Technical Assistance for Development of Integrated System
for Prevention and Early Warning of Forest Fires

INTEGRATED SYSTEM FOR PREVENTION AND EARLY WARNING OF FOREST FIRES IN THE REPUBLIC OF MACEDONIA

MACEDONIAN FOREST FIRE INFORMATION SYSTEM (MKFFIS)

Version 2

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Address: Dimce Mircev 9, 1000 Skopje, Republic of Macedonia

Prepared by:

Stevko Stefanoski, MSc. Project Manager

Eisho Sato, MSc, Project Chief Advisor

Igorche Karafilovski

Gjorgji Koneski

Mirjana Veljkovik

Translation: Gjorgji Koneski, Mirjana Veljkovik

Graphic design and editing, cover design, text adaptation: Bato & Divajn

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CONTENT

INTRODUCTION

The Republic of Macedonia is located in two large phytogeographic regions, Mediterranean and Eurosiberian. The natural conditions arising from its location, climate, relief, the pedological and geological structure of the terrain, hydrological and hydrographical characteristics etc. enable the survival and development of a number of plant species.

The plant life in the country is grouped in several communities such as forest or grass communities and crops. The subject of our specific interest is forest vegetation that covers approximately one third of the area of the country, however the low-stem category accounts for most of it and a small part belongs to the category of quality forests. The forest land in the Republic of Macedonia covers 1,159,600 ha, of which the total area under forests is 947,653 ha[1].

Forestry in Macedonia is a branch of the economy that participates with 0.3 to 0.5 percent in the Gross Domestic Product, and if one takes into account other functions of the forests that are in general benefit, their contribution is much greater. Forest management in the Republic of Macedonia is based on the principles of multifunctionality and permanence in production while paying regard to the healthy relation to forests, the ecological principles for the environmental protection and reforestation.

Forests and the forestlands are often recognised by society as a resource generating tangible goods such as timber, forest products, medicinal plants and other fruits through which one only recognises the economic function of forests. However, besides their economic function, forests have other functions related to the social and the environmental aspects, which are of huge importance for the sustainable development of the country and improvement of life quality, in particular in rural and mountainous areas.

Under the influence of the global climate changes, the extreme weather conditions with long lasting droughts and high temperature along with the human's negligence, frequency of fires in open areas and forests has lately significantly increased incurring severe material damage and long-term consequences to the overall plant life in the Republic of Macedonia and thus influencing immediately the decreasing of the utility of their functions.

Year by year, risk of forest fire has become an increasing threat for the forest stock, and at the same time, it has posed a challenge to those institutions with legal competences on the part of prevention, early warning and tackling forest fires. Hence the increasing responsibility for organised international and interinstitutional cooperation, with a view of strengthening the national capacities and capabilities to lower the risk of forest fire and thus the consequences thereof.

Implementation of the project for development of an integrated system for prevention and early warning of forest fires with the assistance of the Japanese International Cooperation Agency (JICA) is only one among a number of institutional initiatives aimed at strengthening the national capacities in the process of efficient and effective management of the occurrences of forest fire in the Republic of Macedonia.

1 Strategy for Sustainable Development of Forestry in the Republic of Macedonia

1. Forests in the Republic of Macedonia

1.1. Forests as Natural Resource

Forests in the Republic of Macedonia represent natural resource and an amenity of common interest and as such enjoy particular protection that is provided for and prescribed under many legal acts and by-laws, with the Constitution of the Republic of Macedonia being the supreme legal document where it is specifically emphasised that "all the natural resources of the Republic of Macedonia, the flora and fauna, amenities in common use…are amenities of common interest for the Republic and enjoy particular protection." The operationalisation of this Constitutional provision has been transposed to a number of laws the implementation of which has also been the competence of a number of entities who undertake special measures for prevention, early warning and protection of forest resources against any risks that can endanger them, including the occurrence of forest fires.

Planning, managing, keeping of forests and the forest land, the rights and obligations related to the use of forests, including other issues covered by this field, are regulated with the Law on Forests (*Official Gazette of the Republic of Macedonia no. 64/09, 24/11, 53/11, 25/13, 79/13 and 147/13).*

The long-term policy in the area of forestry in the Republic of Macedonia is defined with the Strategy for Sustainable Development of Forestry in the Republic of Macedonia, which the Government adopts for the period of 20 years. This Strategy is a methodical document that ensures multifunctional management of forests and sustainable development of the forestry, increasing of the forests contribution, enhancement of the public and social functions of forests and the forestry through a common development strategy, with overall valuation of its general-use features and the increase of awareness of the environmental and social values of the forests, all in line with the Spatial Plan of the Republic of Macedonia.

Planning of the management of forests and the forest land in the Republic of Macedonia is governed through: Special Plans for Woods Management, Program for Woods Management and Annual Plans for Woods Management. Forestry as a special agricultural branch is under the governance of the Ministry of Agriculture, Forestry and Water Economy, which supervises the implementation of the plans and programs for the wood managements and performs other assignments related to forests and the forest land in Macedonia.

The majority of forests in the Republic of Macedonia (approximately 90%) are owned by the state, and their management is assigned to Macedonian Forest (Makedonski sumi) Public Enterprise for the Management of State-Owned Forests.[2] These two institutions are of special significance for the establishment of a sustainable and efficient forest protection system, including protection of forests against fires.

The Law on Forests is a comprehensive legal act that regulates issues related to: the ownership of the forests in the Republic of Macedonia, implementation of the policy related to forests as stipulated by the Strategy for Sustainable Development of Forestry, drafting of the general plan for forests, inventory of forests, establishment of a National Council for Forestry, Forestry Cadastre and Information System, monitoring of forest ecosystems and forest fires, and other issues related to the sustainable management of forests in the Republic of Macedonia.

1.2. Endangerment of Forests from Forest Fires

The occurrence of forest fires has been a dominant risk in the Republic of Macedonia for decades, and it seriously endangers the life and the health of the citizens, destroys irrevocably the wood potential in the country, incurs major financial damage and leads to severe degradation of the natural surroundings and the environment of the Republic of Macedonia.

2 JP Makedonski sumi was established by the Decision of the Government of the Republic of Macedonia of 15 December 1997, and began its operation on 1 July 1998.

When we consider providing quality and comprehensive analysis of the situation with forest fires, we must note the fact that there is a serious problem of providing accurate and timely data by competent institutions or there is no integrated system through which continuous and timely communication and exchange of accurate and, most important, identical data could be obtained.

The following table presents the situation with the forest fires in the Republic of Macedonia for the 1998-2012 period. We took the following as the key parameters for consideration: total number of forest fires on an annual level, burned area in hectares, burned wooden mass in m3 and estimated direct financial damage.

Overview of forest fires in the period 1998 – 2013

Year	Number of fires	Burned area in ha	Burned wooden mass m^3	Incurred direct damage in MKD
1	2	3	4	5
1998	151	2,858.70	26,104.00	43,580,628.00
1999	90	1,465.00	5,687.00	9,494,446.50
2000	398	32,938.90	562,303.00	938,764,858.50
2001	255	7,312	84,451	140,990,945
2002	121	1,726	9,145	15,267,578
2003	193	2,282	15,328	25,589,261
2004	161	2,034	15,130	25,259,535
2005	260	3,361	7,313	12,208,900
2006	185	3,065	23,517	39,261,139
2007	620	39,162	392,914	655,961,705
2008	339	10,587	69,418	115,892,400
2009	104	2,582	3,123	5,182,100
2010	105	2,282	4,013	6,746,900
2011	390	20,857	65,043	105,725,546
2012	430	22,650	158,433	263,045,099
2013	170	6,379	16,236	26,711,484
Total	**3,972**	**161,541**	**1,458,158**	**2.429,682,524**

Table 1: Overview of forest fires in the period 1998-2013

Source: Ministry of Agriculture, Forestry and Water Economy, State Inspectorate of Forestry and Hunting.

Special significance for raising the seriousness of risks of forest fires in the Republic of Macedonia to a higher level throughout the analysed period (1998-2013) belongs to 2007. Actually, as a result of the great extent of forest fires in the summer 2007, the mechanisms of the Crisis Management System were used for the first time in the Republic of Macedonia, and the Government of the Republic of Macedonia issued a Decision declaring a crisis situation on the entire erritory of the Republic, followed by coordinated addressing of forest fire occurrences from one place (Crisis Management Centre), with efficient and rational use of all available national resources and the use of the mechanisms for international assistance and cooperation.

Moreover, thorough analysis of the national capacities and weaknesses related to forest fires handling was conducted after the end of the crisis. As a result of that analysis, the Government of the Republic of Macedonia issued a decision for enhancing the material and technical capacities of the competent institutions by procuring dedicated off-road fire-fighting vehicles, aircraft and other equipment, and the Crisis Management Centre initiated a project proposal for developing an integrated system for prevention and early warning of forest fires within the technical cooperation between the Governments of the Republic of Macedonia and Japan.

2. Organizational, Institutional and Legal Frame for the Protection of Forests Against Fires

2.1. Joint Institutional Responsibility and Competencies in Implementing Protection of Forests Against Fires

When it comes to protection of forests against forest fires, the occurrence of which has been causing serious damages and consequences on forests in the past decade, the legal competence and responsibility for taking preventive and other operative measures is distributed between the relevant institutions competent for the area of forestry, first of all the Ministry of Agriculture, Forestry and Water Economy, Macedonian Forest Public Enterprise, Fire-fighting services, local self-government authorities and other bodies.

Certainly, relevant competent institutions for the general forest management have the primary responsibility to take preventive measures against forest fires within their possibilities and capacities, whereas involvement of institutions competent for complex management of risks causing great loss to the material, natural, cultural and other resources such as the Directorate of Protection and Rescue, the Crisis Management Centre is required, as is engagement of forces and means of the Ministry of Internal Affairs, the Ministry of Defence and other institutions in special cases, with a view of providing expanded inter-institutional engagement.

With regard to the involvement in the process of forest fire risk management, a short review of the legal competencies of the Directorate for Protection and Rescue and the Crisis Management Centre is provided below.

Adoption of the Law on Protection and Rescue was the basis for the establishment of a special state body, the Directorate for Protection and Rescue, which is competent for planning, organising and implementing of measures related to the protection and rescuing of people, environment, material goods, natural resources, flora and fauna and the cultural heritage against natural disasters, epidemics, epizooties, epiphytotic diseases and other accidents.

The Law on Protection and Rescue is one of the rare laws that stipulate a direct legal obligation for the preparation and adoption of the Assessment of Endangerment, in this case from natural disasters, epidemics, epizooties, epiphytotic diseases and other accidents. This Assessment is a basis for adoption of the Protection and Rescue Plan. The procedure and method of its preparation and adoption are regulated by the Methodology for the Contents and the Method of Assessment of Hazards and Planning of Protection and Rescue.

The Law on Protection and Rescue also regulates the issue of damage assessment and removal of consequences caused by natural disasters, epidemics, epizooties, epiphytotic diseases and other accidents. Particulars in the damage assessment process are regulated with the Unified Nature and Other Disaster Damage Assessment Methodology, adopted by the Government at the proposal of the Ministry of Finance.

Adoption of the Law on Crisis Management of 2005 established the Crisis Management Centre and regulated the Crisis Management System in the Republic of Macedonia . In the very first article of the law, in defining the general provisions, the law states that the Crisis Management System includes collection of information, estimation and analysis of the situation with a purpose of taking the required prevention measures, early warning and managing of all the risks and hazards that may endanger the safety of the Republic of Macedonia and cause Crisis and a Crisis situation. Concerning handling of risks of forest fires, in 2007, the mechanisms of the Crisis Management System were fully employed after a crisis situation on the entire territory of the Republic of Macedonia was declared as a result of large-scale forest fires.

The Law on Crisis Management has assigned the competencies for the drafting of the assessment of *all risks and hazards* to the Crisis Management Centre, i.e. the managing bodies within the Crisis Management System (the Assessment Group and the Steering Committee). At the same time, the National Platform enhances the national mechanisms within the interagency approach in the process of identification, assessment and managing of the potential risks in the Republic of Macedonia.

This law stipulates the rights and obligations of entities that comprise the Crisis Management System. The managing competence within the system is assigned to both Government bodies, the Steering Committee and the Assessment Group, and establishment of a special government administration body, the Crisis Management Centre, is provided for with a purpose of ensuring the organisational, administrative and expert support to the system.

