events and damages are recorded and some are not. It is very difficult to estimate the human impact. No mathematical model can estimate the pyromaniac intentions of the man.

Therefore, in this project, the proneness approach of the area to appearance of any event was used. The developed maps can be further used for different planning purposes (spatial, urban, forestry, water economy, agriculture plans). In our country there are several official methodologies established for this purpose and they were used for the development of these risk maps.

The soil erosion risk was estimated according the modified methodology of Gavrilovic. As the main estimator of the soil erosion risk mapping was taken the Erosion Coefficient – Z. There were several estimation criteria used: slope (extracted from DEM), land cover, structural measures, erosion types, soil and geology types. The final map was consisted of five risk classes that consist 13 subclasses depend of the value of the erosion coefficient. Finally a "what-if" scenario was developed which showed what will happen if the land cover which is protecting the soil is removed (by fire or forest die back).

The wildfire risk was estimated according the established methodology in the official regulative. It consisted of several estimation criteria: slope, altitude, aspect, soil, fuel models, air temperature, precipitation, air humidity, human impact and existing of structural measures. The final map was classified in four risk classes.

The landfall/landslide risk map was prepared using slope and geology as estimation criteria. It is implied that for this kind of map also it is needed to include trigger factor (water, construction activities).

For determination of drought and desertification, there have been used the rainfall and the temperature.

The torrential flood risk maps were created with assigning "hot spots". These are places where the current water regime and structural measures are compromised (illegal construction, landfills in the riverbeds and channels).

The final step of the procedure was merging the separate risk maps into one integrated multi hazard map. Also the layer of critical infrastructure was added to this map.

PROJECT ACHIEVEMENTS

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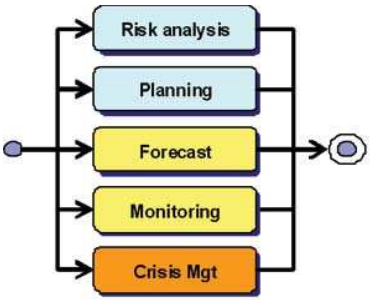
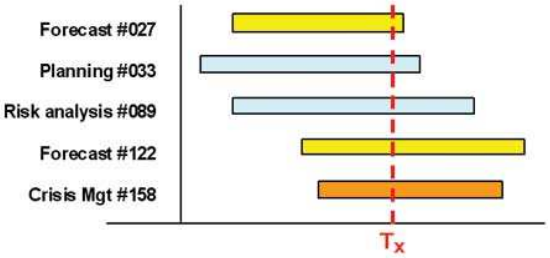
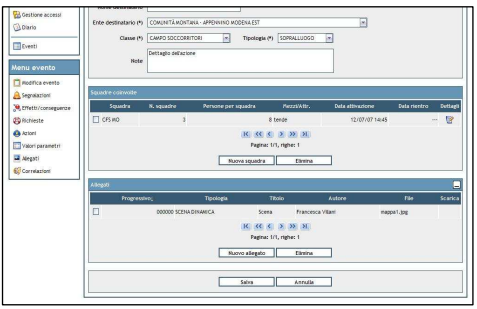
Flavio Bonfatti, University of Modena and Reggio Emilia (Italy)
- DSS concept on planning/emergency and Journal of Events

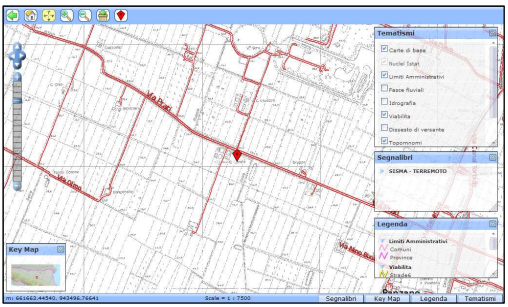
Pangea — 3D RTE – Funzione / Functions — Pangea

