ERASMUS+ PROJECT

NatRisk

A HANDBOOK

for Civil Sector Training about Natural Disasters

January, 2018

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CONTENTS

1. INTRODUCTORY REMARKS

Natural disaster is an event of hydro meteorological, geologic or biological origin caused by actions of natural forces such as: earthquake, flood, torrent, storm, heavy rain, atmospheric discharge, hail, drought, escarpment or landslide, snowdrifts and avalanche, extreme air temperatures, accumulation of ice on watercourse, epidemic contagious diseases, livestock epidemic contagious diseases, occurrence of pests and other large-scale natural events which can endanger health and life of people or cause damage of large-scale.[1]

Occurence of significant number of various kinds of natural disasters, of different frequency and intensity is specific for the territory of Serbia. With an average of 100 disasters in ten years from the beginning of the 19th century, number of the natural disasters by the end of the 20th century reached the number of even 2.800 disasters in ten years.

Table 1. Number of natural disasters by periods.
Source: National strategy of protection and rescue in emergencies, Official Gazette of the Republic of Serbia, No. 86/2011

1900-1940	1960-1970	1980-1990	1990-2000
100	650	2.000	2.800

In most cases occurence, scope and duration of natural disasters cannot be predicted in advance, but there are some phenomena for which, based on experience, statistics and methods of modelling as well as the place where they usually occur, it is possibile to expect that they could occur. An assessment of vulnerability of the territory of the Republic of Serbia to floods and landslides has been done and, based on the available statistics, the map of natural disasters risk (forest fires, floods, landslides and earthquakes) has been made.

[1] The Law on Emergencies ("RS Official Gazette", No 111/2009, 92/2011 and 93/2012)

The estimated area of the Republic of Serbia vulnerable to natural hazards covers total area of 57.33 **%**.

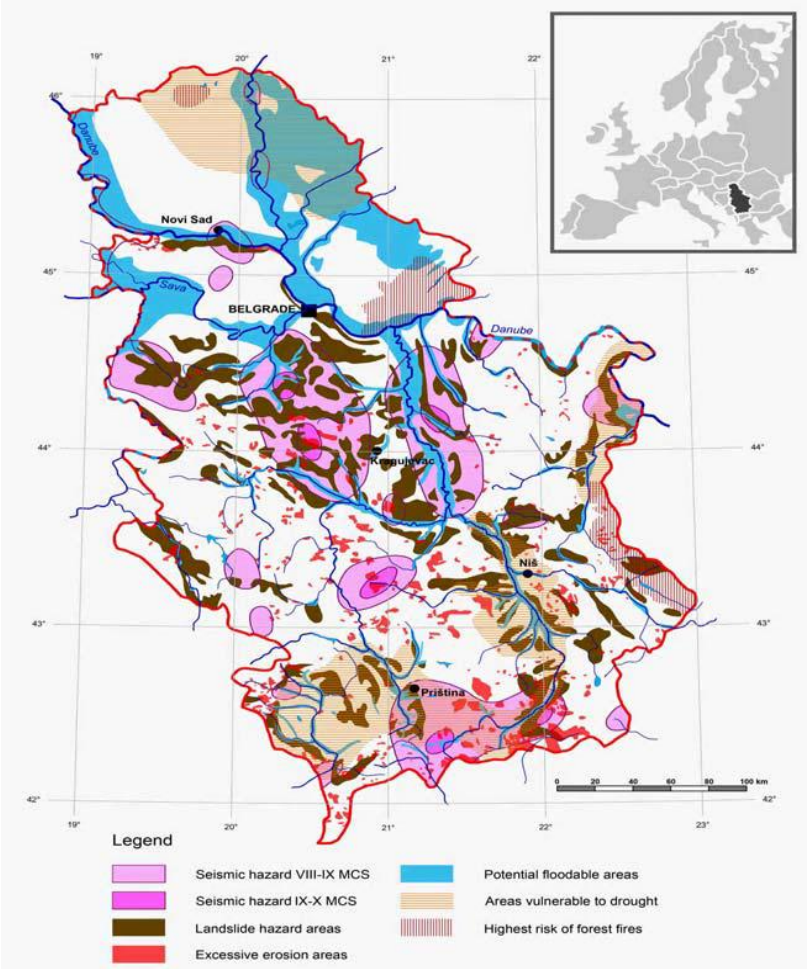


Figure 1. Integral vulnerability map of the natural hazards on the territory of Serbia
Source: Natural Hazard Assessment for Land-use planning in Serbia [2]

[2] Dragicevic, S., Filipovic, D., Kostadinov, S., Ristic, R., Novkovic, I., Zivkovic, N., Andjelkovic, G., Abolmasov, B., Secerov, V., Djurdjic, S., 2011. Natural Hazard Assessment for Land-use Planning in Serbia, International Journal of Environmental Research, 5 (2), pp. 371-380.

Positive trend of number of catastrophic and unfavourable natural events especially reflects with the events depending on the meteorological conditions.

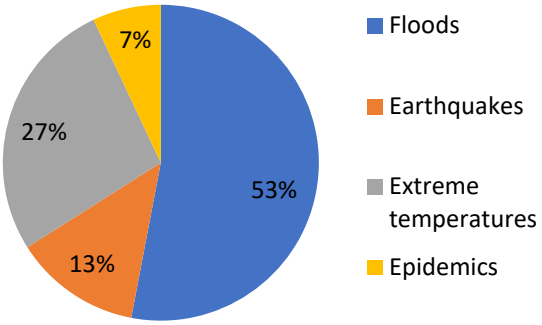


Figure 2. Frequency of various natural disasters in Serbia from 2000-2011. Source: EM-DAT.

Territory of Serbia is subject to natural disasters and the risk varies depending on the type of the disaster and possible damage. Natural disasters endanger health and lives of the population, inflict enormous material damage and thus significantly influence upon everyday life of population of the Republic of Serbia whose material position is unenviable even without the damage caused by natural disasters.

In the following chapters readers will be introduced to the characteristic natural disasters affecting the Republic of Serbia, the normative and legal framework for the engagement of the protection and rescue system subjects in those cases, as well as certain measures and procedures that are undertaken in order to reduce the effects and eliminate consequences in the case of the emergence of characteristic natural disasters affecting the Republic of Serbia.

2. EARTHQUAKES AS NATURAL DISASTERS

2.1. Briefly on earthquakes – general terms and definitions

An *earthquake* is a natural phenomenon during which strong vibrations occur in the ground due to sudden disturbance in the Earth interior causing enormous energy release within a short period of time in the form of *seismic waves*.

The place of failure occurrence in the Earth interior is called a *hypocentre* (*origin*, *focus*), and its vertical projection on the Earth surface (where earthquake is felt first) is named an *epicentre*.

The *magnitude* of an earthquake is a measure of the seismic energy released at the hypocentre. It is expressed by the Richter scale, which has 9 units, and is intended to be a rating of an earthquake event, independent of the location of observation. The magnitude permits comparison of sizes of various earthquakes.

The *intensity* of an earthquake indicates the destructive severity of an earthquake in terms of its effects on the Earth surface that can be determined by the level of damage to engineering structures and the reaction of people and animals. Hence, an earthquake would be associated with various intensity values in different localities, depending not only on the size of the released energy and epicentral distance, but also on the geological soil conditions, the structural typology, and the construction quality. Among several earthquake intensity scales in the world the most common one is the 12-grade Mercalli–Cancani–Sieberg (MCS) scale (grade I – XII). The intensity is mostly used in the seismic zonation.

An earthquake cannot be predicted, but we can learn how to protect ourselves.

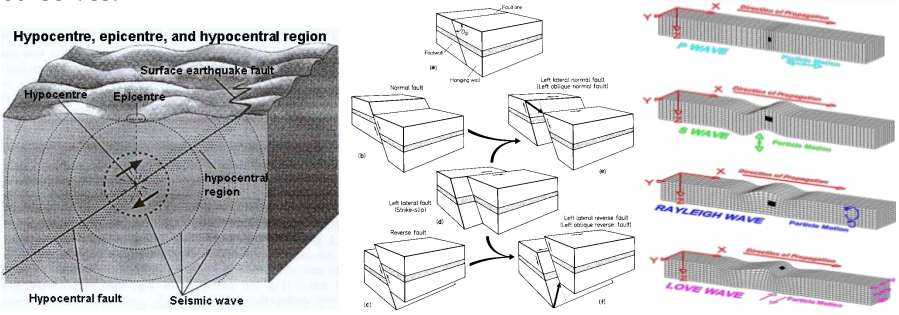
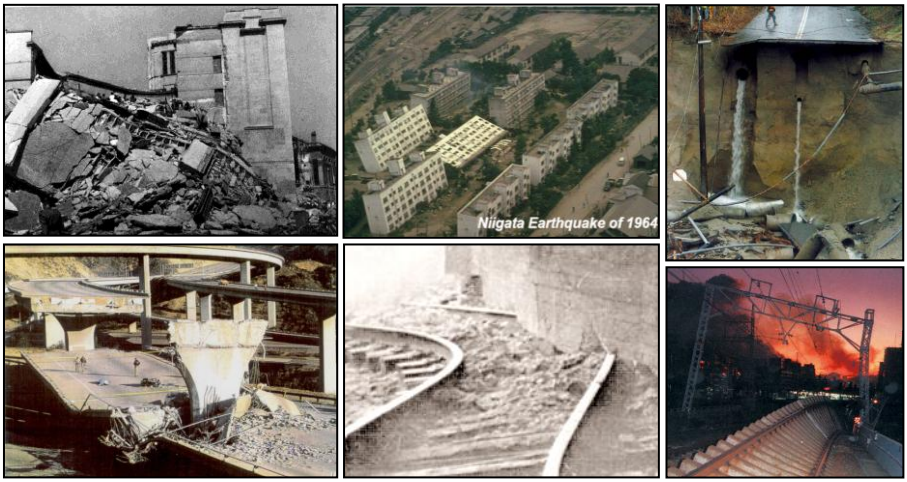


Figure 1. The focus and epicentre of an earthquake (left) [1]; faults (middle); seismic waves (right) (source: web.ics.purdue.edu).