The Assessment Group is a Government body that conducts permanent assessment of risks and hazards to the security of the Republic of Macedonia, and proposes measures and activities for their prevention, early warning and handling. In the part of the competencies related to the assessment and drafting of the assessment, the law assigns direct legal obligation to the Crisis Management Centre to “prepare and update the unified assessment of all risks and hazards to the security of the Republic of Macedonia” where the risk of forest fires in the recent years is gaining in importance.

The Law on Crisis Management further dedicates a special heading to the security assessment issue in the Republic of Macedonia, and with a purpose of planned, timely, purposeful and coordinated adoption of decisions, guidance and recommendations for taking measures for prevention, early warning and handling, the Assessment of Endangerment of the Republic of Macedonia from all risks and hazards was prepared. At the proposal of the Assessment Group, assessment is made by the Crisis Management Centre and submitted for consideration to the Steering Committee. The assessment is adopted by the Government, and the decisions resulting thereof are obligatory for all entities in the Crisis Management System.

Article 45 of the Law on Crisis Management provides for the Government to prescribe, with regulation, the methodology for the preparation of the assessment, its contents, structure, method of keeping and updating, and defining the entities within the Crisis Management System which are submitted the assessment as a whole or as excerpts.

When it comes to the assessment of risks of forest fires, this project anticipates a special activity for the preparation of the Forest Fire Risk Assessment Methodology, which will be explained in detail in point 6 hereto.

3. Need for an Integrated System for Prevention and Early Warning of Forest Fires

Occurrence of forest fires in the Republic of Macedonia poses a complex risk, which has been intensified year by year and caused serious damage and consequences to the forest resources and the environment. The competent institutions are facing increasing challenges in terms of the successful managing of risks of forest fires and decreasing the consequences.

The contemporary principles of a comprehensive risk management imply development of a sustainable legal, organisational and institutional system, which will have solid bases for efficient inter-institutional cooperation, communication and sharing of information, by employing the advantages of the modern information technology. Experience and the lessons learned in the previous years have referred to the need for development of the Integrated System for Prevention and Early Warning of Forest Fires, which is the subject matter of this project.

3.1. Problems in the Inter-Institutional Communication, Coordination and Sharing of Information

Problems in the inter-institutional communication, coordination and sharing of information that are related to the whole cycle of the forest fire risk management generally emerge from the legal, organisational, institutional and technical nature. Problems of the formal and legal nature arise from certain incompleteness of the laws and by-laws and ambiguity in the legal competencies, which should be surpassed in the future by organised intersectoral activities. The second aspect of the problem, which relates to the organisational and institutional positioning of the institutions that have had shared competencies in the forest fire risk management has been the subject of systemic analysis in the recent several years, and in order that the evident problems are surpassed, it is necessary to build capabilities and standard procedures for inter-institutional employment of the resources and capacities based on the “who is the first that is responsible” principle and the principle of “proportional response depending on the intensity of the occurrence (forest fire) and expected damage (cost-benefit analysis).”

However, the basic precondition for standardisation of procedures for overcoming the above noted problems is the existence of adequate technical capacity and tools (hardware, software and other technical equipment), which can be employed by the competent institutions to achieve fast mutual communication, access to required data, sharing of information in a standardised and unified manner with a purpose of supporting the decision-making system, from the lowest to the highest levels.

3.2. Initiatives for Strengthening the National Capacities for Handling the Forest Fires

Analyses related to the problems caused by the occurrence of forest fires, which are made within all involved institutions such as the Ministry of Agriculture, Forestry and Water Economy, PE Macedonian Forest, Crisis Management Centre, Directorate for Protection and Rescue and others, are constantly used for different aspects of strengthening of the national capacities for handling the forest fires. In the past years, significant initiatives have been launched in the organised inter-institutional and international cooperation with a purpose of improving the national legislation in this field and its harmonisation with the European Union

good practices and standards, and such initiatives have provided the adequate fire-fighting equipment, training and drills for the operational forces and similar activities.

The initiative for the development of the Integrated System for Prevention and Early Warning of Forest Fires, within a whole range of initiatives, is a novelty since it implies the construction of a modern Information System that will connect all competent institutions of significance for the forest fire risk management.

4. Project on Development of Integrated System for Prevention and Early Warning of Forest Fires

4.1. Initiative for Project Cooperation with the Japan International Cooperation Agency - JICA

Detailed analyses of the conditions with the forest fires in the Republic of Macedonia, especially after the 2007 summer "crisis situation," have identified many weaknesses in the national system for the crisis management and addressing accidents and disasters. Post-crisis situations and analyses indicated the necessity for the development of an Integrated System for Prevention and Early Warning of the Risks of Forest Fires. This was a direct reason for the Crisis Management Centre to undertake a task of formulating an initial content of the draft project application within the technical cooperation between the Government of the Republic of Macedonia and the Government of Japan, through their Japan International Cooperation Agency – JICA. Launching the project initiative at the time was founded on the following reasons:

- Engagement of the total national resources (financial, human, material, and alike) for handling the forest fires occurrences was at a very high level,

- Damages caused by fires (direct and indirect) had a huge negative economic, social and environmental impact and entailed serious financial implications on the budget of the Republic of Macedonia,

- In the summer 2007 the mechanisms of the newly established Crisis Management System were triggered for the first time with a purpose of handling the large-scale forest and open area fires,

- Experience in handling the fires in 2007, along with the identified weaknesses in the national system directed to a need for the development of the Integrated System for Prevention and Early Warning of the Risks of Forest Fires.

The basic aim of this project is directed towards strengthening the national system for coordination, communication and fast exchange of information and data in the process of prevention and early warning of risks of forest fires in the Republic of Macedonia.

Formal approval and the signing of documents for the project and the development of the Integrated System for Prevention and Early Warning of Forest Fires was made in January 2011, and the project start was counted as of May in the same year. The project has an implementation period of three years, and its completion is projected for May 2014.

4.2. Project Objectives, Expected Results and Activities

The goal of the project is directed towards decreasing the occurrences of major forest fires through strengthening the national capacities for the prevention and early warning of risks of forest fires, whereas the objective of the Project is strengthening of the capacity of the Crisis Management Centre for notification-transmission of information and data to the relevant institutions competent for prevention and early warning of forest fires along with the improvement of the mutual cooperation.

The expected results of this project refer to:

1. Development of a national system for assessment of risks of forest fires, and

2. Strengthening of the national mechanism for coordination, sharing of information and cooperation between relevant institutions for prevention and early warning of forest fires.

Achievement of the first result is anticipated through the implementation of the following project activities:

1. Development and establishing of the forest fire risk assessment methodology,

2. Identification and collection of data/information useful for the forest fire risk assessment,

3. Development of an integrated GIS system with a the necessary database, including software, hardware and equipment along with the necessary training for the use and maintenance of the system,

4. Preparation and issuance of the GIS-supported maps related to risks of forest fires,

5. Development of the assessment methodology related to damages and consequences of forest fires,

6. Organizing workshops and trainings for the forest fire risk assessment.

Development of a sustainable coordination mechanism between the Crisis Management Centre and the relevant institutions by identifying problems related to the sharing of information and coordination.

Achievement of the second result is anticipated through the implementation of the following project activities:

1. Development of sustainable coordination mechanism between the Crisis Management Centre and the relevant institutions by identifying problems related to the sharing of information and coordination,

2. Periodical organising of meetings of the Group for Technical Coordination of the Project,

3. Improvement of the situation with the transmission of information and the increase of the public awareness regarding prevention and early warning of risks of forest fires,

4. Assessment of the coordination efficiency between the Crisis Management Centre and relevant institutions.

4.3. Participants in the Implementation of Project Activities

The project is considered to have started on 14 May 2011 with the arrival of the permanent experts on the Japanese side, the Project Chief Advisor and the Project Coordinator. With a purpose of coordinated and harmonised project management, the following two bodies for the project were established: The Technical Coordination Body and the Project Steering Committee. Institutions included as partners in the implementation of the project participate in these bodies through their nominated representatives, and they are as follows: the Ministry of Agriculture, Forestry and Water Economy, the Ministry of Environment and Physical Planning, the Secretariat for European Affairs with the Government of the Republic of Macedonia, the Crisis Management Centre, the National Hydro-Meteorological service, the Directorate for Protection and Rescue and PE Macedonian Forest.

5. Macedonian Forest Fire Information System - MKFFIS

The basic precondition for successful coordination in implementing the measures in all phases of the forest fire risk management (prevention, early warning, handling and recovery) is a well established system for mutual communication and information sharing. Within this project for the development of the Integrated System for Prevention and Early Warning of Forest Fires, the basic objective is providing a common platform for sharing information and data based on the up-to-date Web-based Geographic Information System (GIS), in which all the institutions that are competent in different phases of the process of protection from forest fires are connected.

This system is based on the integrated Web platform and has its own recognisable name, the Macedonian Forest Fire Information System (MAKFFIS-www.mkffis.cuk.gov.mk). By developing such a system, the Republic of Macedonia has become the only country in the region that has established high standards in this field, by the model of the European Forest Fire Information System (EFFIS) established on the level of the European Union.

5.1. The Methodological Setting of the Integrated System for Prevention and Early Warning of Forest Fires - MKFFIS

The first planned activity within this project was connected with defining and setting a special methodology for monitoring and assessment of risks of forest fires. With a purpose of introducing the best world experience and practices in this field and defining corresponding methodological tools, consultation with a number of foreign and domestic scientific institutions have been conducted, like the Faculty for Remote Control Technologies at the Tokyo University and the Institute for Earthquake Engineering and Engineering Seismology and the Faculty of Forestry at Ss. Cyril and Methodius University in Skopje.

In defining the basic methodological setting of the Integrated System for Prevention and Early Warning of Forest Fires – MKFFIS, we have been guided by the general Risk Assessment Methodology, which is prescribed with the Regulation for Preparation of the Assessment of Endangerment of the Republic of Macedonia from all risks and hazards, where Risk is defined as the function of danger, exposure, vulnerability and the capacity of the system, or: R = f(HxExVxC).

The following table gives a summary of the elements that make the risk of forest fires and the tools for monitoring and assessment of each element separately.

A) Forest fire risk elements and risk assessment tools:

	Risk element	Risk assessment tool
Forest fire disaster risk	Hazard	v1) Hot spot map v1) Forest fire history
	Exposure	v1) Forest vegetation map v2) Table of expected damaged forest
	Vulnerability	v1) Vegetation Dryness map v2) Fire Weather Index map
	Capacity and measures	v1) Topographic map, etc. v2) Map of facilities, infrastructure and resources

Table 2: Forest fire risk elements and risk assessment tools

The adopted methodology for the monitoring and assessment of each element of the forest fire risk provide development of special tools such as: for forest fire Hazard, a hot spot map and a fire history map are developed; for monitoring of the Exposure of forest vegetation, a forest vegetation map and a damaged forest value map are developed; for monitoring the Vulnerability, a vegetation dryness map and a fire weather index map are introduced; and for monitoring the capacity and measures of the institutions within MKFFIS all necessary topographic and other maps and a suppression resource data are set.

The methodology does not only stay on specifying the required tools for the monitoring and assessment of the forest fire risk, but also anticipates the necessary data for each tool separately, the source of that data and the time and spatial resolution of data. That is shown as a summary in the following table:

B) Necessary data to create forest fire risk assessment tools:

Map	Necessary data	Data provider	Time /Spatial resolution
1) Hot Spot Map	3900 and 10800 nm channel of MSG-SEVIRI (-IR039*, -IR108*, -PRO*)	EUMETSAT ftp://ftp.eumetsat.int/pub/OPS/out/simon/FIRE/	every 15 minute; 3 km by 3 km
	Fire Products of Terra/Aqua-MODIS (MOD14*, MYD14*)	ftp://nrt2.modaps.eosdis.nasa.gov	2 to 4 times a day; 1 km by 1 km
2) Vegetation Dryness Map	Vegetation Index and Water Index that are collected by Terra/Aqua-MODIS	Through web site of a specific US agency.	Once a week
3) Fire Weather Index Map	temperature, moisture, wind speed and wind direction, rain fall	Automatic Weather Stations through Hydro-Met[1]	Once a day
4) Forest Vegetation Map	species, age, diameter, wooden mass, slop etc.	PEMF	Once a year
5) Forest fire history	fire report	PEMF, MAFWE[2]	Event by event basis
6) Topographic Map etc.	1/25,000 digital map	AREC[3]	
7) Map of facilities, infrastructure and resources	buildings. infrastructure, equipment, etc	CMC	
8) Table of expected damaged forest	value as per Form 9 of the FMU inventory	PEMF	

Table 3: Necessary data to create forest fire risk assessment tools

3 Hydro-Met: Hydro Meteorological Agency

4 AREC: Agency for Real Estate Cadastre: http://www.katastar.gov.mk

Such methodological setting of the monitoring and assessment of the forest fire risk follows the world experience and good practice in this field, and above all the standards established by the European Forest Fires Information System (EFFIS) and thus enlists the Republic of Macedonia among rare countries that develop their own/national information system for monitoring and warning of forest fires.