ON-LINE	Pannello / Panel	Icona / Icon	Funzione / Function
Abilitazione Enabling	--	--	Abilita condivisione scena in rete Enable network-shared scene
Abilitazione Enabling	--	--	Listener – Commander Listener – Commander
Pulsanti Scena 2D RTE 3D RTE Scene Buttons	1		Avanti Pannello successivo Next Panel
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Home Home
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Attiva / Disattiva alta risoluzione ON / OFF high resolution
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Vista dall'alto View TOP
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Blocca LoD Lock LoD
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Blocca su Target Lock target
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Sottosuolo Underground
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Collegamento ipertestuale Hyperlink link
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Consulta Layer Review layer
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Crea filmato AVI Create AVI film
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Scatta foto Take picture
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Genera report Create report
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Misura distanza Measure distance
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Vai ... Go ...
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Keymap Keymap
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Manuale utente User manual
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	1		Informazioni Information
Pulsanti Scena 2D RTE 3D RTE Scene Buttons	1	Tematismi	Gestione di pannello Panel selector
Pulsanti Scena 2D RTE 3D RTE Scene Buttons	1		Schermo intero Full screen
Pulsanti Scena 3D RTE 3D RTE Scene Buttons	GPS		Home Home
Pulsanti Scena 2D RTE 3D RTE Scene Buttons	GPS		Attiva / Disattiva alta risoluzione ON / OFF high resolution
Pulsanti Scena 2D RTE 3D RTE Scene Buttons	GPS		Blocca su Target Lock target









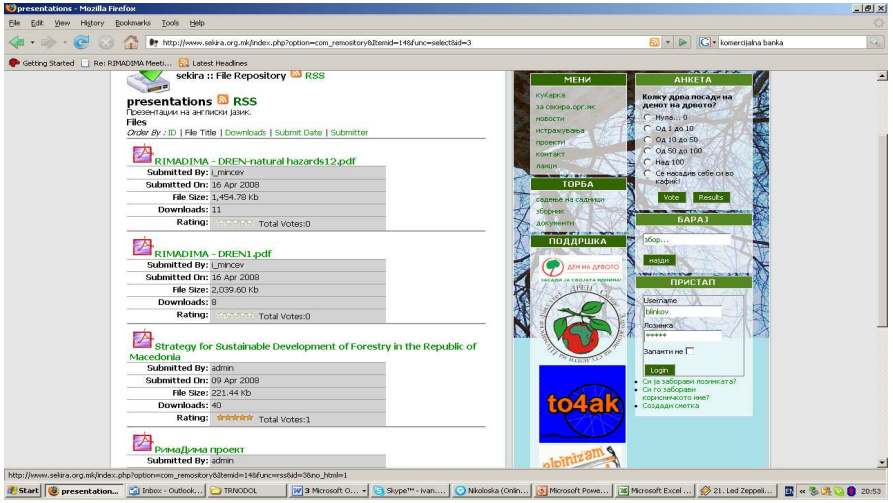
РЕЗУЛТАТИ ОД ПРОЕКТОТ

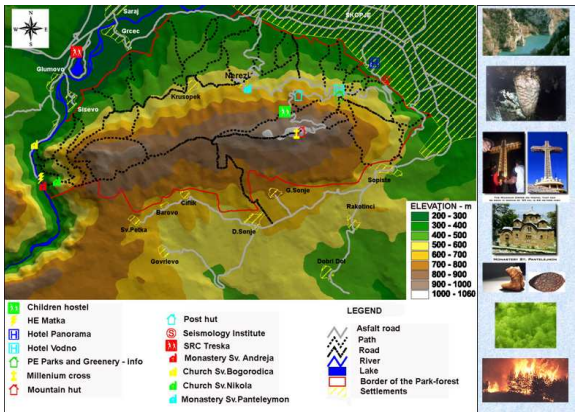
РЕЗУЛТАТИ ОД ПРОЕКТОТ

RimaDima
RISK MANAGEMENT • DISASTER MANAGEMENT

PROJECT ACHIEVEMENTS

PROJECT ACHIEVEMENTS





All these analyses were done using contemporary geomatic techniques: GIS/RS. The field measurements were done using GPS (forest paths, border lines, location of critical objects, location of structural objects, etc.)

All existing maps and layers in hardcopy (topographic, geology, soil, isothermal, humidity, forest stands) were scanned, georefferenced and digitized. The choice of using the raster and vector layers was depending on the needs.