Primary and secondary effects of earthquakes

Besides ground shaking (vibration) of different severities and ground displacements along faults, earthquakes can trigger secondary effects [2]:

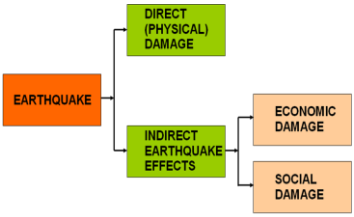
- Differential ground settlements, land and mud slides, soil liquefaction, ground lurching, and avalanches;
- Floods from dam and levee failure;
- Tsunamis and seiches (not characteristic for the Republic of Serbia);
- "*Natech*" events (technological accidents resulting from natural events) [3] such as fires resulting from earthquakes, the release of hazardous materials, chemical and radioactive contamination, as well as the destruction of vital transport and technical infrastructure, residential buildings, industrial buildings, and facilities.



Direct and indirect earthquake effects

Occurrence of a major seismic event in a built-up urban area can have a particularly severe impact, resulting in the complete disruption of economic and social functions in the community.

- *Human impact*, considering fatalities, injured, and sick population, and even people that needs to be evacuated or those that lose access to basic services.
- *Environmental impact*, based on harm to natural resources and natural spaces.



- *Economic impact* [1], which considers financial and material losses. Sometimes the cultural heritage is included in this category.
- *Societal impact*, including the disruption of daily life/use of critical facilities (transportation, energy, water, food, health, etc.), adverse effects on the reputation of the damaged areas, social unrest, and psychological effects.
- *Political impact*, as the capacity to govern and control the country.

2.2. Seismic activity on the territory of Serbia

Seismic activity is present on the territory of Serbia, where 50% of the territory is potentially threatened by the earthquakes magnitude of which is 7 and 20% by the earthquakes magnitude of which is 8 [4]. Historically, the territory of Serbia has experienced the earthquakes of magnitudes up to 6.3 on the Richter scale.

A strong earthquake, which can cause damage to engineering structures, occurs on the territory of Serbia every ten years on average. Majority of the earthquakes take place in Central Serbia, South Serbia, and Autonomous Province of Kosovo and Metohia. Fewer earthquakes have been located in Eastern and South Eastern Serbia, whereas the smallest number has been located on the territory of the Autonomous Province of Vojvodina [5].

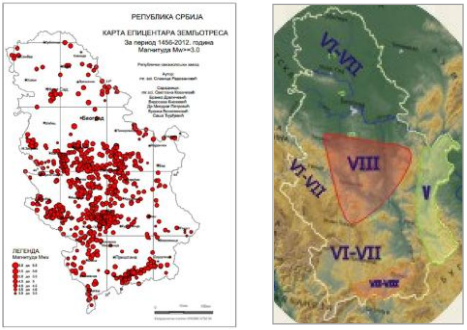


Figure 2. Map of epicenters of the earthquakes in Serbia (left); Map of earthquake intensities experienced on the territory of Serbia (right) [6].

Table 1. Areas vulnerable to seismic hazard on the territory of Serbia [7]

Natural hazard	Area [km2]	Percentage of total Serbian area [%]
Seismic hazard VI II–IX MCS	16388.59	18.55
Seismic hazard IX–X MCS	1109.71	1.26

[1] The direct economic losses caused by the Montenegro earthquake of April 15, 1979 (Yugoslavia), alone were estimated about 10 percent of the gross national product (GNP) of Yugoslavia for 1979, which was four times the GNP of Montenegro itself [2].

2.3. Seismic hazard, seismic risk, and emergency management

Seismic hazard is defined as expected occurrence of a future adverse seismic event.

Seismic risk is defined as expected consequences of a future seismic event to the natural and manmade environment.

Seismic risk management is the process of systematic application of management policies, procedures, and practices to the tasks of identifying, analysing, assessing, treating, and monitoring seismic risk [8]. It involves:

- a formal, quantitative evaluation of potential injury or loss over a specified period of time;
- the prospect of future mal-performance of a safety or security systems.

For building a culture of seismic risk management, greatest energy should be devoted in building the three pillars of sustainability:

- leadership development (people asset),
- capacity development (physical asset),
- awareness development (public awareness, training, and education programs).

Seismic risk assessment is a process used to determine risk management priorities by evaluating and comparing level of seismic risk against predetermined standards, i.e. *acceptable (target) risk level*, which represents the level of protection that a society can accept according to its economic possibilities.

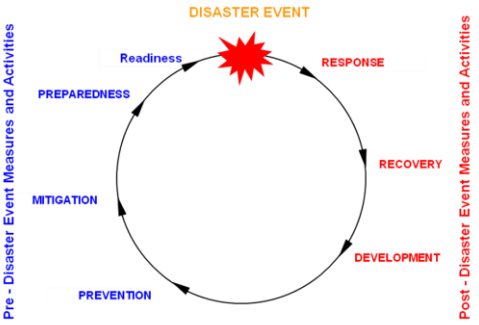
Components of Risk Assessment

Emergency is, thus, realisation of a hazardous event requiring the organisation and response of the society other than in normal condition.

Emergency management comprises measures such as:

- organised analysis,
- planning,
- decision making, and
- assignment of available resources,

that are indispensable to:



The Emergency Management Cycle

- prevent [2,3],
- mitigate (lessen the effects of),
- prepare for,
- respond to, and
- recover from the seismic hazard effects (possibly taking 5-10 years or even more).

Problem areas for emergency management in case of earthquake event:

- Earthquake onset is sudden, usually no warning; following a major earthquake, secondary shocks may give warning of a further earthquake;
- Major effects arise mainly from violent ground movement (vibration), fracture, or slippage; especially they include widespread loss of or damage (usually very severe) to structures, lifeline systems, essential services, and life support systems, plus considerable casualty due to lack of warning;
- Severe and extensive damage, creating the need for urgent counter-measures, especially search and rescue, and medical assistance;
- Difficulty of access and movement;
- Response problems may be severe, extensive, and difficult (e.g., rescue from a high occupancy building collapses, or in a circumstances where additionally a chemical or radiation hazard exists, etc.);
- Victim identification may often be very difficult;
- Recovery requirements may be very extensive and costly;
- Rarity of occurrence in some areas may cause problems for economies of counter-measures and public awareness.

2.4. Normative-legal framework for the engagement of subjects of the protection and rescue system in case of earthquake event in the Republic of Serbia

Strategic dimension of the protection and rescue system in the Republic of Serbia is established in an integral way by adoption of the *National Strategy for Protection and Rescue in Emergencies* in 2011 [10] and it has been normatively regulated by the *Law on Emergencies* (2009, 2011, and

[2] "Building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did not happen". (Kofi Annan, Secretary General, United Nations, 1999).

[3] European Union experience – for every €1 invested in disaster prevention, €4 to €7 are saved in disaster response [9].

2012) [11]. In addition, the bylaws relating emergencies, provisions of which are related to the entire system, such as the *Instruction on Methodology of Risk Assessment and Protection and Rescue Plans in Emergencies* adopted in 2012 [12], have closely defined the necessary elements important for the system functioning. The *National Programme for Natural Disaster Risk Management* [13] was adopted in 2014 and is directed towards building of the appropriate long-term risk management system in case of natural disasters in the country. The *Action Plan for Implementation of the National Programme for Natural Disaster Risk Management (2016-2020)* [14] defines the detailed implementation of strategic activities, the holders of the realisation, performance indicators, the timeframe for implementation, and the necessary financial resources.

Republic Seismological Institute

The Republic Seismological Institute is dealing with detailed monitoring of seismic activity on the territory of the Republic of Serbia and in the border areas, in order to inform the public about the main parameters of earthquakes and the assessment of their consequences, with an aim to take the necessary measures on time for the affected population [10].

In order to create the conditions for greater security of the citizens of the Republic of Serbia and their property in case of an earthquake event, the Republic Seismological Institute organises lectures in the centres for information with the topic of understanding the basic information on earthquakes.

Sector for Emergency Management

The Sector for Emergency Management is a specialised organisational unit within the Ministry of Interior Affairs (MIA), which coordinates activities of all the state and civilian institutions involved in crisis and emergency management on all levels of political territorial organisation [10, 11].

Representatives of the *state agencies organisational units, local government bodies, public companies, health institutions, centres for social work, Red Cross, Mountain Rescue Service, divers, associations of citizens,* etc., are also members of the staffs.