5.2. Conceptual Design of the System

Led by the adopted methodological matrix, along with the necessary data and tools for the assessment of the risk of forest fires, we established and designed the conceptual design of the system where the place, role and assignments of all institutions included in the project as the service providers and the system users were defined in more detail. A scheme with a diagram of the conceptual design of the integrated system for prevention and early warning of forest fires is given as Annex 1 hereto.

5.3. Necessary Information and Other Equipment Required for the Needs of the System

Concurrently with the establishment and the adoption of the conceptual design of the system, we identified and ensured the necessary information (hardware and software) and other technical equipment thus fulfilling the necessary preconditions for the start of the Macedonian Forest Fire Information System. An overview of the equipment provided for the needs of the Macedonian Forest Fire Information System is given in Annex 2 hereto.

5.4. Users of MKFFIS

The users of the Macedonian Forest Fire Information System have been identified by the system's Conceptual Design. The National Hydro-meteorological Service (meteorological data) and the Public Enterprise "Macedonian Forests" (forest vegetation data) are fundamental service providers. Other institutions having access to MKFFIS and its products are: Ministry of Agriculture, Forestry and Water Economy, Ministry of Environment and Spatial Planning, Crisis Management Center, Directorate for Protection and Rescue, Forest Police, Fire Brigades, National Parks and Protected Areas, as well as other institutions involved in handling forest fires (Army, Police, Fire-fighting associations etc.).

In its second stage of development, the improved MKFFIS allows web based public access to some products such as: Hot Spot Map, Vegetation Dryness Map, FWI Map and others. By this, the citizens and the general public will be able to obtain information on the situation of forest fires in the country.

6. Tools and Products of MKFFIS, Their Presentation and Interpretation

Two MKFFIS versions exist:

1) MKFFIS version 2 requires to input access ID and password.
2) MKFFIS - Public does not require to input any of these.
MKFFIS version 2 requires access ID and password. MKFFIS - Public does not need require any of this.

URL address of each MKFFIS is the following.
MKFFIS version 2: http://mkffis1.cuk.gov.mk
MKFFIS - Public: http://mkffis.cuk.gov.mk

MKFFIS version 1 was developed in April 2013. MKFFIS version 2 was developed in March 2014 by improving MKFFIS version 1 in the light of improving interface, improving performance, and adding new functions.

The figure below shows the MKFFIS version 2 log-in interface.

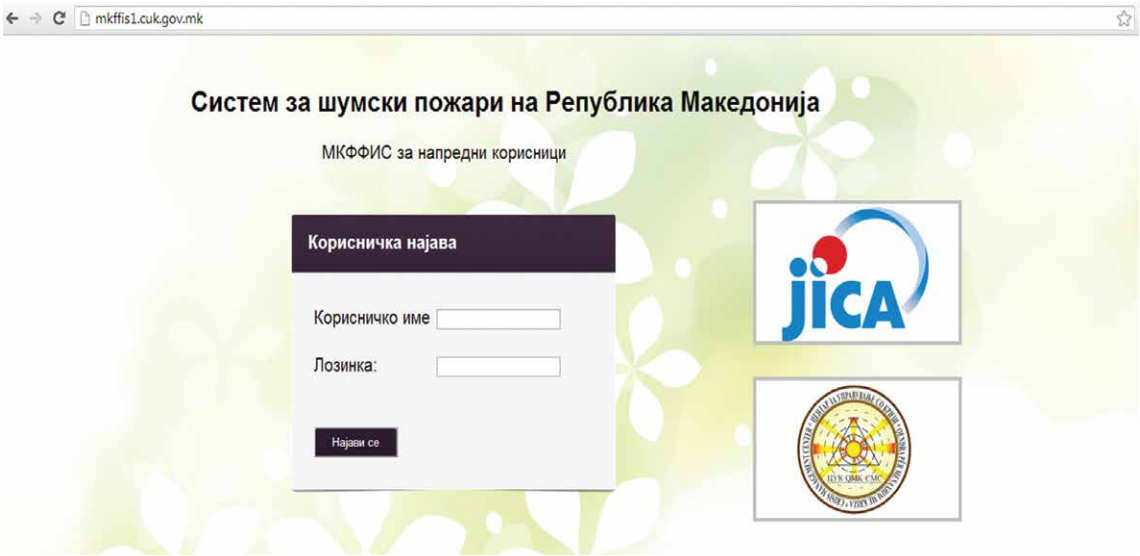

Figure 1: MKFFIS ver.2 log-in interface

6.1. Product description of MKFFIS version 2

6.1.1. Hot spot map

Hot spot means the spot that reflects high thermal infrared energy. Hot spot map shows the area where fire might be happening now with high probability.

SEVERI likely-hot spot shows in orange circle dot and SEVERI possible-hot spot shows in yellow circle dot in MKFFIS screen. Likely-hot spot has higher probability of fire occurring than possible-hot spot has. SEVIRI hot spots are updated every 15 minute.

MODIS hot spot shows in red square dot in MKFFIS screen. MODIS hot spots are updated around twice or 4 times a day.

SEVIRI has higher time resolution and has lower spatial resolution. MODIS has higher spatial resolution and has lower time resolution. Therefore, SEVIRI and MODIS would be used in a complementary way.

It should be noted that the Hot spot detection approach does not replace any conventional detection methods, such as monitoring from watch towers. The hot spot detection approach could only provide additional information as to the locations requiring additional attention.

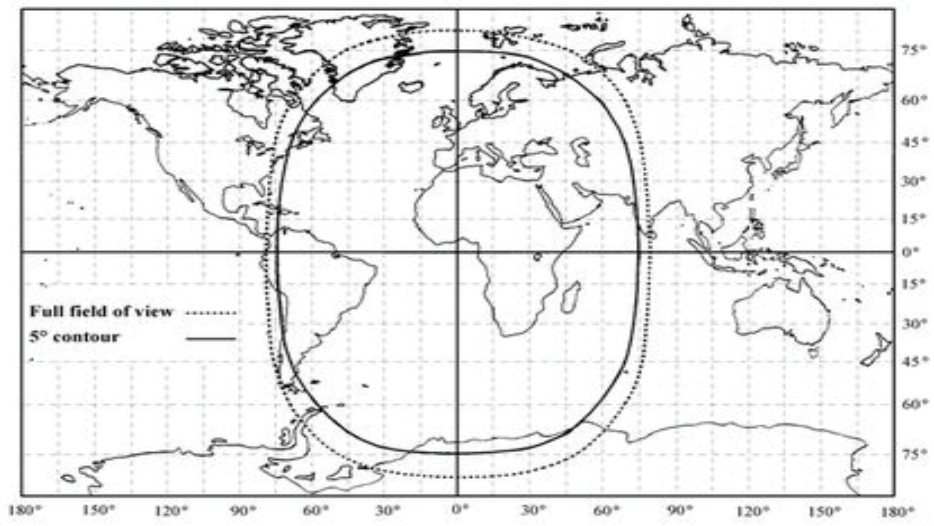

Figure 2: Location of MSG-SEVIRI

MSG-SEVIRI is a static satelite that is above longitude 0 and latitude 0.
EUMETSAT also provides information about SEVIRI hot spot location having longitude and latitude in web site: ftp://ftp.eumetsat.int/pub/OPS/out/simon/FIRE/

MKFFIS automatically read longitude and latitude of SEVIRI hot spots by following procedures:

1) Go to ftp://ftp.eumetsat.int/pub/OPS/out/simon/FIRE/

2) MKFFIS automatically reads the longitude and latitude of hotspots in:

List of detected fires (latitude, longitude, radius) </areaDesc> <circle>-26.314,26.442 1.869</circle> <circle>-25.697,32.521 1.974</circle> ... ...

Terra/Aqua-MODIS is an orbital satellite. NASA provides information about MODIS hot spot location having longitude and latitude in web site: ftp://nrt2.modaps.eosdis.nasa.gov

MKFFIS automatically read longitude and latitude of MODIS hot spots by following procedures.

1) Go to ftp://nrt2.modaps.eosdis.nasa.gov

2) MKFFIS automatically reads the longitude and latitude of hotspots in:

latitude,longitude,brightness,scan,track,acq_date,acq_time,

satellite, confidence,version,bright_t31,frp 35.053,-2.544,318.8,2.6,1.6,2012-08-06,02:40,A,97,5.0,290.1,94.5 35.049,-2.553,317.8,2.6,1.6,2012-08-06,02:40,A,94,5.0,289.6,90.8
... ...
MKFFIS version 2 has a filtering threshold in confidence value. Hot spots having confidence values of over 20 % are shown in Hot spot map.

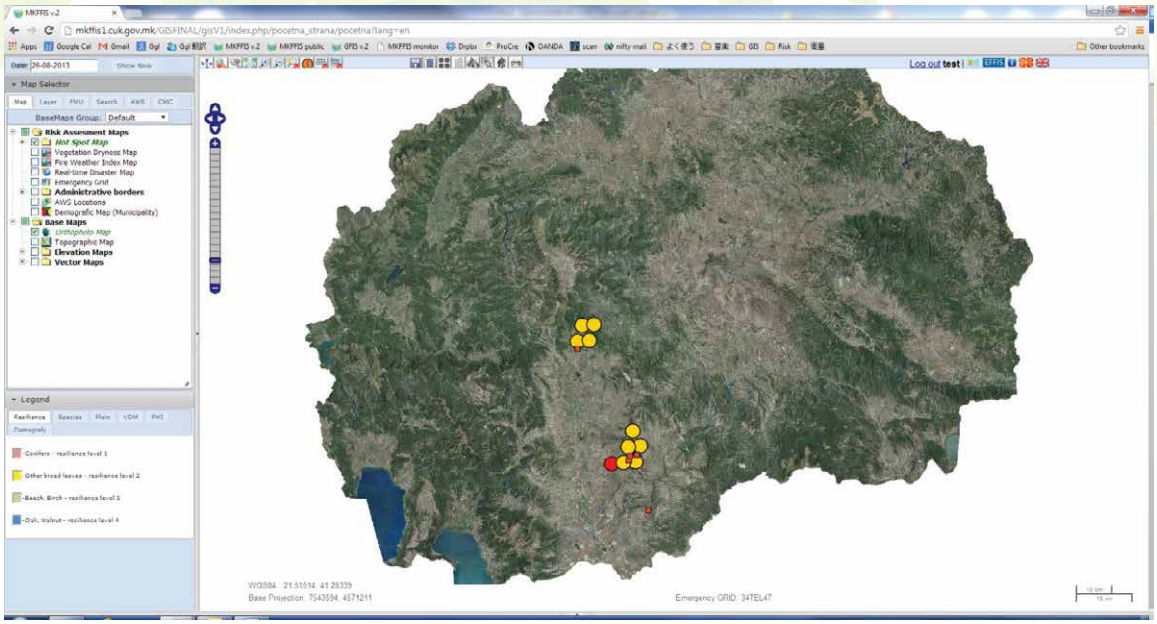

Figure 3: Hot Spot map - SEVIRI and MODIS

6.1.2. Vegetation Dryness Map

Vegetation Dryness shows dryness of vegetation fuel as is calculated below.

Vegetation Dryness = (measured Water Index) - (calculated Water Index)

(Here “measured” means “measured by Aqua/Terra MODIS.”)

The measured Vegetation Index can provide the calculated Water Index because there exists specific correlation between Vegetation Index and Water Index.