There were several type of images that could be used for defining the land cover/land use pattern as: Landsat 7 (from 2000), acquired free from the US Geological Survey, spatial resolution 28 m; ASTER (MODIS) – stereo pair, (from 2003) acquired from NASA, spatial resolution 15 m, VIS and NIR. The land cover was created using object oriented classification approach and further on the data was checked and updated with aerial images.

The DEM was extracted using the ASTER stereo pair using the topographic maps as reference. The DEM was with cell size of 80 m. The accuracy of the DEM was checked using trigonometric points from the topographic maps which are claimed to have accuracy of 0,5 m by the producer. There were 198 points taken for accuracy and it yielded quite good results, the RMSE (Root Mean Square Error) was 18,9 m.

The data gathered from the field with the GPS were transferred in the computer on an already established computer model. Also on the field there was a photo documentation created from different: risk infrastructure, erosion sites, and structural measures. Some of these photos were linked with the existing model.

The analyses were done using GIS tools with the pixel based model with pixel size of 80 m *(note: this approach yield at least 100 times more precise results compared with the classical approach which is currently used in forest planning).*

Most of the input parameters were in vector format and were further converted into raster. This approach was chosen as most appropriate because it enables combining several multiple parameters at once. The results are much better than to simply overlay the layers, in a case the mutual relationship of the processes is taken into account for more real zoning. This approach is a step further towards using more intelligent tools for risk assessment and it can be used for risk proneness assessment. The final maps are developed in pixel format. These maps are showed in the appendix.

6. Recommendation for improvement of the system for Risk/Disaster Management and Prevention Against Natural Hazards

The modern approach of risk management from natural hazards has 3 main phases: risk analysis, risk assessment and risk management. Risk analysis includes identification of the possible hazards that can appear in certain area as well as the consequences of them. Risk assessment means selection of priority risk based on comparative analysis of the possible risks. This analysis depends on: the probability of risk appearance, the frequency as well as the estimated financial outcomes. Risk management, the final phase in preparation of risk studies for certain area, covers several segments: defining the goals of risk management, analysis of the approach of risk management, planning structural and non-structural measures for

risk management, implementation of the adopted system for risk management and development of software for risk management.

One of the fundamental principles of the modern European model of risk prevention from natural hazards is planned use of space and resources. In the mountainous/forest region planning with forest resources is essential. The modern approach to risk management from natural hazards is so called pro-active approach, despite the old reactive approach (crises management, emergency). Pro-active approach includes: monitoring of the situation, sustainable planning (spatial, urban, forest, water-economy etc.), sustainable management, planning in case of emergency. Important component of this system also is the participation of the public. Informing the local habitants for the potential risk of natural hazards, in time alarming in case of a danger as well as active participation in case of a hazard are vital elements for hazards management. Prevention is one of the vital elements as well.

6.1. The Actors in the Risk/Disaster Management and Prevention Against Natural Hazards in the country

For RDMPANH there are different actors depend on he nature of the risk and the territorial distribution.

The situation in this area in our country is different from the other countries. With the program for decentralization, the local self-government gain big competence in this area. The main problem is that the local self-government doesn't have competence everywhere. In the forest areas the dominations of forests and meadows is absolute. According to the forceful laws of the country, forest and pastures management in public property (89% of the forest is public property) is organized on national level. This means that the local self-government has no competences in the forest system. Here comes a collision when the local self-government got competence for something where it has no approach. The subject that manages the forests in the country is enterprise organized on national level, directorate office in Skopje and 30 regional branch-offices. Exceptions of this are the forests in national parks that are managed by the appropriate subject, as well as the communal park-forests that are under competences of the local self- government. In case of natural hazard in mountainous/forest region, the subject responsible for forest management is obligated to monitor the situation, to note the natural phenomenon, as well as to organize their managing. This particularly refers to protection of forest fires. The other events as landfalls, landslides, etc are noted in the reports. All activities in the forests are made according to the 10 years plans. Due to danger from forest fires, this problem is solved with additional documents and plans.