Formation of *headquarters for emergencies* on republic, regional, and local level was adopted as standing bodies engaged in the event of disaster or emergency (the units of local government, town, or municipality have primarily operational role, a region is mediator between local and national

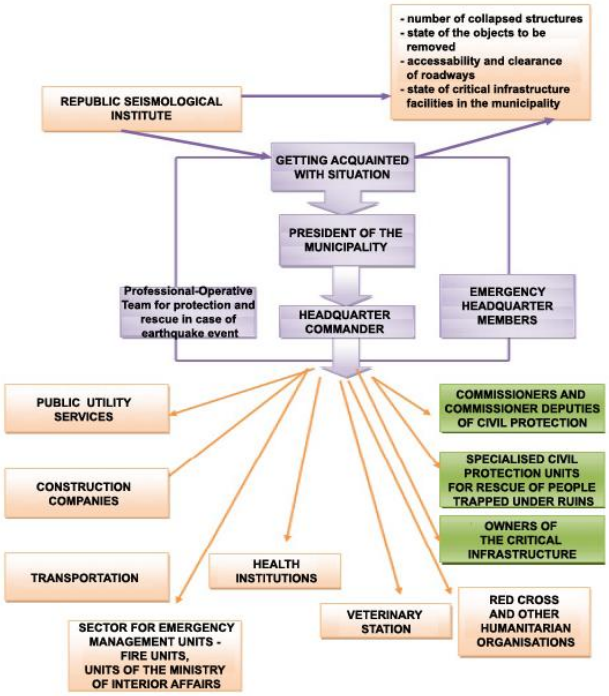
level of authority). The *National Training Centre for Emergency Management* is in charge of the staff's and staff commanders' education.

One of the priorities is the involvement of the Republic of Serbia in the *EU Civil Protection Mechanism* [15].

Protection and Rescue Plan in case of earthquake event

The protection and rescue plan in case of earthquake event includes [12]:

- A schematic presentation of entities engaged in protection and rescue (as presented in figure [16]);
- An overview of the obligations (measures and tasks) of the participants in protection and rescue;
- An overview of the protection and rescue forces and the available capacities;
- evacuation, care, first aid and medical assistance, asanation, and other tasks of civil protection;
- Tabular overview of endangered areas, towns, or structures with an overview of the number of endangered objects and the number of inhabitants that are estimated to be endangered;
- Map with marked endangered urban areas;
- Elaborated operational procedures for the action of protection and rescue forces;
- An overview of professional–operative teams (intended for assessing the safety of facilities after earthquakes and landslide activation; removing parts of damaged facilities; landslide remediation; care of the vulnerable



population; storing and distribution of construction materials; storing and distribution of food, water, hygienic, and sanitary materials; organisation and engagement of volunteers for repairation assistance, etc.);
- Organisation of hygienic–epidemiological protection (holders of realisation and activities);
- Organisation of providing food, water, and medicine;
- Organisation of reception points of human assistance and material and technical means;
- An overview of the locations for the disposal of waste building materials and other material collected during the site clean-up.

2.5. Pre-earthquake studies, measures, and activities for reduction of earthquake consequences

Earthquake disaster prevention arrangements are of long-term character with permanent governmental and professional activity for the needs of establishment of consistent scientific bases and their practical application in reduction and mitigation of seismic risk. In seismically active regions, components for earthquake risk reduction should be realised through combined efforts of each individual country of the region in close cooperation with other countries. Pre-earthquake measures for planning of earthquake risk reduction at regional and national level are as follows [2]:
- Studies on seismicity of the region considering instrumental and historical data of occurred earthquakes;
- Elaboration of a seismotectonic map of the region;
- Performance of seismic hazard studies and elaboration of seismic hazard maps of each country;
- Performance of detailed studies on vulnerability and acceptable seismic risk level in each country;
- Physical planning of seismic regions based on damage evaluation and vulnerability studies;
- Elaboration of national laws and regulations for protection against earthquakes;
- Elaboration of national codes, instructions, and manuals for aseismic design and construction of new structures and prevention of existing structures and utilities, and their continuous improvement;
- Elaboration of seismic microzoning maps for significant urban areas and zones with high seismic hazard as basic data for design and planning;

- Studies for planning, design, and construction of structures of vital importance;
- Development and improvement of national design and construction control organisations with a specialised section in earthquake engineering and engineering seismology;
- Development of research and training centers in the field of seismology, earthquake engineering, seismic risk mitigation, physical, urban, and disaster preparedness planning within existing civil engineering institutions, design and construction control organisations, departments of civil engineering and architecture at the universities, in close cooperation with seismological, geophysical, geological, and other organisations and institutions, and long-term cooperation among centres of the participating countries of the region;
- Continuous education and improvement of knowledge of scientists, engineers, and planners for the need of application of established scientific basis in the process of physical and urban planning, design, and construction in the region;
- Permanent recording of the earthquakes;
- Combining of seismological instrumentation with other types of instruments for the purpose of short-term earthquake prediction;
- Development, installation, operation, maintenance, and data collection of regional strong motion instrumentation networks and continuous strong motion instrumentation of typical and important buildings, structures, and utilities, as well as establishment of standardised earthquake damage and ground motion data banks;
- Development and improvement of the network of seismological stations with telemetred and computerised systems for rapid collection and analysis of earthquake data.

Land-use planning

Earthquake damage can be reduced by proper land-use policy, which should be gradually realised through the processes of general, physical, and urban planning. To decrease earthquake damage, the urbanisation pattern (land occupancy, adopted structural typology, distribution of material property and its density concentrations, etc.) should comply with the level and the spatial distribution of the expected seismic hazard.

One is left with fairly limited possibilities of modifying what exists in old urban cores, while calling the attention of decision makers (local government and city authorities, in cooperation with specialised and

authorised land-use and disaster preparedness planning agencies) to the potential consequences of prevailing seismic hazard when urbanisation of new region, town, or even new settlement is planned.

Integrated assessment of seismic risk

While the frequency and magnitude of earthquakes at a specific location cannot be predicted with accuracy, risk management in earthquake-prone areas can be informed using vulnerability and loss models for buildings, lifelines, and critical infrastructure.

Vulnerability depends on many factors: structural age, type of construction, use, geometry, height, conservation degree, etc.

The degree of *losses* inherent to existing or planned regional/urban land-use is quantitative measure of existing or potential seismic risk and might be expressed through:

- *physical losses* (percent of damaged or lost buildings/building gross area), or
- *functional loss* (loss of function).

By applying an appropriate damage cost factor to physical vulnerability functions, an *economic loss* (loss-of-value function) can be estimated.

The loss is the result of damage and can be divided into two categories:

- *determined losses* defined by investements;
- *undetermined losses* mainly characterised by homelessness, injuries, and loss of human life that makes corresponding quantification imposible.

Proper estimation of the size of· possible disaster as well as the required level of pre-disaster capital investments necessary for mitigation of the earthquake consequences should be based upon the loss model capable of incorporating a *long-term effects of earthquake losses*, which in the long-run can lead to unrecoverable national economic damage.

Requirements for the earthquake-resistant design criteria

For the purpose of defining seismic design parameters based on seismic risk, it is necessary to know and analyse several factors, the most important of which are [17]:

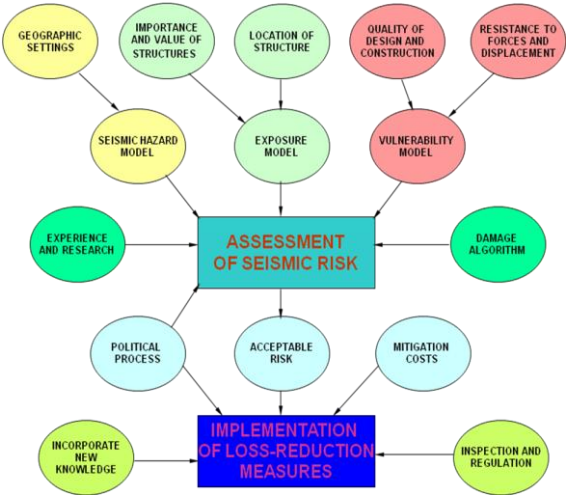
- the seismicity model of the area;
- the probability of earthquake occurrence and its return period;
- the seismic exposure;
- the economic life-time of the structure;
- the importance and purpose of the structure;
- the level of protection, i.e. acceptable seismic risk.

An appropriate earthquake-resistant (*aseismic*) design is the one that provides adequate safety against injury and loss of life, minimum damage to property and ensures continuity of vital services, achieving this at an acceptable cost. To provide complete protection against earthquakes is not economically acceptable or technically feasible. On the other hand, the risk of total failure of structures, especially those of high categories, has to be thoroughly eliminated. It is generally accepted that earthquake-resistant design criteria should satisfy the following conditions:

- To resist minor earthquakes, without damage;
- To resist moderate earthquakes (the so called *design earthquake*, which may occur once or several times during the serviceability life of the structure) without structural damage (damages to structural components, which provide resistance of the structure against horizontal and vertical loads), but with some non-structural damage (damages to the remaining structural components, mainly architectural);
- To resist major earthquakes of intensity and severity of the strongest experienced in the area (the so called *maximum earthquake*, which is of low probability of occurrence throughout the serviceability life of the structure, but still may occur) without collapse and with limited structural and vital non-structural damage. In most structures, it is expected that structural damage, even in a case of major earthquake, could be limited to repairable level.

Combining the seismic hazard parameters with the structural parameters as defined according to the seismic design codes (Eurocode 8 [18]) and the design philosophy, decision on the level of acceptable seismic risk and the optimum structural concept is made:

- construction of structures to resist the forces generated by seismic hazards; and,
- strengthening of existing structures to render them more resistant against the seismic hazard forces.