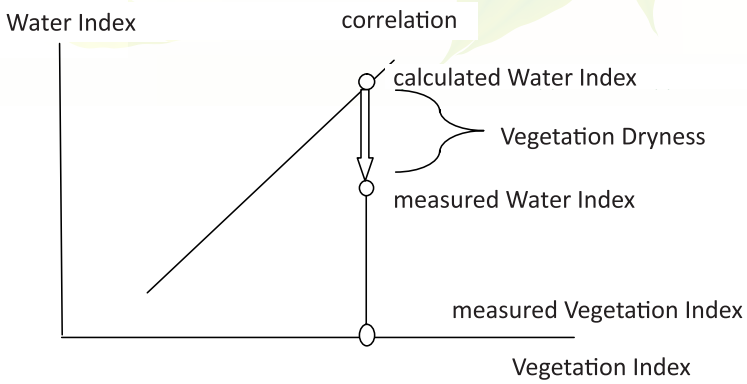

Figure 4: Correlation between Water Index and Vegetation Index

Water Index, Infrared Index (Normalized Difference Infrared Index): NDII

Vegetation Index (Normalized Difference Vegetation Index): NDVI

NDII = (NIR - SWIR) / (NIR+SWIR)=800nm−3900nm/800nm+3900nm）

NDVI = (NIR-R) / (NIR+R)=800nm−600nm/800nm+600nm）

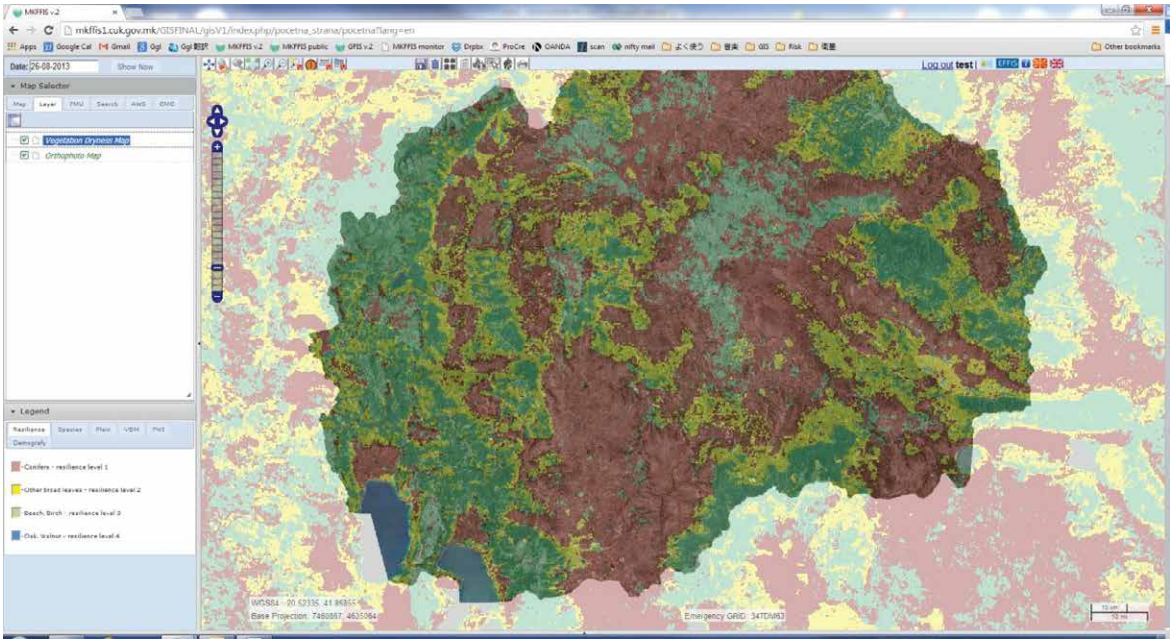

Figure 5: Vegetation Dryness map

6.1.3. Fire Weather Index Map

Fire Weather Index (FWI) shows the expected intensity of fire if forest are ignited. Following photos shows the degree of fire when FWI is 9, 17, 24, and 34.

Figure 6: FWI - 9

Figure 7: FWI - 17

Figure 8: FWI - 24

Figure 9: FWI - 34

In MKFFIS threshold value in 2013 of fire danger are set as follows. (Threshold values in 2014 might be modified.)

fire danger class	FWI
Very low	0 - 5.2
Low	5.2 – 11.2
Moderate	11.22– 21.3
High	21.3 – 38.0
Very high	38.0 and over

Table 4: Treshold values of FWI in MKFFIS in 2013

Fire Weather Index is calculated daily by using temperature, relative humidity, wind speed, and rainfall.

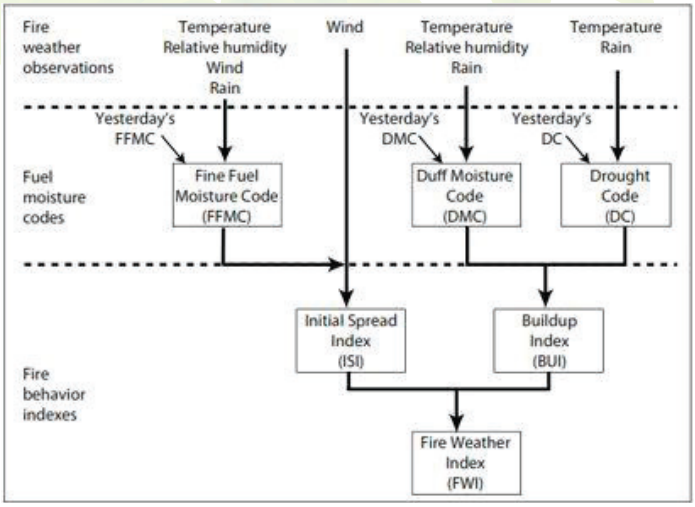

Figure 10: Flow chart for calculating FWI

(Source: Wagner, Equations and FORTRAN Program for the Canadian Forest Fire Weather Index System,1985)

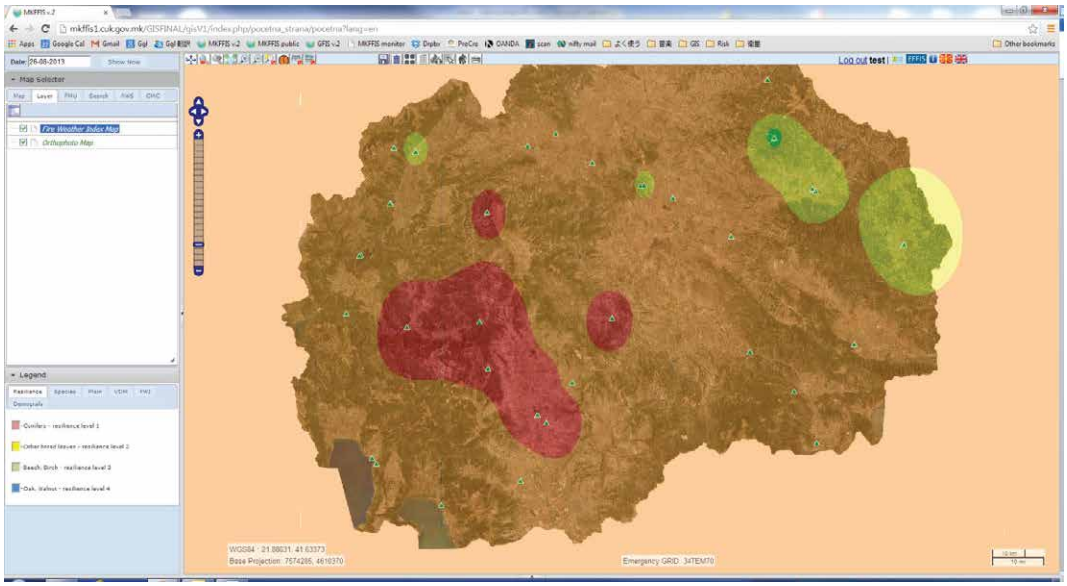

Figure 11: Fire Weather Index (FWI) map

6.1.4. Forest vegetation map [5]

Forest vegetation in sub-compartment is shown in forest vegetation map. Forest vegetation map is created by using information from PEMF forest inventory and PEMF forest management map.

Generally speaking the lower the wood density is, the easier it burns. Therefore, conifer forest is more easily burnt than broad-leaf forest. Conifer forest shows in pink color in Forest vegetation map. The orders of less resilient species against fire are: conifer < other broad-leaf < beech/birch < oak/walnut.

5 There are two kinds of forest vegetation map: 1) forest vegetation map in MKFFIS, which shows information of CMC server, and 2) forest vegetation map in GFIS, which shows information of PEMF server. The forest inventory that has a link with forest vegetation map in MKFFIS shows the limited fields such as species, age, volume per hectare, etc. The forest inventory that has a link with forest vegetation map in GFIS shows all the fields in inventory.

Including the map of fire resilience, there are mainly three types of forest vegetation maps:
1) Map of forest resilience against fire (category of conifer < other broad-leaf < beech/birch < oak/walnut)
2) Map of 10 year risk (category I, II, III, ...), and
3) Map of species (pine, birch, beech, oak and other categories)

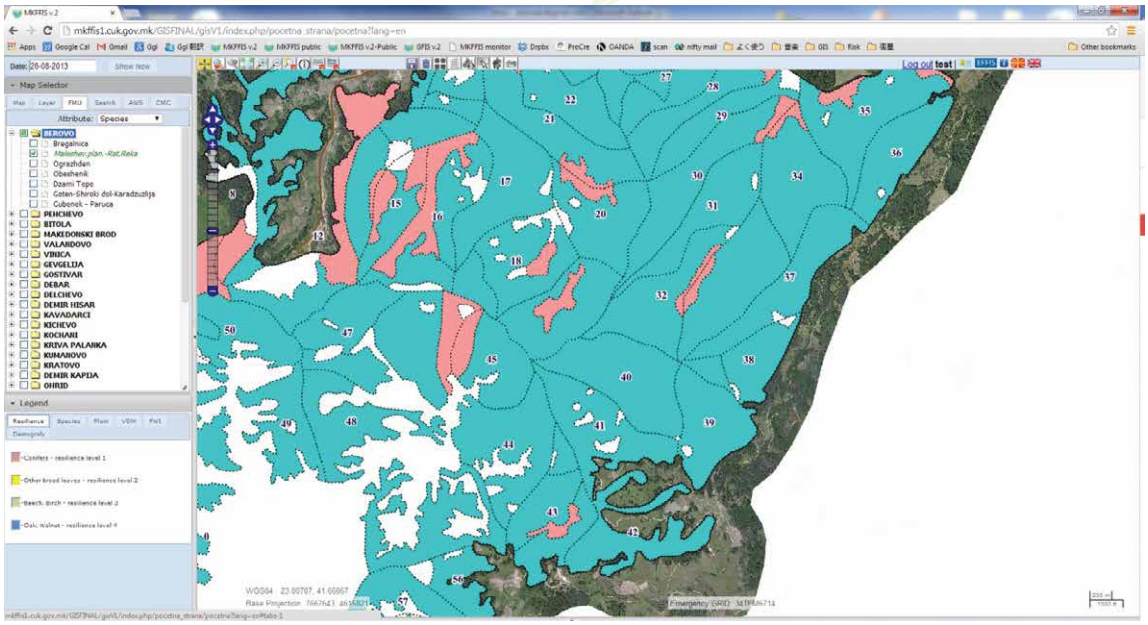

Figure 12: Map of forest resilience against fire
(category of conifer < other broad-leaf < beech/birch < oak/walnut)

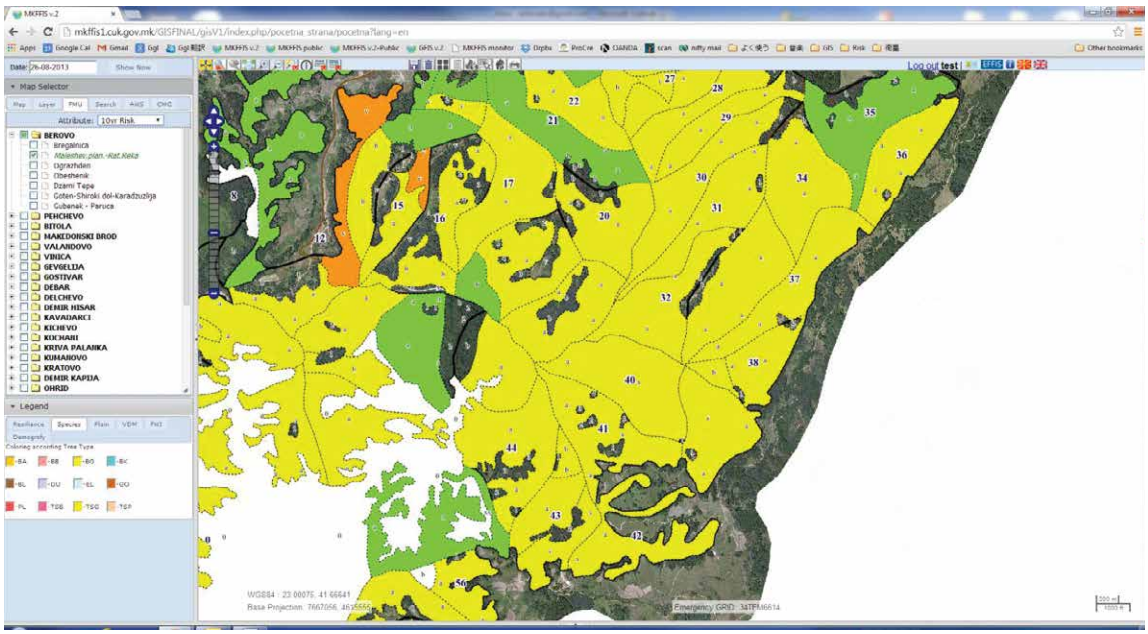

Figure 13: Map of 10 year risk (category I, II, III, ...)