There are several groups of "actors" involved in the process of RDMPNH as follow:

- ***Planning agencies*** (Agency for Spatial and urban planning and other private organization who prepare urban plans; Institutions involved in forest management planning; Institutions involved in agricultural management planning, institution involved in water management planning, institution involved in planning civil construction etc).
- ***Line ministries*** - as ministries involved in resource management (Ministry of Environment and Physical Planning; Ministry of Agriculture, Forestry and Water Economy, Ministry of Transport and Communication)
- ***Line ministries*** - as ministries involved in crises situations (Ministry of Health, Ministry of Interior Affairs, Ministry of Defense and Ministry of Finances).
- ***Institutions witch are involved in managing certain resource*** (Institutions involved in forest, water and pasture management)
- ***Monitoring institutions*** (State for hydro-meteorological administration, Laboratory for seismology, Institute of seismology and earthquake engineering, institutions that manage the forests)
- ***Inspection institutions*** (for forest and hunting, for nature and environment, for communal affairs, for protection and rescue on national and local level)
- ***Emergency preparedness and response centers***. (Crises Management Centre, Protection and rescue directorate, Institution on local level, Red Cross, Public enterprises etc.)
- ***The Educational/scientific institutions***
- ***Finance agencies*** (insurance companies...)
- ***Non-governmental organizations*** (Red Cross, Red Half-Moon etc.)
- ***The media***
- ***All citizens.***

If we intend to improve the system of risk management we have to improve all of them.

6.2. Contemporary system for Risk/Disaster Management and Prevention Against Natural Hazards in Mountainous/Forested Regions

Each hazard has its own characteristics. In case of an earthquake or flooding there is one type of approach, in case of fire another, in flash flood the approach is of completely third type, while drought and erosion are completely different.

General attitude is that in mountainous/forest region areas the approach of risk management from natural hazards, from retroactive (crisis management, emergency) should be changed in to **pro-active approach** (risk management, monitoring, forecasting models, and plans for emergency).

Precisely this is the essence of modernization of our system. Each actor in the system, each institution should have defined tasks and hierarchical set.

One of the major problems in the country is data no transparency. Different institutions develop their own data bases. Development of forecasting models

depends on different factors i.e. different data. They should be combined in one place and made available for everyone. In this case everyone would use them for it's own needs (for making different plans for reassures management, for making different plans and operative programs in case of emergency, for making long-term strategies for mitigation any hazard as drought. Because the country is poor, probably the best solution is one institution to sublime the data.

According to the current legislation (article 35 from the Law for spatial and urban planning, Official Gazette №24/08), the "Agency for spatial and urban planning" keeps and updates the only spatial-informational system of data-base. According to the multidisciplinary character of the data, perhaps the best solution is the database related to natural hazards to be organized in this agency. In this direction is the idea of forming national infrastructure of spatial and land database, with defined rules of their use and exchange. Beside this, the different institutions should develop or improve the capacities of their ADP and GIS departments.

Related to the institutional setup, we suggest, one institution hierarchically to have the role of coordinator of the activities in this field. As part of this institution there should be an operational sector for emergency i.e. forces for protection and rescue. Beside them, there also should be a sector for coordination of different hazards where emergency is not as necessary (such as drought, erosion, desertification etc.). This institution should coordinate all actors involved in the system for risk management from natural hazards on national, regional and local level. The biggest part of the local self-governments don't have the capacity for this activity, help is needed from the government institutions.

6.3. Recommendations for erosion and torrent control

Recommendations for erosion and torrent control should be aimed in two groups:

- Pre-event measures;
- Measures during the event.

Pre-event recommendations present a system of measures, solutions, activities and capacities directed to monitoring of the situation in the catchments and taking pre-event activities for avoiding risks-catastrophes.

This phase is crises-pre-event situation and action - casual phase. In this phase the conditions and factors for appearance of risks are analyzed, elaborated and improved, no matter if the character of the risk is natural or natural-anthropogenic.

Measures during the event are system of measures, solutions, activities and capacity directed to managing the crises and sanctioning the outcomes from the disaster (floods, landfall, landslides, and fires).

This phase of crises management and sanctioning the damages is so called resulting phase, because with it the results are solved not the causes.