Studies for planing, design, and construction of critical infrastructure

Critical infrastructures include, inter alia, transport (roads, railways, bridges, tunnels, airports, port and harbour facilities), water (supply, flood protection, sewerage), energy (electricity, gas, oil, nuclear), telecommunication and digital communication, finance, food, health, research, and emergency and security services. The resilience of critical infrastructures (their ability to bounce back from shocks) is essential for the efficient response during emergencies, including the provision of energy, water, food, communications, health and emergency response services, and transport, as well as for the provision of many societal functions post-disaster and the restart of social and economic recovery.

It is very important that correct earthquake engineering decisions be made for these complex and costly installations, from the standpoint of safety as well as of cost. Particular attention should be given to the evaluation of the seismic risk of existing major dams, chemical factories, and other industrial facilities, power plants, pipelines, and other systems, the secondary effects of which, like floods or environment pollution, could be even more disastrous than the direct destructions of the earthquake itself.

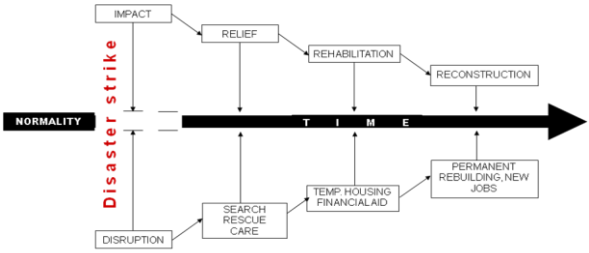
In the design and construction process particular attention should be given to the following aspects [2]:

- Regional studies for evaluation of seismic hazard of the site for establishment of two levels of acceptable seismic risk, taking into account known and potential seismic zones;
- Local detailed site studies for determination of amplification factors and factors of modification of expected ground motions;
- Determination of two levels of design criteria for serviceability and ultimate state based on operational and safety requirements;
- Specific studies on possible surface faulting, slope seismic stabilities, subsoil instabilities, induced seismicity, and other;
- Methods and techniques of structural planning, analysis, and design to be applied in the preliminary and final design;
- Specific requirements on structural planning, structural detailing, quality control, and seismic instrumentation.

A systems approach of risk assessment methodologies, in which critical infrastructures are treated as an interconnected network, is being encouraged [3]. Facility owners and operators should prepare security plans and exercises for the protection and resilience of the services, as well as represent a key sector to be involved in a national risk assessment process.

2.6. Post-earthquake measures and activities

A uniform post-earthquake assessment tools should be used to achieve both scientific and practical goals through coordinated efforts of the civil protection centres and the teams of engineers–specialists.



Stages in the Progressive Restoration of Normality in an Area Following a Disaster Strike through Relief, Rehabilitation, and Reconstruction Activities

Immediate post-earthquake emergency measures and actions

These are emergency measures for an immediate protection of population and other material goods placed in seismic jeopardy, as well as urgent rehabilitation of serviceability of vital lifeline systems [2].

- Establishment of centres, which will carry out emergency protection measures in each city, village, and institution.
- Extinguishing of fires, in the first stages by volunteers, and protection against fire by professional staff.
- *Rescue*: emergency rescuing of people who may be trapped in building and under debris (equipment for detecting building-collapse trapped live survivors).
- *Treatment and care of victims*: to dispose of the dead, to render first aid, to ensure identification tagging of casualties, organisation of field triage centres in the parks and/or lawn areas outside the facilities, organisation of an improvised surgery sites with operational tables for treatment of heavy injuries, to identify needs in terms of medical treatment, hospitalisation, and medical evacuation; evacuation of injured persons not requiring immediate medical attention and

those not in critical condition to the medical centres in the neighbouring towns; establishing air lift for transporting heavy injuried persons.

- *Evacuation*: evacuation from densely populated and dangerous places; to determine whether persons need to be evacuated from the stricken area immediately, or whether such a requirement is likely to arise later.
- *Shelter*: organisation of temporary housing, medical centers, and other public utilities based on the immediate needs; to provide shelter for victims whose housing has been destroyed or rendered unusable. This may involve:
  - urgent repair to some housing;
  - issuing tents, tarpaulins, and/or containers to provide means of temporary shelter;
  - accommodating groups of homeless people in community buildings such as schools, sports halls, etc.

- *Food*: establishment of centres for food supply and organisation of other emergency activities; bringing field kitchens; to organise and distribute food to disaster victims and also emergency workers; to estimate damage to food stocks; to estimate food reserves available (including unharvested).
- *Communications*: to re-establish essential radio, telephone, telex, facsimile, and informatics (Internet) links.

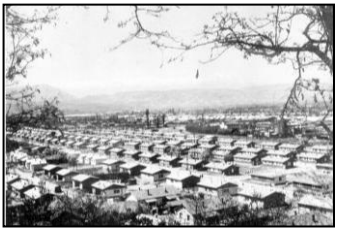
- *Clearance and access*: to clear key roads, airfields, and ports in order to allow access for vehicles, aircraft, and shipping; also to prepare helicopter landing sites.

- *Water and power supply*: to re-establish water and power supplies, or to make temporary arrangements for them (tank-trucks). The provision of potable water is often difficult, particularly in the early post-impact stages. Water purifying equipment might therefore have to be obtained and/or water purifying tablets used.
- *Temporary subsistence supplies*: to provide supply, such as clothing, blankets, disaster kits, cooking utensils, and plastic sheeting, so as to enable victims to subsist temporarily in their own area, thus helping to reduce the need for evacuation.
- *Health and sanitation*: to take measures to safeguard the health of people in the stricken area and to maintain reasonable sanitary facilities.
- *Restoration of public services*: clinics under makeshift roofing, pharmacy, post offices, and shops in mobile vans.
- *Public information*: to keep the stricken community informed on what they should do, especially in terms of self-help and on what action is in hand to assist them; to prevent speculation and rumor concerning the current and future situations.
- *Security*: to maintain law and order, especially to prevent looting and unnecessary damage; to restrict entrance to severely damaged buildings unsafe for any kind of use.

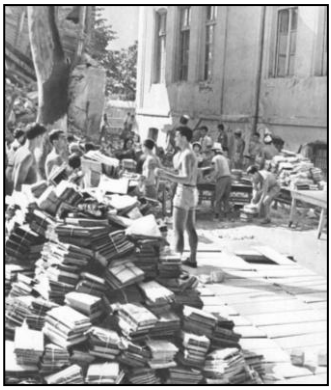
Short-term post-earthquake studies and activities

Short-term measures have to be undertaken for obtaining more practical and also transferable data that can be of potential use for the development of revitalisation, restoration, and long-term rehabilitation programs [2].

- Planning and provision of temporary housing (prefabricated settlements), organisation of medical centres, supplies, schools (hangars), and other public activities.
- Salvage and re-housing of archives and of national treasures.
- Disinfection of the damaged areas by air spraying.
- The comprehensive damage and usability inspection and classification of buildings, structures, local and regional infrastructure according to the damage and usability level using *uniform*



methodology for damage classification.



- Studies of earthquake effects and damage distribution.
- Seismic activity studies with existing and temporary installed seismic stations and immediate installation of strong-motion accelerographs and seismoscopes for recording of stronger aftershocks.
- Acquisition of seismic records and their processing for the purpose of elaboration of seismic design criteria for repair and strengthening of damaged buildings and structures.
- Elaboration of requirements and instructions for repair and strengthening of damaged buildings and structures.
- Reconsideration of physical and urban plans with mapping of spatial distribution of earthquake effects.
- Estimation of value of earthquake-induced damage, planning of financial and legal actions for reduction of earthquake consequences.
- Urban planning for construction of new settlements for housing, medical centers, schools, and other public utilities based on the immediate needs, existing stock of usable buildings, and future urban development.
- *Construction requirements*: remove ruins and unstable building elements that pose direct hazard to occupants or pedestrians, and demolition (by explosives) of heavily damaged buildings, whose unexpected collapse may endanger humans or the other buildings in the vicinity; repair and strengthening of damaged buildings with parallel elaboration of site investigations and design for repair and strengthening.

- *Disaster welfare enquiry*: to make arrangements to handle national and international enquiry concerning the welfare of citizens and residents, including tracing of missing persons and family reunion.

- *Maintenance of public morale*: measures to assist the physical and psychological rehabilitation of persons who have suffered from the effects of disaster.

Emergency earthquake damage inspection and classification

Objectives of the emergency damage inspection

1) Primary: To save human life and prevent injuries by identifying buildings, which have been weakened by the earthquake and are therefore threatened by subsequent aftershocks.
2) Secondary:

- To save properties by identifying emergency strengthening needs and measures (shoring, bracing, partial or total demolitions, etc.);
- To record damage and assess usability and thus allow use of as many buildings as possible, as soon as possible, and at an acceptable level of risk;
- To provide information about the required number of temporary housing units, to indicate transportation routes that may be dangerous because they are lined with hazardous buildings, to indicate temporary shelter sites;
- To collect the data necessary for obtaining reliable estimates of the disaster to allow authorities to take relief measures, formulate disaster mitigation policies, and allocate available resources;
- To provide data that will identify frequent causes of damage, so that potential rehabilitation plans may take into account such assessments;
- To provide information for practical research studies that may lead to:
  - reconsideration of urban plans by mapping the spatial distribution of earthquake effects;
  - re-evaluation of existing codes and construction practices, to updates of seismic maps; and,
  - elaboration of seismic vulnerability models for pre-earthquake assessments.