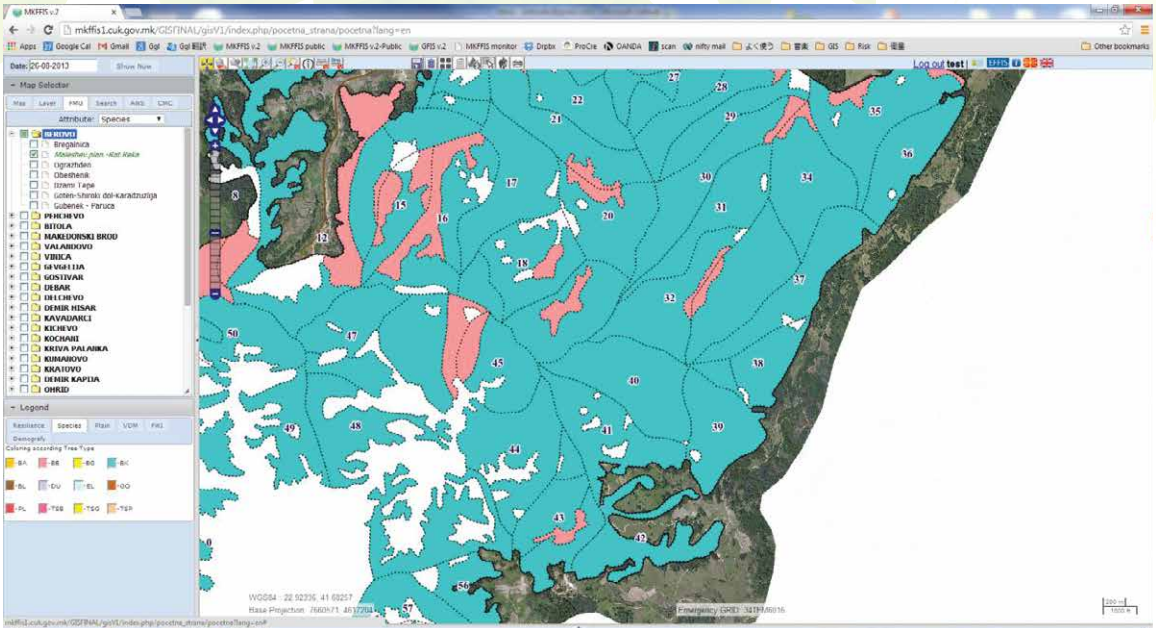

Figure 14: Map of species (pine, birch, beech, oak and other categories)

Proper planning of forest management would contribute to decrease forest fires. For instance, pure monoculture pine forest is fragile to forest fire. If pure pine forest should exist in fire prone area, that pure pine forest would be mixed with more-fire-resilient species such as oak.

6.1.5. Forest fire history

Information of past forest fires is explained in the table of forest fire history. The locations of past forest fires in selected period are graphically shown in MKFFIS screen.

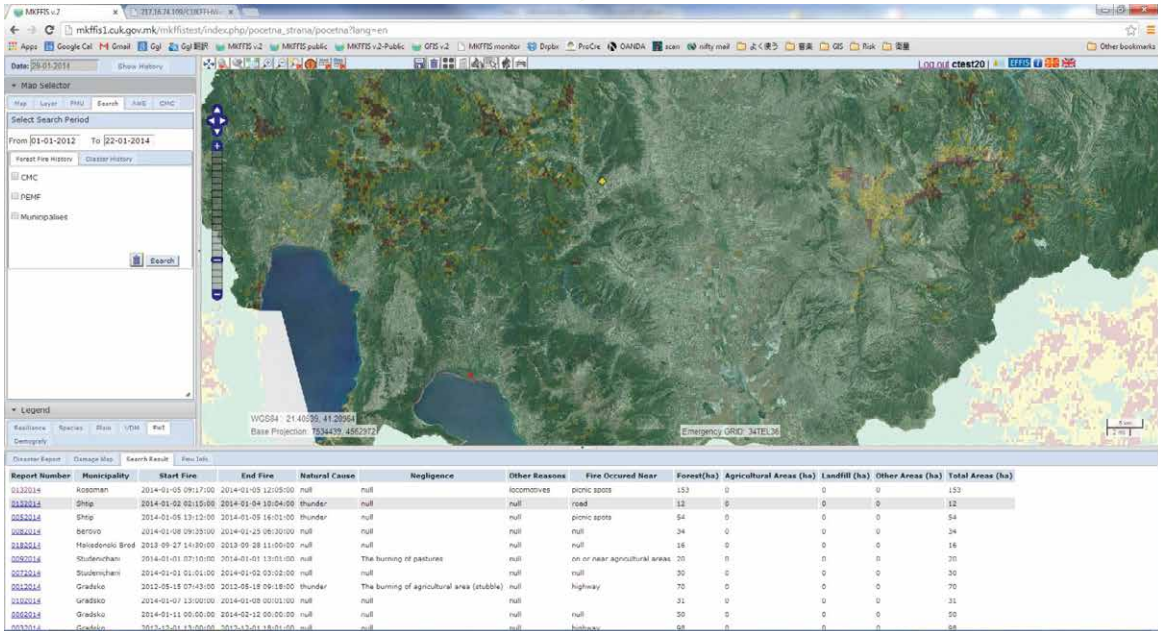

Figure 15: Forest fire fire history

6.1.6. Map of Daily Events

The real time disaster map is a new map and a new function in the MKFFIS showing daily events occuring on the teritorry of the Republic of Macedonia [6]. This novelty in the system will ensure a faster and better way of data and information transfer about events and situations in progress on the teritorry of the entire country.

These daily event data will be entered into the system by the staff of the Regional Crisis Management Centers. Each event entry will contain the necessary data for the event to be graphically presented, depending on the nature of the event (as a point, polygon or line) and with an icon, as well as with predifined event description fields, as per the internal operation procedures of the Crisis Management Center.

As a new function, this is intended to increase CMC capacity in terms of operational coordination in order to more eficiently cope with and respond to forest fires and other emergencies. In addition, the new daily event mapping function is linked to a dedicated database, which also reinforces CMC capacity in the area of analysis, information documentation and statistics gathering.

6 Daily Events, as intended by the Crisis Management Center, are all reports originating from the Regional Crisis Management Centers relating to accidents, disasters, catastrophes etc. caused by a variety of risks.

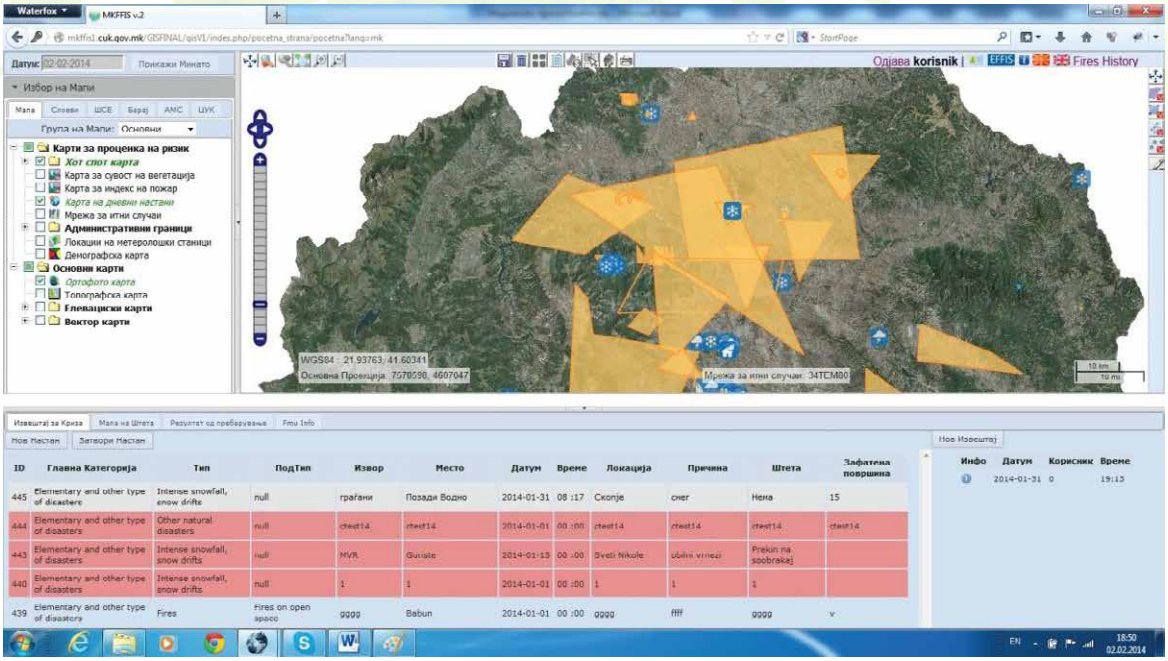

Figure 16: Map of Daily Events

6.1.7. Emergency Grid

Modern ways of disaster management require set standards and technologies for quick and accurate spatial identification of the event. This poses a challenge to institutions and systems which specialize in crisis management. The world has seen a variety of standards based on scientific and applied theories and practices. Unfortunately, the standards for the response to emergencies often come as a result of lessons learnt from experienced disasters and catastrophes often resulting in human casualties and material, cultural, natural and other losses.

The risks causing emergencies are often complex and require inter-departmental response involving the capacities of a variety of national and international institutions (civic, military etc.). This even more stresses the need to develop and introduce standards which allow interoperability and compatibility in the processes of planning and execution of emergency coping activities.

At this stage, the Republic of Macedonia does not own a reference grid system for two-dimensional marking/positioning of points in space. The Crisis Management System needs to formulate and adopt an emergency grid that would ensure complete inter-departmental interoperability of powers in the event of emergency, as well as a coordinated response to states of crisis. The development of MKFFIS was seen as an excellent opportunity to establish the basis of the Emergency Grid, initially to serve the needs of the Crisis Management System, and later to be further developed to grow into a National Reference Emergency Grid (Macedonian Referent Emergency Grid - MKREG).

The Geographic Grid is a method to discretize space and store spatial information by their indirect positioning. Technically, the geographic data grids are predefined spatial referencing structures comprised of cells having regular shape or surface. Normally these cells are squares based on a specific coordinate reference system. There are many types of grids which are available for a number of purposes.

The Military Grid Reference System – MGRS forms the basis on which the Emergency Grid implemented in MKFFIS is established.

A single grid unit of the Emergency Grid does not represent a point on the surface of the earth; it rather denotes a square area of 100x100km, 10x10km, 1x1km, 100x100m, 10x10m or 1x1m, depending on the accuracy of the coordinates. The total number of figures when expressing spatial location data is 7, 9, 11, 13 and 15, depending on the required accuracy.

The typical coordinate systems used in Macedonia are the coordinated of longitude and latitude, and as of lately, due to GIS devices and Google Eartj, the eastern and northern UTM coordinates. In case of longitude and latitude coordinates, there are three ways of representation: (a) degrees, minutes and seconds; (b) degrees and minutes and (c) decimal degrees. The grid based system is easier used compared to the coordinate systems using latitude and longitude or UTM. It can provide a unique description (a series of 15 alphanumeric characters) of a certain location with a 1x1m resolution.

One coordinate of the Emergency Grid system is broken into three components and is interpreted in the following way:

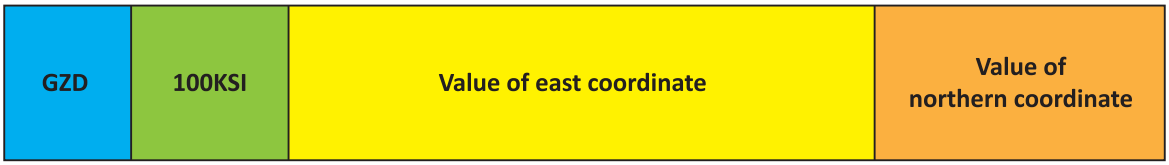

Figure 17: Emergency Grid Coordinate Components

1. Grid Zone Designation (GZD):

The first part of one coordinate of the Emergency grid (three characters) is the grid designation. The ITM zone 6° wide, enumerated with the number "34" is cut with an 8° high latitude belt marked with a "T". The intersection of the UTM zone "34" and the latitude belt "T" represents a 6° x 8° polygon called grid zone which in this system is identified as 34T. The grid zone designation for the entire territory of Macedonia is 34T.