To elaborate and make recommendations about risk management from erosion and torrent (legal and sub-legal acts), these documents is necessary to make and adopt, trough several phases and procedures:

- Institutional level (cross sartorial bodies - commissions)
- Expert - professional level
- Institutional - expert - professional level
- Public presentation
- Adopting the document.

Recommendations for risk management from erosion understand determination of criteria package, measures, decisions, capacity and activities for prevention and control risk of erosion.

6.4. Recommendations for forest fire control

According to the previous experiences the land managers (forest managers, managers of other lands), who have primary responsibility for fire prevention and initial attack, need to be strengthened in performing their duties.

It is strongly recommended that the institutions that manage the forests in our country (PEMF, PI's NP and PCE) shall be strengthened through provision of professional training and equipment in order to improve forest fire prevention, preparedness and initial suppression capabilities.

Considering the increasing degradation and destruction of the forests of the country as a consequence of climate extremes, socio - economic changes and fire, as well as secondary damages or disasters following the fire, it should be considered to elevate the status of the national enterprise for forest management PEMS to a National Forest Service mandated to have primary responsibility and supervisory functions for forestry and forest protection, notably fire protection, in the whole country. Regarding the other institutions the situation is the same.

This would follow the principle of "land/resource managers being responsible for fire management".

The negative experiences in other countries, where urban-focused fire services have prime responsibility for rural fire management, should be taken into consideration when taking decision to strengthen the land manager's capabilities.

However, the improvement of efficient support of the professional and voluntary fire services in institutions that manage forests in the country is very crucial.

Given the need on the one side, and the availability/willingness of civil society on the other side, to involve civil and voluntary engagement on forest fire management it is urgently recommended to implement Article 22 (1) (11) of the Law on Local Self -government: "Fire Protection Provided by the Territorial Fire - fighting Units" i.e. the Law on Fire Protection (Official Gazette №67/04), especially considering Article 7, which is stipulating:

(1) For the purpose of extinguishing fires in forest and open spaces, under circumstances of increased danger of occurrence of such fires, the municipalities – at a request of the Protection and Rescue Directorate – shall engage seasonal

firemen, who operate as part of the units of Article 5 herein. Priority in engaging seasonal firemen is given to firemen working in voluntary fire fighting units and associations in which they have been active for at least two years.

There is need for an efficient system for early warning and suppression of forest fires to be established. This is recognized also in the National Strategy for Sustainable Development of Forestry which was adopted at 19 June 2006 on the 107th Parliamentary Session. There is Action Plan 2007-2009 in the frame of the Strategy with action: Preparation of study for prevention and protection of forest fires. It should to ensure to get elaborated study with analysis on the condition and the rate of risk of forest fires with draft measures for control and suppression.

In order to be solved all structural and technical problems regarding forest fires the most important is preparation of National Strategy for Forest Fire Protection. In that cause, the institutional structure (for all whether governmental or nongovernmental institutions and organizations), their competences and responsibilities will be defined for longer period. Then, all further laws or regulations regarding forest fires will be in agreement with this.

6.5. Recommendations for the forestry sector on national level

In the forestry sector detail changes are needed about protection from natural hazards. Until now, the forests in the country were managed on traditional way, where the economical approach is dominant. The strategy for sustainable forestry is the base for changes. The forestry needs raising the human, institutional and technical capacities in different areas, as well as in the area mentioned - risk/disaster management. The forest ecosystems should sustain stable, there should be reduction on the landfalls and landslides, to prevent soil erosion, as well as to minimize flooding and continue the duration of the reservoirs. The enterprises which management the forests should do that on sustainable - multifunctional way. Because of this, the following changes are needed:

a) Administrative - legal

   - Changing the law for forests, in which the accent will be put on the multifunctional forestry (modern European and world approach), also including the principles for risk/disaster management,
   - Functional forest division according to FAO methodologies and changes in the rulebook for forest management planning

b) Changes in the curriculum of Faculty of Forestry in conjunction with multifunctional forestry including risk/disaster management

c) Strengthening the capacities of the engineers – employed in the public enterprises, through different professional trainings about the modern approach for multifunctional planning as well as managing

d) Strengthening the risk/disaster management, particularly emergency activities capacities of all the employees in these enterprises.