Earthquake damage data collection

The determining factor for the classification is not the extent of damage in terms of repair costs, but rather how serious the physical damage is, i.e. to what extent has it affected the load carrying capacity of the principal structural system.

Good assessment and classification of damage and usability must be based on sound engineering judgment.

The procedure of data collection depends very much on the level of preparations and training of inspection teams performed before the damaging earthquake occurrence. These in-advance preparations are very essential for training and rapid performance of damage classification in order to assure implementation of the uniform methodology. When this is not done in advance, it should be planned to have at least one-week training courses and trial classification of the inspection teams with significant number of instructors and supervisors. In that case the most difficult part will be the preparation of necessary inspection files (maps and inspection forms) as well as organisation of the mobilisation of the inspection teams under extremely difficult post-earthquake conditions.

The entire process of data collection should be performed within one to two months after damaging earthquake occurrence. Requirement for photographs to be taken on damage of structural and nonstructural elements is very important in completing evidence and data set on earthquake damage, since these data will disappear within a short period of time.

Composition of the damage and usability inspection team

The team should be composed minimum of two engineers and one technician – driver.

Tasks of the damage and usability inspection team

- Engineers:
- to judge the damage degree and post-earthquake usability of the structures;
- to decide and recommend emergency measures, if required;
- to document the damage;
- completion of the inspection form, preparing daily, weekly, and final report with cumulative presentation of inspected buildings and structures, and submitting them to the sectional headquarters.
- Technician:
- to assist in obtaining information about the structure, drawing sketches.

Basic procedural steps of post-earthquake damage and usability inspection and classification, and effective damage data acquisition

- Mobilisation of the staff of the inspection teams and headquarters;
- Distribution of in-advance prepared files for earthquake damage inspection to each headquarter and inspection team;
- Completion of damage inspection forms structure by structure parallel in each sector and damage and usability classification of structures;

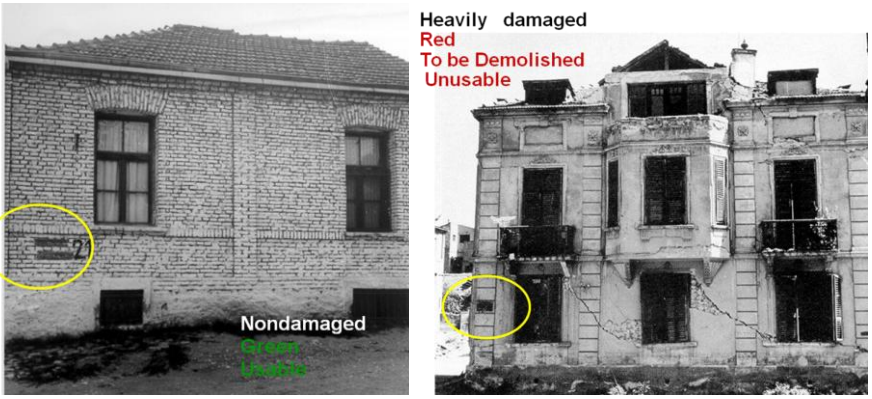


Figure 3. Non-damaged (usable) building (left); havily damaged (unusable) building (right) [2].

- Preparation of cumulative daily and weekly reports as well as final reports of each inspection team and headquarters of the sectors and the communes;
- Submission of the cumulative reports to the commune, district, and country responsible authorities for earthquake damage and usability classification;
- Archiving of one copy of the complete set of performed damage and usability classification within civil defence headquarters of the commune and submission of other two copies to the regional and country headquarters responsible for further actions for evaluation of economic losses and reduction of earthquake consequences.

Long-term post-earthquake measures and activities

Long-term measures basically do not differ from the already discussed pre-earthquake measures (described under Section 5), but basically all data and results obtained from short-term activities, particularly the data on damage distribution and classification as well as observed vulnerability of various structural types of buildings and other engineering facilities, should be consistently implemented for decreasing of the seismic risk in the case of repeated seismic activity that normally should be expected [2].

Measures of reconstruction, including the replacement of buildings and infrastructure, which have been destroyed by the disaster, are also of long-term nature.

2.7. Civil protection role of citizens in case of earthquake event

Family Guide for Emergency Preparedness and Response [19] by the Ministry of Interior Affairs of the Republic of Serbia, Sector for Emergency Management, has the purpose to increase public awareness of disaster risks and disaster reduction and to help citizens to understand their civil protection role and to perform it to the best of their ability.

What to do during earthquake?

- Stay calm and coolheaded and do not allow being overwhelmed with panic. Be aware that some earthquakes are actually foreshocks that may shortly be followed by a stronger quake.
- Do not panic!
- Do not try to run away.
- Drop on the floor, curl up, and protect your head.

Instructions on how to act if you are indoors during an earthquake

- Find shelter in a safe place at home, such as door frames, bearing walls, place under a table, solid furniture, and stay there for the duration of an earthquake, or cover your face and head with your hands and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or shelves.
- Stay in bed if you are there and protect your head.
- Stay inside until shaking stops and it is safe to go outside (research has shown that most injuries occur while people are attempting to leave a building). You can go out to an open area from the ground building or from the first floor, but make sure to be at a safe distance from any buildings.
- Avoid stairs and elevators for the duration of an earthquake.
- Do not use the elevator.
- Do not go out on the terrace or balcony.
- Do not hold shelves above the bed.
- If you are near or inside a tall building, stay away from glass and external walls.

- If you are in a public building (school, company, shopping centre, recreation centre, or store), remain calm and avoid panic. Stay away from the crowds of people who are moving towards the exit in a panic.
- Be aware that there may be a power outage, and that the alarms (fire alarm, etc.) may turn on.
- Always keep a flashlight prepared, and a transistor radio with spare batteries.
- Immediately turn off all sources of electricity, gas, and water. If you have used any source of heating, turn it off when the earthquake stops.
- If there is a fire, try to extinguish it and notify the local fire and rescue units.

- If necessary and if you are able, join the earthquake rescue teams and help them search and assist the people trapped under the rubble of collapsed buildings.

Instructions on how to act if you are outdoors during an earthquake

- Move away from street lights, utility wires, and buildings, the greatest danger is in the vicinity of buildings, at exits, and alongside exterior walls.
- If you are on the street, watch out for the objects that can fall on you, such as chimneys, roof tiles, broken window glass, and the like.
- Protect your head with your hands or a handbag.

How to act if you are in a moving vehicle during an earthquake

- Stop if traffic safety permits.
- Avoid stopping near buildings, trees, overpasses, and utility wires.
- Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

How to act if you are trraped under rubble during an earthquake

- Do not light a match.
- Do not move about.
- Cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall, so that rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause inhale

dangerous amounts of dust.
- Stay calm and try to orientate yourself.
- If you are pressed by rubble, start removing it slowly to save strength and beware of sharp objects and ensuing injury.

Instructions on how to act after the first shock

- Be ready for aftershocks. If the building is damaged and since there is a possibility of a stronger earthquake, leave the building calmly, without panic and in order: mothers with children, the elderly, the sick, the disabled, etc.
- If you are in a damaged building and smell gas or see broken wires, do not burn candles or matches because of the risk of fire and explosion.
- Check whether someone is injured.
- Do not move seriously injured persons.
- Follow the instructions of competent authorities.
- Use the phone only if necessary to avoid the overloading of phone lines.
- Do not use cars in order not to obstruct rescue teams in carrying out their duties.
- Avoid entering into the house, in particular if it is damaged and if you smell gas or see damaged wires.

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3. FLOODS

3.1. Introduction

The natural disasters affecting the flood society occupy a significant place in their influence and the size of the damage they inflict. Flooding is the occurrence of the spillage of large waters from the river bed, or the occurrence of an unusually large amount of water at a particular site due to the action of natural forces or other causes such as damaging dams, war destruction, and the like. A large inflow of water in the river, which is due to strong rains, clouds of clouds or snow melting, causes water from the riverbed and flooding of the terrain.

The position of floods between natural disasters

Among natural disasters, floods today represent extremely important events in the world. Quantitatively, these include 32% of harmful events, 31% of economic damage and 55% of human casualties in the period 1986-1995 [14]. Statistics show that the number of accidents is attributed to floods on the rise, while the number of killed people due to floods remains stable [6].

3.2. Causes of floods

Floods are among the most complex phenomena, so the causes of the formation of flood waves are multiple and intertwined. Generally speaking, the causes of the occurrence of floods can be divided into direct and indirect causes.

The direct causes include precipitation (rain and snow after dissolution). Until the occurrence of flood waves lead to long, abundant, rainy precipitation that enters the entire basin. Also, the snow cover can contain large water supplies. If there is a coincidence of sudden snow melting with abundant precipitation, there is a sudden increase in water levels in the whole catchment area, which can cause floods in both the higher and the lower levels of the basin.

In the case of very low winter temperatures on the rivers, ice crust can be created which can reach 60 cm in our areas. When spring comes to warming and ice floes, the river creates a risk of accumulation in sloping

parts of the watercourse, which may result in the formation of an ice cap. This plug prevents water from flowing, resulting in spillage and flooding of the river. Then we talk about the so-called ice flood. Floods can also occur by activating the landslides that especially occur after heavy and heavy rain. A massive soil mass can cling to the riverbed and drastically tear it or completely seal it, which creates the riverbed in the upstream part. Demolition can also be a direct cause of flooding.