2. Identification of a 100.000 meter square :

The second part of the Emergency Grid is the identification of a 100,000 meter (100 km or 100k) square represented by two alphabetic characters. The territory of the Republic of Macedonia is covered by six 100k squares marked as DL, EL, FL, DM, Em and FM, as shown below:

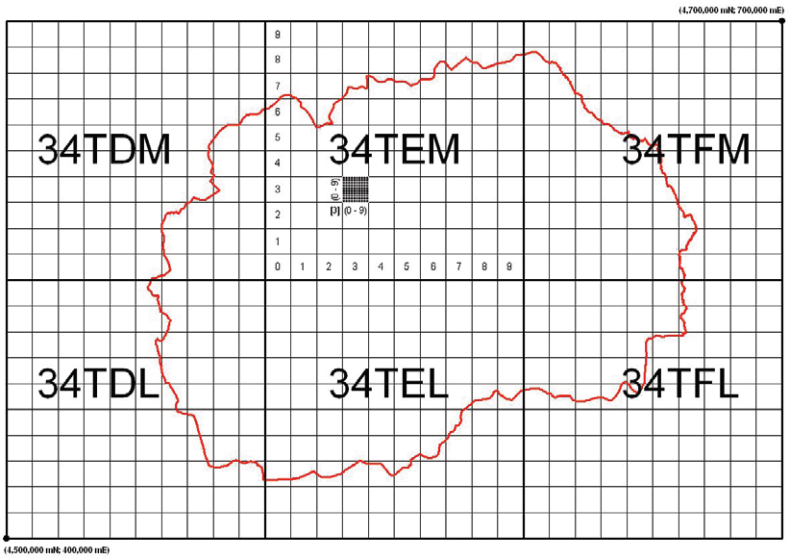

Figure 18: Emergency Grid 100 km square

3. Numeric location:

The third part of the Emergency grid (10 characters) is a numeric location within a 100,000 meter square presented by a n+n digits, where n equals 1, 3, 3, 4, or 5. The numeric definition of the location is based on standard X and Y (east and north) coordinates of the UTM coordinate system, expressed in meters. If a string of 5+5 figures is used, the first five figures give the east coordinate in meters, measured from the left angle of the square, while the last five figures give the northern coordinate in meters, measured from the lower edge of the square. In this case the resolution would be 1x1 meter and the Emergency Grid would present 1 meter square where its northern and eastern coordinates are measured to its south-west angle.

When the required resolution is a 10m one, the last figure of the east and north coordinate can be omitted and only 4+4 figures representing a 10 meter square are used. When a 100 meter resolution is needed, 3+3 figures are used and when 1km resolution is required, only 2+2 figures are needed. For a 10km resolution, 1+1 figures suffice.

The Emergency Grid is expected to provide a better, more efficient and better coordinated multi-departmental operational response (interoperability) in the event of emergencies. It is also expected to aid the prevention, the early warning and the overcoming of consequences resulting from disasters and accidents. The fundamental benefits expected from the establishment of such a system are the following:

- Obtain/transfer location information in a unified format;
- Identify location of emergencies in urban settings where street address model is unclear or lacks accuracy (large campuses, constructions on site etc.);
- Spatial designation of structures/locations far from road infrastructure and remote areas;
- Unified and standard way of presentation/mapping of information/data about existing hazards, exposure to risk elements (population, infrastructure etc.) as well data about the capacities of the relevant authority (resources within the Crisis Management System);
- Improved accuracy in identifying potentially risky locations, as well as improved spatial early warning and alarming;
- Ensure opportunities for further modernization of emergency management by integrating mobile technologies, GPS devices, navigation systems etc.
- Improved interoperability and compatibility of multi-departmental cooperation in times of operational coordination;
- Ensure continuity of political-administrative spatial boundaries etc.

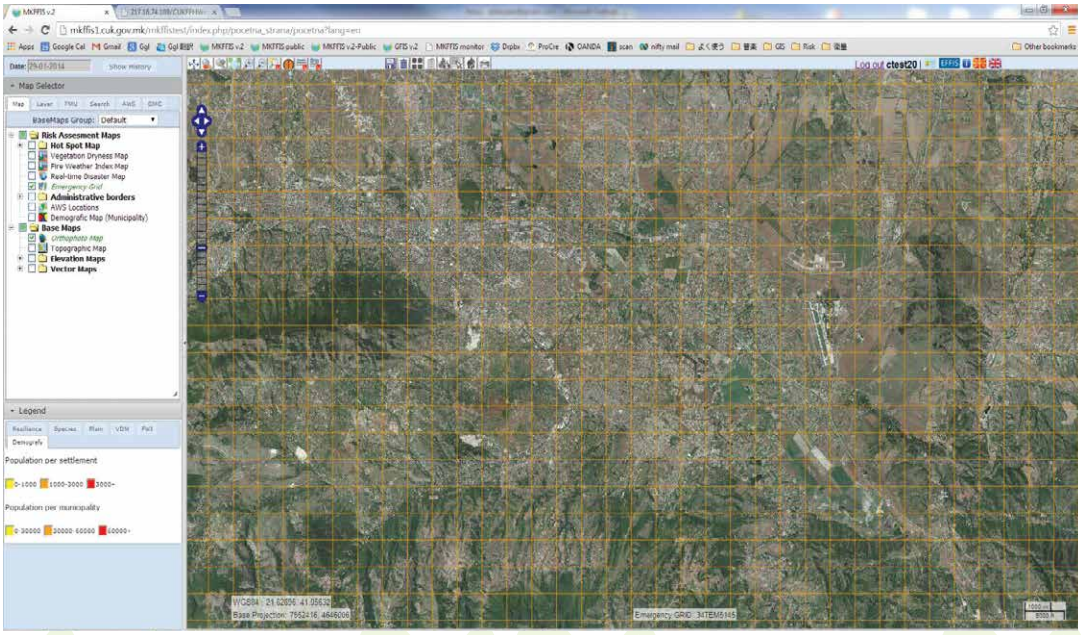

Figure 19. Emergency Grid

6.1.8. Automatic Weather Stations Map

The Automatic Weather Station (AWS) Map shows the locations of the AWS procured by the project, as well as those existing within the national AWS system managed by the National Hydro-Meteorological Service. As per the MKFFIS methodology, data on meteorological conditions are of primary importance for the creation of the Fire Weather Index (FWI) Map. In addition, meteorological data can also be used by MKFFIS users for forest fire behavior analysis and for planning their operational actions.

AWS are an important element of the Macedonian Forest Fire Information System. Meteorological parameters are very significant for efficient forest fire risk management in Macedonia. Meteorological data that can be gathered from MKFFIS are the following: air temperature, air humidity, wind speed, wind direction, rainfall. These data can be obtained either from the AWS sub-menu or directly from the AWS Map, by selecting a certain AWS location.

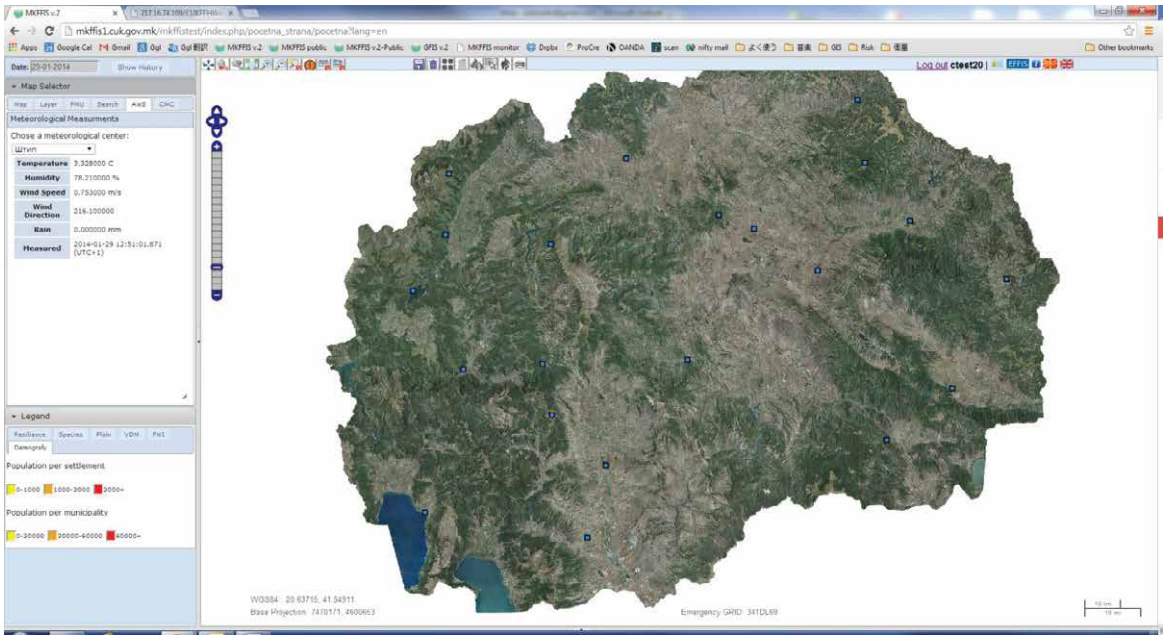

Figure 20. AWS Map

6.1.9. Demography Map

The Demography Map, together with the demographic data advanced search function, is a new MKFFIS module which greatly richens its general purpose. This module draws data from a database which has already been developed in the Crisis Management Center in cooperation with the United Nations Development Program (UNDP) and the National Statistics Bureau. The objective of this new function is spatial representation of demographic dispersion data in Macedonia, at a municipal or settlement level, as required.

Data about population, as an element exposed to risk, is an important indicator for holistic analysis and assessment of forest fire risk as forest fires are often a significant threat to inhabited areas inside or bordering forests. Besides its primary purpose in MKFFIS, this function will assist the Crisis Management Center in the monitoring, assessment and handling of other risks that appear on the territory of the country. This module is now open for further enrichment with data and information related to the population in Macedonia.

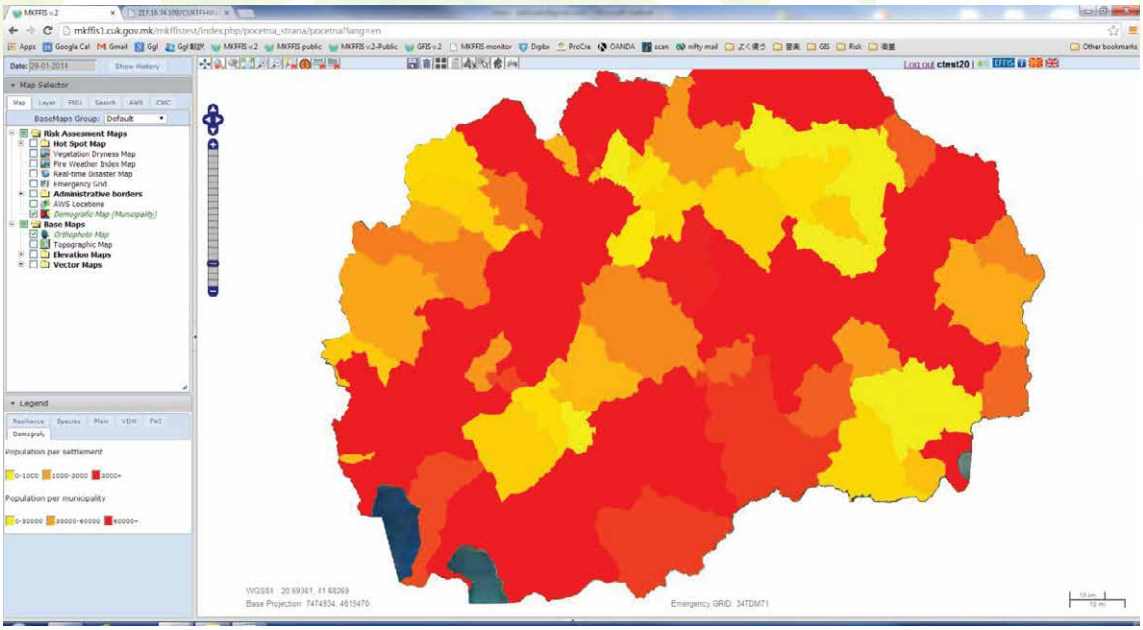

Figure 21: Demographic map

6.1.10. Base maps

Topographic map, orthocenter-photo map, and vector map are prepared to help identify the location of each event. Topographic map can help identify populated areas and road to access fires.