6.6. IT achievements

In today's era of informatics it is normal the model of risk/disaster management to be present through adequate hardware and software instruments. On one side there is the Geographic Information System (GIS software), and on the other side, the operational software. For this purpose, in frames of the Project RIMADIMA, adequate software has been developed by the Italian partners. This software combines geographic information (terrain data, risk zones, access roads etc.) and intervention procedures in case of emergency such as forest fires. Therefore, within the Faculty of forestry, laboratory for students education about risk/disaster management, in fact for modeling with help of modern geomatic tools was formed. Within the PE "Parkovi i zelenilo" - Skopje, division for support for risk management with some natural hazards was formed. In this division, beside the adequate hardware instruments, the above mentioned software was installed as well.

7. List of achievements and outputs

The project consists of 6 work packages and 40 activities.

Working package 1: Project management on national level

Blinkov Ivan, (FFS) and Jagev Velian (PE PG)

Participation on transnational workshops of the expert board and steering committee too: *Jagev V., Blinkov I., Vasilevski K., Dimovski Lj., Bogoeski S.*
Participation on bilateral expert meetings: *Blinkov I., Mincev I.*

Working package 2: An analysis of the basic factor related to natural hazards

Field measuring, prospecting, photo (*Mincev I., Jagev V., Blinkov I., Trendafilov A., Trendafilov B., Simovski B.*)

1 - *Blinkov I., Jagev V.*: Report related to the wp2 that contain several expert studies: Basic natural and socio-economic factors in the working region/areas; An analyze of the natural hazards in the working region/areas; An analyze of the factors related to natural hazards; An analyze of the system for different type of planning as spatial and urban planning and planning management of natural resources; An analyze of the legislation and institutional setup related to natural hazard management system
2 - *Blinkov I., Simovski B., Mincev I.*: Classification and zoning of preservable areas within regions of similar characteristics based on IUCN methodology
3 - *Blinkov I., Mincev I., Simovski B.*: Transnational study on forest ecosystem violation risk probability/meteorological
4 - *Mincev I., Trendafilov B., Jagev V., Blinkov I.*: develop of GIS dataset (created over 100 GIS layers related to the project issues)
5 - *Mincev I.* - An analysis and decoding of satellite images

Working package 3: Natural hazard management system

1 - *Blinkov I., Jagev V.*: National report related to the wp3 (An analysis of the system for risk/hazard management and prevention against natural hazards in the country)

2 - *Jagev V.*: Training for contemporary approach in natural hazard management - Katowice, Poland

Working package 4 – Technical implementation of the risk/hazard management and prevention against natural hazards

1 – Establishing "Laboratory for GIS added modeling of natural hazards" on the Faculty of forestry - *Blinkov et al.*

- *Mincev I.*: Concept for laboratory setup
- *Mincev I.*: Concept for data structure (transnational)
- Office preparation, supply of hardware (2 PC, GPS, color printer, photo-camera) and software (2 Map info and 1 Vertical Mapper), combination with the existed equipment (2 PC - III, plotter, scanner, printer, Total Station)
- *Trendafilov B., Mincev I.*: Hardware and software installing, combining of the equipment and starting the laboratory

2 - Establishing "Unit for crises management within the PE Parks and Greenery" - *Jagev V. et al*

- Office preparation
- Supply of hardware (1 PC, 1 laptop, plotter) and software (RTE - DSS)
- *Jagev V.* - training for use of software RTE-DSS, Czech Republic
- *Jagev V et al..*: Hardware and software installing, and starting the center

3 - *Blinkov I.* - Transnational study on acceptable level of stress with aim to prevent or avoid risk

4 - *Blinkov I., Jagev V., Simovski B., Jarcevska I.*: Implementation of measures for an ecological tourism in harmonization with risk reduction measures

- *Blinkov I., Mincev I.*: Transnational methodology for development of risk maps (single and multyhazard) using GIS technology
- *Blinkov I., Mincev I., Trendafilov A., Nikolov N.*: National report related to the wp4 – Develop of risk maps (developed 21 risk maps in 7 categories)