Indirect causes of floods indirectly accelerate the occurrence of floods. First of all, the size and shape of the river basin, the density of the river network (directly affecting the flow of the river), the relief, the state of the water level of the underground waters and the forestation. The speed of swelling of water along the relief, ie the inclination of the terrain is affected by the vegetation and pedological cover.

An important influence on the occurrence of floods has an anthropogenic factor, which is reflected in the illegal construction of objects near the river, which increases the part of the impermeable surface and reduces the flow, devastation of forests and reduction of wetlands. By destroying the forests, the swelling of water from the basin increases while reducing the swamp by reducing the available water storage capacity in the basin. Incorrect management of accumulations, constitutions, retention, reservoir channels may lead to an unfavorable coincidence and superposition of large-wave waves on the downstream section of the watercourse [8].

Urbanization, which is increasingly expressed in contemporary society, increases the impermeable surfaces (roofs, courtyards, roads, squares, etc.), which reduces surface infiltration and increases the outflow of water. The following flood types [4] (figure 1-4) are distinguished from the main cause of flooding:

- floods caused by rain and snow melting,
- ice floods,
- floods due to the coincidence of high waters,
- flash flood,
- floods caused by land clutter,
- floods caused by demolition of dams.

Figure 1. Floods caused by rain in Obrenovac, May 2014

Figure 2. Ice flood - Ice bark creates a plug at the bridge and stopped the flow of the river

Figure 3. Flash flood in Grabovica near Kladovo, September 2014.

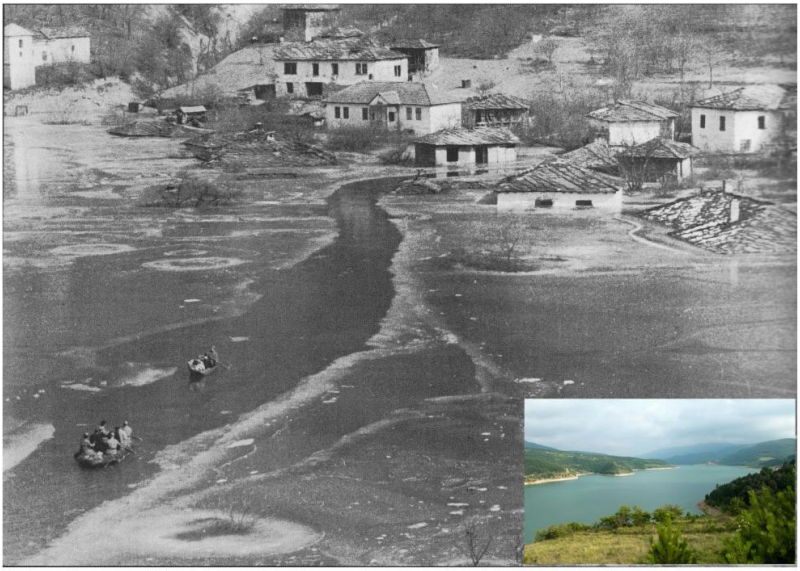

Figure 4. Zavoj Village and the Visočica River 1963. Flood caused by the activation of the landslide due to snow melting; picture in the lower right corner - Zavoj lake today

It is possible to divide the floods and based on the formation time of the water wave [4]:

- flat floods,
- flash floods и
- accidental floods.

Flat floods occur on large rivers, usually in the interaction of several factors and require more than ten hours to form a large flood wave.

In order to create **flash floods**, specific conditions are needed: precipitation of higher intensity or sudden melting of large amounts of snow, more pronounced slope of the terrain, and the existence of erosion processes in the basin. The characteristic of this type of flood is that water suddenly and suddenly falls in less than ten hours, they are relatively short lasting, they bring enormous quantities of sludge and have a devastating effect.

Accidental floods are caused by the current formation of a flood wave due to demolition of the dam or earthquake.

Flood areas in Serbia

The floods in Serbia are affected by 10.968 km2, accounting for 12.4% of the total territory [4]. The largest floating areas are found in the Tisza River basins (2.800 km^2), Sava (2.243 km^2), Velika Morava (2.240 km^2) and Danube (2.070 km^2). The Tisa River has the largest surface area because it has a spacious alluvial plane and a small slope of the longitudinal profile. In the Sava and Danube valleys, floods are conditioned by precipitation, and the Great Morava basin is threatened by heavy floods. Figure 5 shows significant flood areas in the territory of the Republic of Serbia.

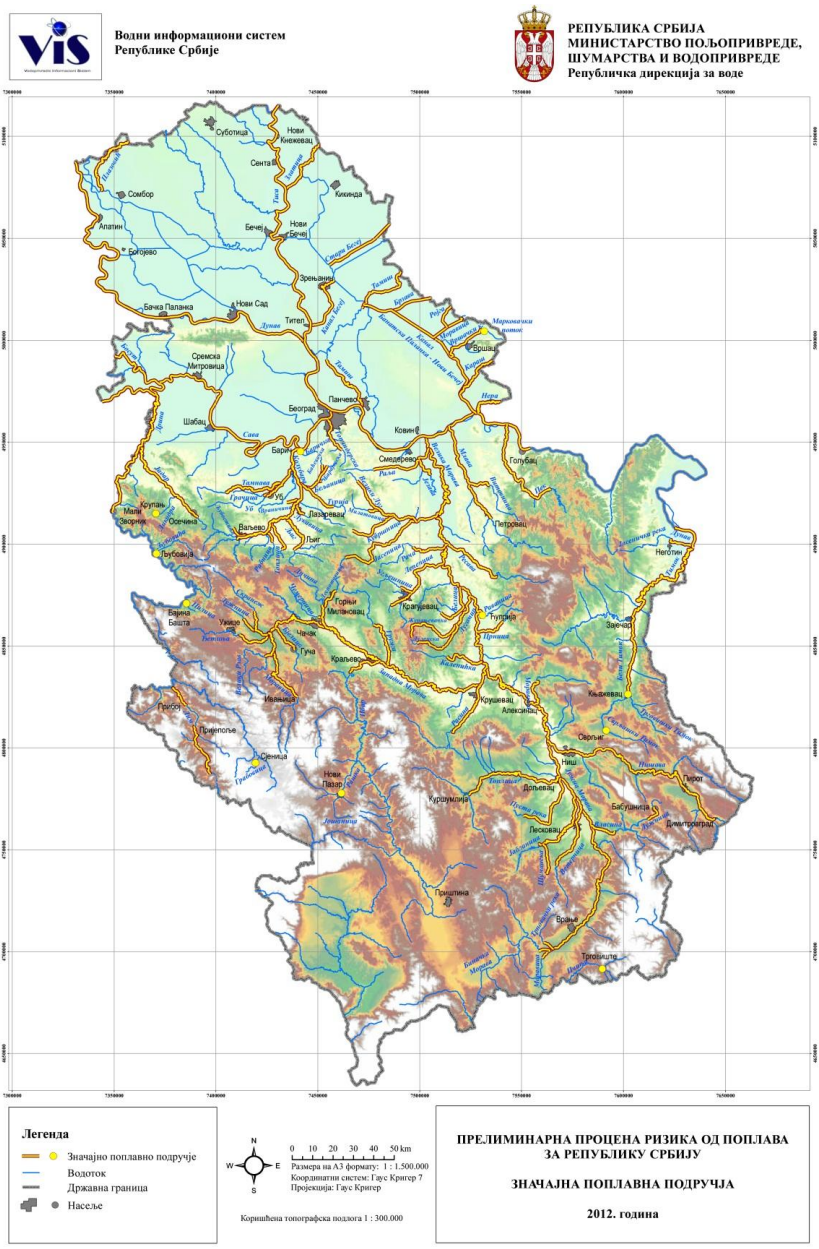

Figure 5. Important flood areas in Serbia (source: Republic Water Directorate, Republic of Serbia)

3.3. The effects of floods

Flood occurs suddenly, it lasts for a long time and usually covers large spaces. The damage caused by the floods is extremely high, because on the banks of the river and in their valleys the greatest concentration of population and commercial buildings, maximum density of infrastructure, as well as the most fertile land [1].

The consequences of the floods can be seen from several aspects [5]: social aspects (housing, education, health, culture), production (agriculture, industry, trade, tourism, mining and energy), infrastructure (traffic, communications and water supply) and general aspects (environment, management).

The social aspect is related to the losses that floods the population. Human casualties are not rare in floods, which points to all the seriousness that accompanies this disaster. In the flash floods that hit Sumadija in 1999, eight people were killed and floods in the floods of 2014 caused the deaths of 51 people, 23 of whom drowned [12].

In addition to human losses, the most severe consequences of the flood are flooded and demolished houses, destroyed economic facilities, facilities of care and health. Large floods with their actions cause evacuation of the population and temporary eviction. In the spring of the Tamiš River, 2005, 1000 inhabitants were emigrated from the village of Jaša Tomić. In the floods that occurred in 2014, 31.879 inhabitants were evacuated, of which 24.000 were from Obrenovac [12].

They cause great damage to the floods because agriculture is the most fertile and largest agricultural area in the valleys of the river. During the flood, a large quantity of sludge, sand and rock material is applied, which leads to devastation of fertile fields that are transformed into infertile soils and crops are destroyed. If the soil is under water for a long time, besides destroying crops in the current year, sowing and yield in the next year are also endangered, as the surface layer deteriorates the quality of the soil.