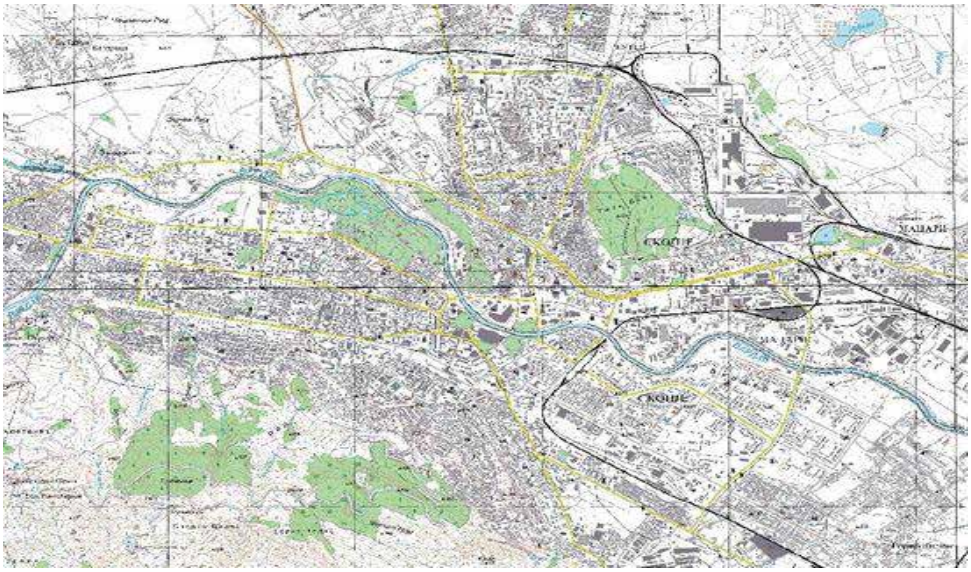

Figure 22. Topographic map

6.1.11. Map of facilities, infrastructure and resources

The map of facilities, infrastructure and resources is another new module in MKFFIS, developed in its second stage of development. This module also draws data from the database already established in the CMC in cooperation with the United Nations Development Program (UNDP). The purpose of this function of MKKFFIS is spatial representation of the exposure of facilities, infrastructure and other structures which may be affected in the event of forest fires, or other hazards. This new function also provides spatial representation of the resources (capacities) of the Institutions forming the Crisis Management System which could be used on the process of handling forest fires or other emergencies.

This function, combined with the quick search offered by the Emergency Grid, enables system users to quickly identify locations affected by forest fires or other risk. It also ensures a swift and accurate navigation of the available resources towards the location of the event.

The map of facilities, infrastructure and resources which initially is intended to serve the purposes of MKFFIS, is open for further enrichment/update with new data obtained in cooperation with the authorities of the Crisis Management System.

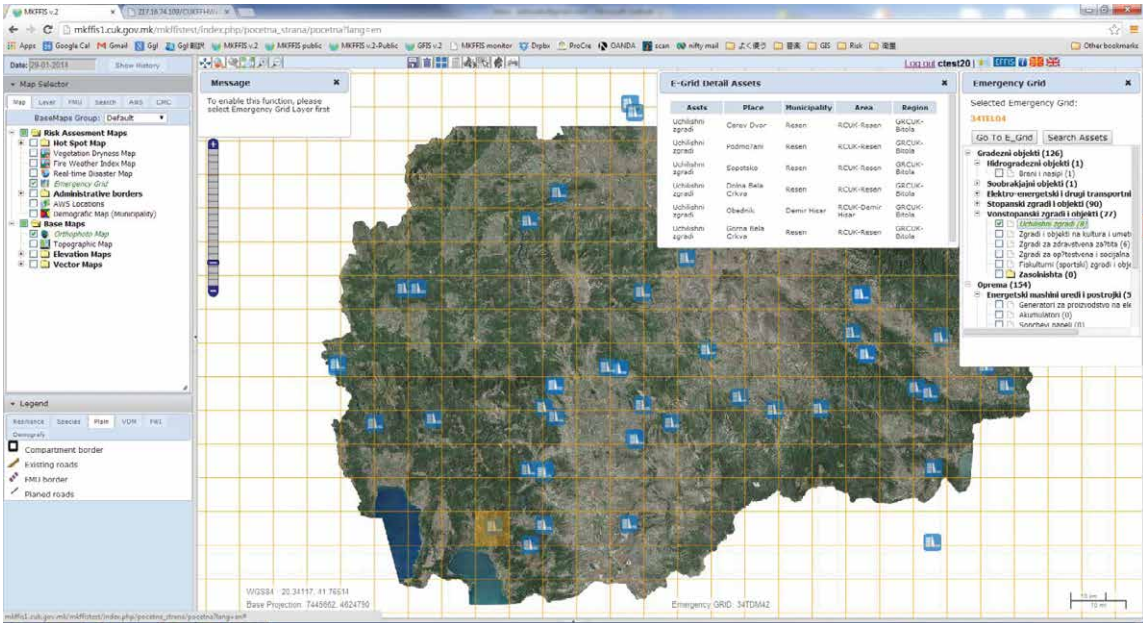

Figure 23. Table of construction and equipment

6.1.12. Table of expected damaged forest

Officers who want to assess expected value of lost forest caused by fire may to this by drawing a polygon in the expected burnt area. If the polygon is drawn in a selected FMU (Forest Management Unit), the total value of expected damaged forest in polygon-intersected area is calculated and shown in MKFFIS screen. Data source of forest value is Form 9 of PEMF's Forest Management Plans. When using this function, the officer in charge can decide whether or not suppression operation by using helicopters would be reasonable by comparing the cost of helicopter operation and the loss of expected damaged forest.

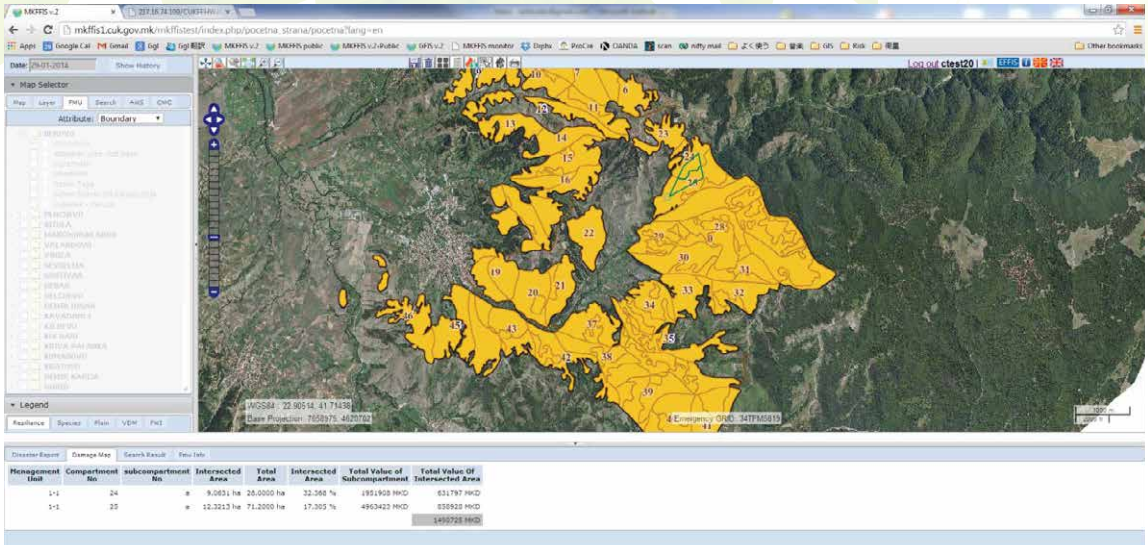

Figure 24. Table of expected damaged forest

6.2. Product description of MKFFIS-Public

Without using any access ID general public can access MKFFIS-Public (http://mkffis.cuk.gov.mk), which would be considered a simple version of MKFFIS version 2.

MKFFIS-Public has three most important risk assessment maps, which mean Hot Spot Map, Vegetation Dryness Map, and Fire Weather Index Map.

Hot Spot Map shows the area where fire might be happening now, with high probability. Vegetation Dryness Map shows the area where dry vegetation exists. Fire Weather Index Map shows expected intensity of fire if forests are ignited.

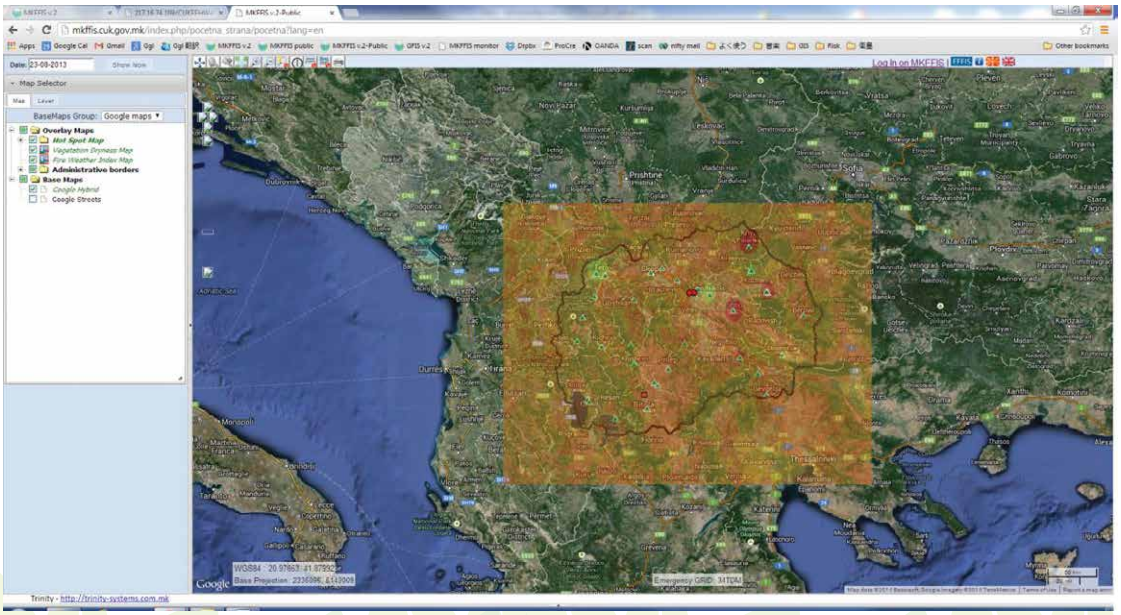

Figure 25. MKFFIS-Public

6.3. Forest Fire Risk Interpretation

Forest fire disaster risk is explained in Table1.

Table 5: Eight risk assessment tools included in MKFFIS

	Risk element	Risk assessment tool
Forest fire disaster risk	Hazard	- Hot spot map - Fire history map
	Exposure	- Forest vegetation map - Table of expected damaged forest
	Vulnerability	- Vegetation Dryness map - Fire Weather Index map
	Capacity and measures	- Topographic map etc. - Table of construction and equipment

Therefore, the areas where forest fire disaster risk is high are explained in table 2.

Table 6: The areas where forest fire disaster risk is high

	Risk element	Risk assessment tool
Forest fire disaster risk is high.	Hazard	- Hot spot map shows likely hot spots. - Fire history map shows high frequency.
	Exposure	**- Forest vegetation map shows conifer.** **- Value of expected damaged forest is high.**
	Vulnerability	**- Vegetation Dryness map shows high value.** **- Fire Weather Index map shows high value.**
	Capacity and measures	- Topographic map etc. show difficult accessibility. - Important cosntuctions exist and less amount of suppression equipment is deplyed.

The situation is explained with two cases.

In case 1: Hot spot appears. This is a fire alert phase.

In case 2: No hot spot appears. This is a normal phase.

Case 1 [Hot spot appears.]:

When hot spot appears, there comes a fire alert phase. In the fire alert phase, CMC etc. issues fire alert to related organization such as PEMF.

Fire alert should include:

- Compartment number where hot spot appears,

- longitude and latitude where hot spot shows, and

- emergency grid number where hot spot appears.

The longitude and latitude of hot spot are found by clicking the circle of hot spot.