Working package 5: Development of recommendations on all level of governments related to natural hazards in mountainous/forested regions

1 - *Blinkov I., Jagev V., Trendafilov A., Nikolov N.*: National report related to the wp5 (general and detail concepts and recommendations for improvement of the system of natural hazard management in mountainous/forested regions)
2 - *Blinkov I.*: Report – Summary of all reports and studies related to the project including the recommendations for system improvement – (delivered copies of the summary to the represents of different institutions – governmental, local, economic, scientific, media and NGO)
3 - *Jagev V., Bogoeski S.*: Definition of standard procedures for decision support systems use for risk management on a level of the public enterprise - approved by the City council
4 - *Blinkov I.*: Recommendations to the working group for preparation of new legislation related to the forests

Working package 6: Public awareness

1 – *Blinkov I., Mincev I.*: Delivering information to the operator of the transnational web-site of the project
2 – *Mincev I.*: Delivering and updating data to the portal for forestry in the country
3 – *Blinkov I., Mincev I., Simovski B.:* Delivering and update of information on the info-chart of the project on the Faculty of Forestry
4 – *Blinkov I.*: Presentation of the project RIMADIMA on 3 international scientific conferences (BALWOIS 2008, UNESCO–BRESCIE workshop –Novi Sad; Congress of environmentalists – Ohrid), total 300 participants

5 - *Blinkov I., Mincev I.*: Presentation of scientific achievements of the project on 3 scientific conference –"Conference - Sustainable forestry" - Ohrid, October 2007 (1 papers); "III Congress of environmentalists", Ohrid, October 2007 (2 papers); BALWOIS conference May 2008 - Ohrid (1 paper),

6 - *Simovski B., Dika J., Mincev I., Trendafilov B.*: Lessons for primary school children related to the natural hazards

7 - *Blinkov I., Mincev I., Nikolov N.*: Lessons to the participants on South East Regional Meeting of forestry and nature conservation students – 40 students (delivered handouts of presentations)

8 – *Blinkov I., Mincev I.*: Separate lectures about the natural hazards for students

9 – *Blinkov I., Simovski B.*: Preparation, printing and deliver of 3 types of leaflets (guide with recommendation for eco-tourists, natural hazard management (for adult); forest and natural hazards (for children)

10 – *Jagev V., Trendafilov B., Mincev I., Blinkov I.*: Preparation and printing of posters related to the natural hazards

11 – *Blinkov I.*: Preparation of final brochure related to the project

12 – *Trendafilov B.*: Technical preparation of the materials for setting on the CD

13 – Printing of the brochure

14 – Disc copping (CD with material related to the project)

15 – *Blinkov I., Jagev V., Mincev I., Trendafilov A.*: Presentation of the project achievements on workshops organized by the PE Parks and greenery (September 2007 and August 2008)

16 – *PE Parks and greenery* – delivering information to media

17 - *Blinkov I., Jagev V.*: interviews for media (5 TV and 2 printed)

During the project were realized 5 diploma thesis mentored by prof. d-r Ivan Blinkov. Mr. Ivan Mincev, mentored by prof d-r Gittas, lunched his master thesis on the Environmental Management Department within the Mediterranean University in Chania, Greece on the problematic directly related to the RIMADIMA project.

Expert team of the project:

Prof. Ivan Blinkov PhD (team leader, overall expert), FFS (Faculty of Forestry)
Grad. eng. Ivan Mincev – IT/GIS/RS/DSS expert, FFS
Prof. Aleksandar Trendafilov PhD, erosion and torrent control expert, FFS
Prof. Nikola Nikolov PhD, forest fire control, FFS
Ass. Bojan Simovski, forest ecosystems,eco-tourism, FFS
Grad. eng. Bozin Trendafilov, IT/GIS expert, FFS

Grad. eng. Velian Jagev, (deputy team leader, overall expert), PEPG
Grad. eng. Sreten Bogoeski, forest management, fire control, PEPG
Grad. eng. Ilinka Jarcevska, environment, PEPG

Other supported technical stuff.