A special problem, which is a companion for flooding, is the deterioration of water and soil quality. In urban settlements, sewage, damage to the water supply network and pollution of drinking water occur, while in rural settlements there is pollution of wells with drinking water. The occurrence of water contamination is favorable for the development of various infectious diseases and epidemics, which again requires significant costs for rehabilitation.

Floods have a great impact on the environment because their application is flooded by the floating terrain, often changing the flow of the river and forming lakes that change the use of land. Particularly damaging flash floods are caused by the massive quantities of infertile earth and rock masses.

Figure 6 shows damage in millions of euros that caused floods in Serbia in the period from 1999 to 2014 [12].

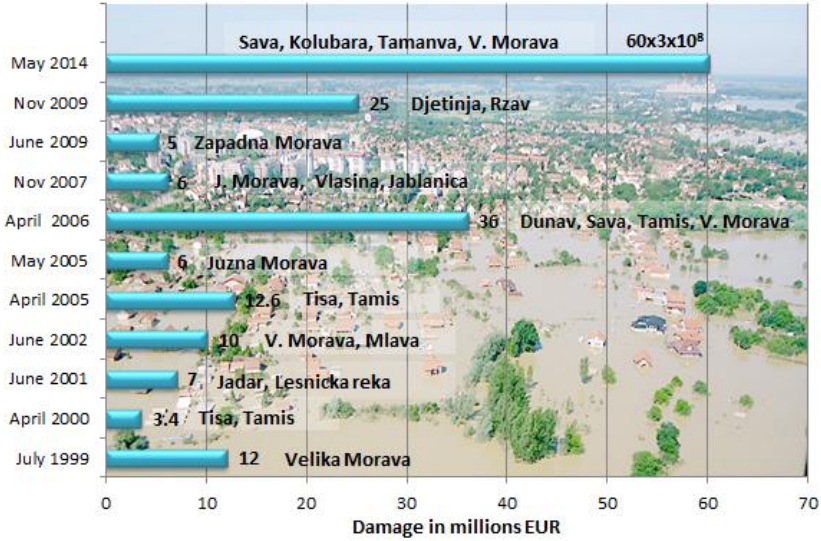

Figure 6. Damage from floods in Serbia for the period from 1999 to 2014 [12]

Statistics on one of the biggest floods that have occurred recently indicate that in the floods of 2014 the total value of destroyed goods is estimated at 1,800 million euros, which represents about 3% of the total gross domestic product. Of this amount, 57% represents the value of destroyed goods that need to be repaired or restored while losses in production represent the remaining 43% [12].

This and similar examples (especially given the fact that the area around Obrenovac was flown several times in 1930, 1937, and 1981 with the constant construction of embankments between floods) point to the need to review the strategy in the fight against floods.

3.4. Flood protection

Legislation in flood protection

Flood protection is legally regulated by the Law on Waters (Sl.glasnik no. 30/10, 93/12 and 101/16) from which all other by-laws are enacted [16]. Managing the risk of harmful effects of water includes [16]:

- preliminary assessment of flood risk,
- development of flood risk management plans,
- general plan for flood protection,
- operational plans for flood protection,
- implementation of regular and emergency flood defense and
- protection from erosion and torrents.

The preliminary assessment of the flood risk for the territory of the Republic of Serbia was made by the Republic Directorate for Water in accordance with the Law on Waters and the Rulebook on the Establishment of the Methodology for Preliminary Assessment [13,16]. It is based on available and easily accessible information and includes the systematization of data on the current level of flood risk and the analysis of long-term tendencies that affect the risk of floods. Preliminary risk assessment considers significant floods from the past, the likelihood of occurrence of similar floods in the future and the necessary activities to reduce the risk of floods. It is also used to define priority works, to plan the necessary resources, to create maps and flood risk management plans.

The Flood Risk Management Plan provides for the reduction of possible harmful consequences of flooding. Plans for certain water areas are brought by public water management companies and contain: method of implementation, priorities and competent legal entities with the necessary funds. The flood risk management plan is based on risk maps and flood risk maps. The flood risk map contains data on the boundaries of the floodplain for floods of different return periods, the depth of water, while the flood risk map contains information on the possible harmful effects of floods on human health, the environment, the economy and cultural heritage.

The general plan for flood protection includes measures that must be taken preventively and during the period of large water intake. The General Plan is adopted by the Government of the Republic of Serbia for a period of five years. Currently, the "General Plan for the Protection of Floods for the

Period from 2012 to 2018" is in force [11]. The general plan is for the waters of the I and II lines and for inland waters.

The general plan stipulates:

- organization of flood defense and management of the flood defense,
- phases of flood defense (regular defense, emergency defense and emergency state of flood defense),
- preventive works and measures (outside the flood defense period),
- the proclamation and the abolition of the flood defense,
- the duties, responsibilities and powers of persons managing the protection of floods in waters and order,
- the duties and responsibilities of companies and other entities involved in the implementation of the flood defense.

The overall flood defense plan is the continuation of an organized flood defense in accordance with the Law on Waters. The implementation of the plan allows the institutionalized, coordinated and efficient implementation of the flood defense.

The Operational Plan for I order water shall be made by public water management companies and the competent minister shall issue an order on the establishment of the plan.

The operational plan is adopted for each year, it must be harmonized with the General Plan and contains:

- the method of organizing flood defense,
- the names of the sector and stocks, companies and organizations that perform defense and the names of responsible persons,
- the necessary resources,
- the criteria for declaring regular and emergency flood protection,
- the mode of operation in case of floods on a particular section,
- engaging work force, machinery, equipment and materials for the implementation of flood defense and
- preventive flood protection measures.

The Operational Plan for the waters of the II order shall be adopted by the competent authority of local self-government in accordance with the General Plan and the Opportunity Plan for water of I order.

Regular and extraordinary flood protection on waters of the first order is carried out by a public water supply company and on the waters of the second order of the local self-government unit.

Flood prevention measures

Floods are a natural disaster, and the history of these disasters indicates that they will certainly happen in the future. In spite of developments in many areas of science and technology, flood risks have not been eradicated, on the contrary, floods are more destructive in recent times with more and more disastrous consequences. As complete protection is never possible, nor can absolute flood safety be achieved, and on the other hand an acceptable level of protection that provides sufficient security is very expensive, it is necessary to find an alternative approach in the fight against floods that would involve people adapt to floods or to live with floods [7]. This approach to flood control includes a combination of structural and non-structural measures.

Structural measures include reconstruction, rehabilitation and modernization of existing defense systems, construction of new embankments, watercourse regulation, construction of temporary zones and reservoirs for redirecting and retaining water [9]. The use of structural measures, in the most vulnerable areas, can not save the floodplain, but it is also necessary to further reduce the risk of flooding by applying non-structural measures [2].

Non-structural measures include the zoning, renewal and maintenance of swamps, fields for swimming and water acceptance, the development of a flood mitigation system that should include monitoring, forecasting, early warning, evacuation, relief and recovery after flood [7].

More recently, non-destructive measures emphasize green infrastructure measures that are better suited to the idea of sustainable development, because they, unlike structural ones, are acceptable for future generations and are friendly to the environment [10].

There is no single concept of a flood protection system for all risk areas, but a comprehensive analysis of all relevant factors for a specific case must be carried out, and then adopt protective measures. For example, a complex analysis has determined that the topographical conditions of the Kolubara River do not allow the construction of dams and accumulation basins for accepting flood waves, but the construction of embankments and channeling of troughs is necessary [3].

Procedures in case of flood

In case of catastrophic floods, protection and rescue is regulated by the Emergency Situations Act [15]. The Act prescribes the operation, proclamation and management of emergency situations, the system of protection and rescue of people, material goods and the environment in case of natural disasters. This Law defines the jurisdiction of state bodies, local self-government units and the participation of the army and police in protection and rescue, as well as the rights and duties of citizens, companies and civil protection.

The decision to declare an emergency situation on the proposal of the competent Emergency Situation Headquarters for the territory of the municipality shall be made by the Mayor or Mayor for the territory of the Republic of Serbia Government upon the proposal of the Republic Emergency Situations Headquarters. An emergency situation shall be pronounced immediately after the knowledge of the imminent danger or after it has occurred and can be declared a municipality, city, part or all of the territory of the Republic of Serbia.

Coordination and management of emergency protection and rescue is carried out by Headquarters for Emergency Situations (republic, province, district and city).

The subjects of the protection and rescue system are:

- state administration bodies, and local self-government units,
- companies, legal entities and entrepreneurs and
- citizens, groups of citizens and associations.

These entities constitute a unique system of protection and rescue on the territory of the Republic of Serbia.

According to this Law, the Ministry of the Interior plays an important role through the Emergency Situations Department, which organizes and carries out activities aimed at protecting the life, health and property of citizens. The Ministry drafts important by-laws such as the Draft National Strategy for Emergency Response and Rescue, the Proposal for a Long-Term Development Plan for the Protection System and the National Emergency Response Plan. Units of local self-government establish the Emergency Situations Headquarters, adopt a plan and program for the development of the protection system, all in the territory of the local self-government.

The Law on Emergencies defines the place, role, rights and duties of citizens during an emergency situation. During a state of emergency, it is

necessary for citizens to participate in protection and rescue. Also, they are trained for personal, reciprocal and collective protection, are obliged to implement prescribed and ordered measures and carry out civil protection tasks.

3.5. Conclusion

Floods that have occurred in the last decade indicate a number of weaknesses in the forecast and the early warning system.