Case 2 [No hot spot appears.]:

When no hot spot appears, there comes a normal phase. In the normal phase, RPEMF carries out regular patrol in the compartments where forest fire may happen. (The issue is how to prioritize the patrol area.) Overlaying the each layer can help prioritize.

The most important two layers, next to hotspot map, are Vegetation Dryness Map and Fire Weather Index map. Therefore, firstly, Vegetation Dryness Map and Fire Weather Index map should be overlaid.

In FWI red area is more risky than orange area. In Vegetation Dryness map brown area is the most risky area. Therefore, overlaid area of red FWI map and of brown VDM is prioritized area.

If you want to narrow down the prioritized area, you can add overlaying one more layer, i.e. vegetation map. If you want to narrow down the prioritized area more, you can add overlaying one more layer, i.e. a layer of “Search Forest Fire History”.

Case 1 [Hot spot appears more than one day]:

Another case in Case 1 could be imagined. This could be called Case 1 prime.

Case 1 prime is the case when hot spot keep appearing for more than one day (and occurring of fire is confirmed). This means that a large scale of fire is happening for more than one day. In this case CMC would coordinate the deployment of suppression resources. CMC would discuss whether or not assess to fire is safe. If it is safe, CMC would discuss which access road should be used. Topographic map could be used to decide which access road should be used.

Finding wind speed is another important factor to decide whether or not access to fire is safe. We can read wind speed by checking the layer of “AWS locations”. (Click i-button and click the dot of AWS.) We can also read wind direction by clicking a layer of “AWS Data Overview”.

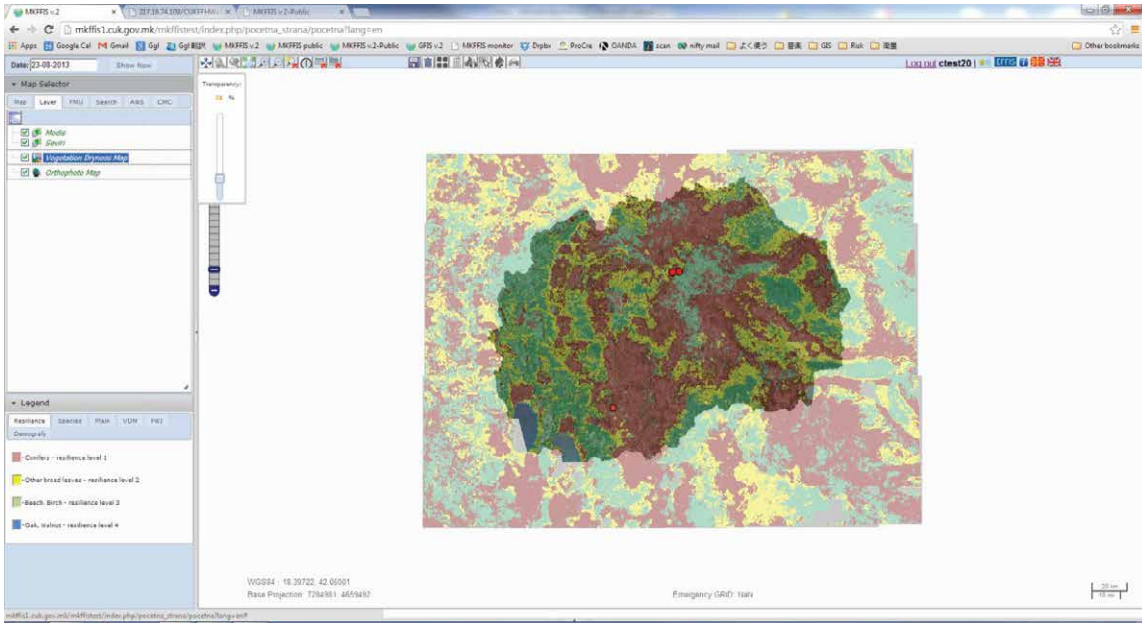

Figure 26: Vegetation dryness (VD) map

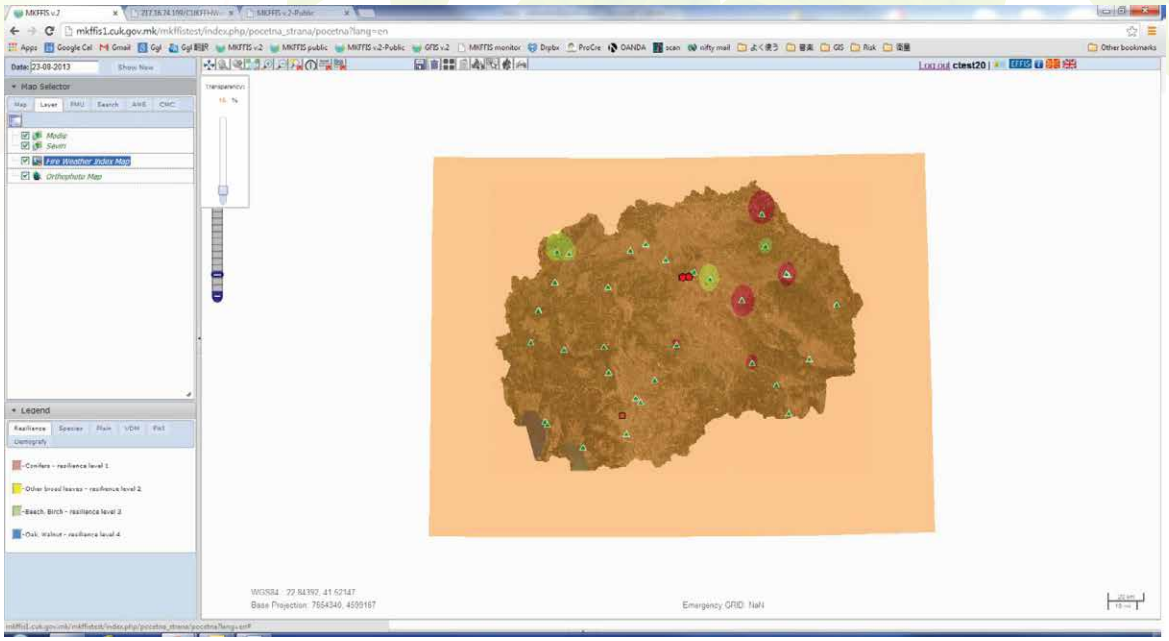

Figure 27: Fire Wether Index (FWI) map

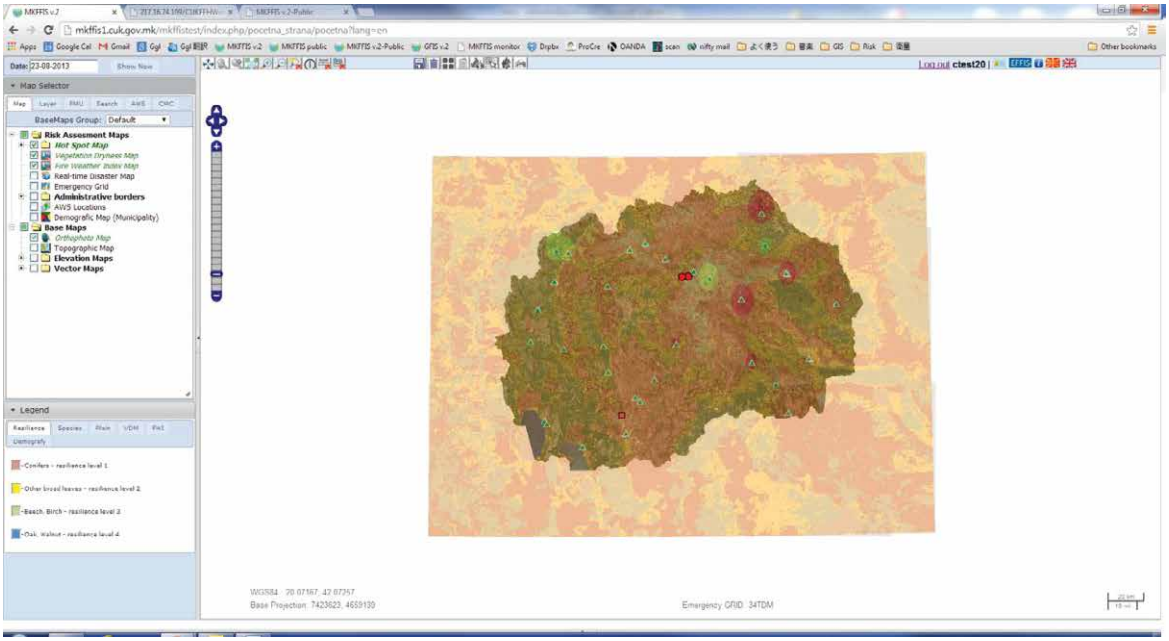

Figure 28: Overlaid [(VD) map + (FWI) map]

6.4. Preparations for practical use of MKFFIS

MKFFIS end – user training was delivered in January and February 2014 and was attended by over three hundred representatives of institutions which are concerned with forest fire prevention, protection and suppression. To a large extent this training was aimed at the staff of the Crisis Management Center, the Public Enterprise "Macedonian Forests", the Protection and Rescue Directorate and the Forest Police. In addition to them, the training sessions were also attended by staff coming from the National Hydro-Meteorological Service, the Ministry of Agriculture, Forestry and Water Economy, the Protected Area "Jasen", the Army of the Republic of Macedonia, the Ministry of Interior, the Territorial Fire Brigade Unit of the City of Skopje, the offices of UNDP and JICA Skopje etc.

	Plan												Actual										
	Sum of CMC HQ	Sum of PEMF HQ	Sum of RCMC	Sum of RPEMF Protection	Sum of RPEMF Implementation	Sum of Regional DPR	Sum of National Park	Sum of Forest Police	Sum of PE Pasture	Sum of F. Brigade	Sum of Others	TOTAL PARTICIPANTS-PLAN	Sum of CMC HQ2	Sum of PEMF HQ2	Sum of RCMC2	Sum of RPEMF Protection2	Sum of RPEMF Implementation2	Sum of Regional DPR2	Sum of National Park2	Sum of Forest Police2	Sum of PE Pasture2	Sum of F. Brigade2	Sum of Others2	TOTAL PARTICIPANTS-ACTUAL
20.јан	1	22	0	0	0	0						23	1	18	0	0	0	0						19
23.јан	1		0	0	0	0					4	5	1		0	0	0	0					6	7
28.јан	10		8	0	0	0						18	11		9	0	0	0						20
03.фев			20	0	0	0						20	2		17	0	0	0						19
04.фев			20	0	0	0						20	2		20	0	0	0						22
05.фев			20	0	0	0						20			19	0	0	0						19
06.фев			10	0	0	0					11	21			10		0	0					12	22
07.фев			0	20	0	0	2					22			0	19	0	0	0					19
10.фев			0	20	0	0	2					22			0	19	0	0	0					19
11.фев			0	20	0	0	2					22			0	20	0	0	0					20
12.фев			0	0	0	22					1	23			0	0	0	22						22
13.фев			0	0	0	13	0	8				21			0	0	0	13	0	7				20
14.фев			0	0	0	0	0	24				24			0	0	0	0	0	23				23
17.фев			0	0	0	0	0		3	12	7	22			0	0	0	0	2		3	7	9	21
24.фев		2	0	0	18	0	0					20		2	0	0	17	0	0					19
25.фев		2	0	0	18	0	0					20		1	0	0	17	0	0					18
Grand Total	**12**	**26**	**78**	**60**	**36**	**35**	**6**	**32**	**3**	**12**	**23**	**323**	**17**	**21**	**75**	**58**	**34**	**35**	**2**	**30**	**3**	**7**	**27**	**309**

Table 7: Participation at MKFFIS User Training

In addition to the MKFFIS basic and advanced operation End User training, a more detailed Training of Trainers was also delivered. Two officers from each Major Regional Crisis Management Centre were invited and attended the training, along with officers representing CMC's Analysis and Strategic Planning Department and Operations Department. Total of 23 officers were trained during this two-day training. These new trainers will be expected, together with other trained staff, to continue training interetsed parties regionally and locally.

Training was delivered in a purpose-fit training environment with access to the application and containing both theoretical and practical elements. A number of trained trainers from the CMC delivered parts of the training, alongside the trainers from the system developers.

As a token of appreciation, the Project Director, Zulfi Adili and the Chief Advisor, Eisho Sato, issued certificates to everyone who attended the training. From a practical perspective, all trainees will be assigned user names and passwords so that they can access and use the functions of their interest.

Annex - System Diagram - MKFFIS/GFIS version 2 Conceptual Design