The risk of flooding is increased by the change in land use such as logging and urbanization, which reduces the available capacity for water storage. In spite of significant investments in flood protection, vulnerability is rising, so it is necessary to include in addition to the necessary structural measures and additional non-structural measures along with the strategy of coexistence with floods, which must be present in the floodplains. In flood defense, a new approach is needed to build new systems in which dams and accumulations of the main flood control structure are in place. Stored water in artificial reservoirs can serve not only to control floods, but also for many other purposes as a source of drinking water, irrigation and ecosystem support. Only an adequate combination of structural and non-structural measures, based on a complex analysis of the basin, can provide integral decoration and flood protection.

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4. LANDSLIDES, ROCKFALLS AND EROSIONS AS NATURAL DISASTERS

4.1. General on landslides and rockfalls

Sliding represents a modern geological process of tearing and moving the masses of slopes in slopes and slopes, over a stable substrate, and on a clearly visible surface or slip zone. The slide is the formation of a slip process. It is, in essence, a part of the terrain where the slipping process is active [10]. **The Landslides** is the formation of a slip process. It is, in essence, a part of the terrain where the slipping process is active [10].

Rockfalls represents a group of larger blocks or smaller sections of the rock masses deposited at the bottom of the slope or shore [10].

Erosion of slopes represents the contemporary exogenous geological process of planar and linear washing of slopes and slopes with occasional atmospheric waters. The basic erosion forms of this process are gullys and ravines and accumulation sediments.

Building settlements and roads on unstable terrain, people caused the launch of numerous landslides. The extent to which landslides are significant for the international community is the fact that in 2002, the International Consortium on Landslides (ICL) was established in Kyoto (Japan) as an international non-governmental and non-profit scientific organization.

In the period from 1967 to 2002, 3,285 people died due to catastrophic slipping in Japan. Lacasse and Nadim (2009) provide data on the damages and victims of soil glide. According to this source in Europe, the number of victims caused by landslides in the period from 1903 to 2004 was more than 15,000 with cases with less than 10 victims not taken into account [6].

4.2. Landslides and rockfalls on the teritory of the Republic of Serbia

The landslides that occur on the territory of the Republic of Serbia are known and investigated in more than 70% of cases. Approximately 25% of the territory of the Republic of Serbia was affected by the landslides and rockfalls. There are 3,137 active or potential landslides in the territory of the Republic of Serbia [4] (Figure 1).

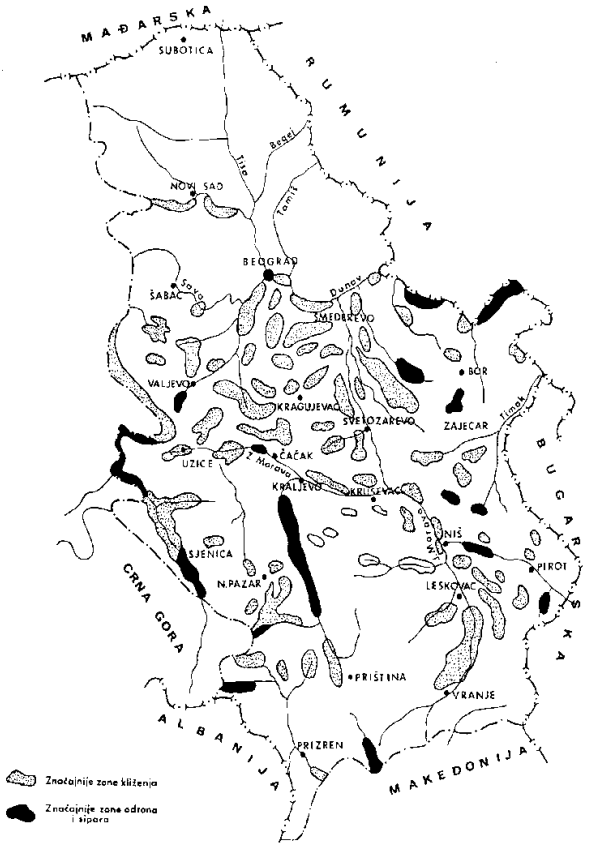


Figure 1. Landslides and rockfalls on the territory of the Republic of Serbia

A certain number of landslides threaten residential buildings in populated areas (about 3,727 buildings and about 7,755 inhabitants), while most landslides threaten local and national roads. The landslides in the Republic of Serbia are widespread in the northern slopes of Fruška Gora, the part of the Danube River between the cities of Belgrade and Smederevo, Raska area, Southern Serbia (Grdelička gorge) and are most common in Šumadija and western Serbia.

Landslides are a serious social problem, as they can result in great human and material damage, either directly or indirectly. Direct damage occurs when the landslide is activated, demolition and damage to objects and human losses (death or injury) in areas affected by landslides. Indirect

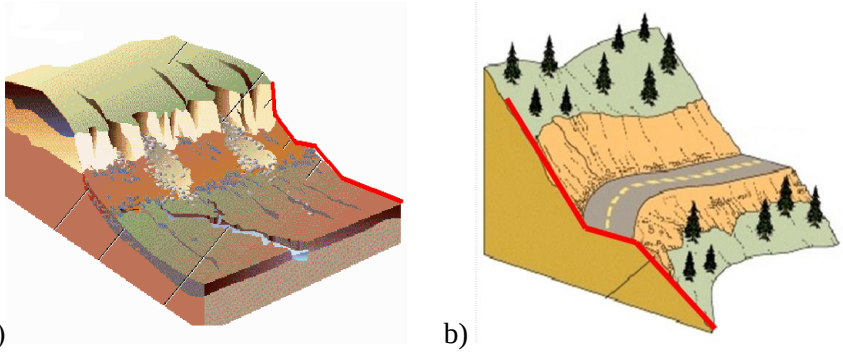
damages are also reflected in a longer period of time in reducing the value of real estate in vulnerable areas, loss of productivity due to damage to goods or traffic cessation and, finally, significant costs of remediation of damages [1].

What makes landslides so terrible is that they often occur with little or no warning and that in a very short time they can leave behind death and destruction.

4.3. Formation and elements of the landslide

Under the landslides, gravity movements of rock masses and soil can be considered in the widest sense. In order to get skating at all, there must be a slope. According to the way the slope is formed (Figure 2), we divide it into:

- natural slopes formed during the movements of the Earth's crust and during the process of degradation, erosion, transport and sedimentation and
- artificial slopes that result from human activity when excavating or filling the soil (embankments, crops, seizures)



a) b)

Figure 2. a) natural slopes, b) artificial slopes

The causes of the genesis are numerous from natural to anthropogenic. The speed of movement can be very different (mm/year to m/s).

The effects of the landslide depend on the volume and speed of the movement of the generated material and the relationship with material goods, or people who may be affected by the movement.

According to international standards, landslides cover a large number of different types of movements, which in our practice are most often encountered with:

- slipping the ground,
- rockslide (slopes of rock material),
- runoff of the rugged ground ,
- complex movement.

Under the clinging of the soil we mean the movement of soil along the slope along the sliding surface in the field or along a thin zone of sloping flat faults in the field (Figure 3).

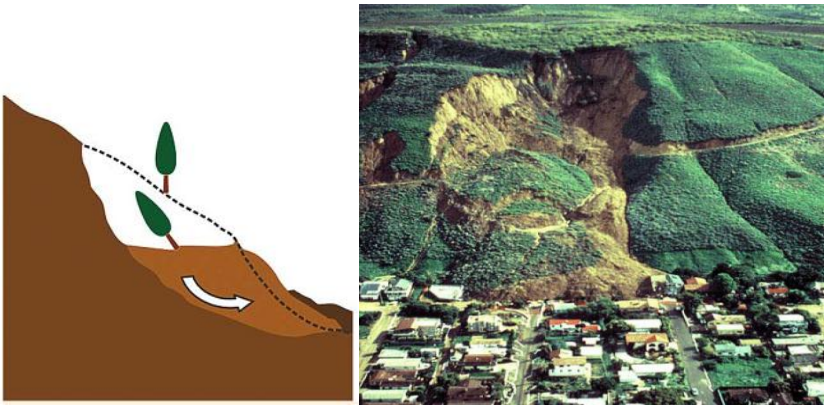


Figure 3. Landing scheme [1] and landslide photos on the ground

Rockfalls are the sudden separation and gravity movement of the wall mass by free fall, rolling or bouncing down a steep slope. It usually disappears due to a slope or dynamic effect (Figure 4). The effects may vary depending on the size of the scattered fragments, the distance to which they are transported, and the elements that are in their direct impact (roads, settlements, vehicles, population).

Figure 4. Schematic representation of rockfalls and photographs of field entrances [1]

Littering and landscapes are a type of sudden movement of the soil, soil decay or soil downward under the influence of gravity, driven by water after abundant precipitation, sudden melting of snow or due to dynamic effects (earthquakes). They are educated in steep slopes and the movement takes place without shearing with the surface (Figure 5).

Figure 5. A schematic view of the site [8] and photographs of the landscapes on the ground

The basic landslide elements are:

– a sliding body or a sliding mass (the entire ground or a wall mass disconnected from its substrate and is driven down a slope or slope),

- a sliding surface (a surface that separates the sliding body from a stable substrate and along which the sliding mass moves along it),
- slide of the landslide (sloping part of the slide),
- toe (the lowest point of the sliding mass) and
- main scarp (section of the visible part of the sliding surface)

According to the position of the sliding surfaces, the landslides can be with shallow and deep sliding surfaces (Figure 6).

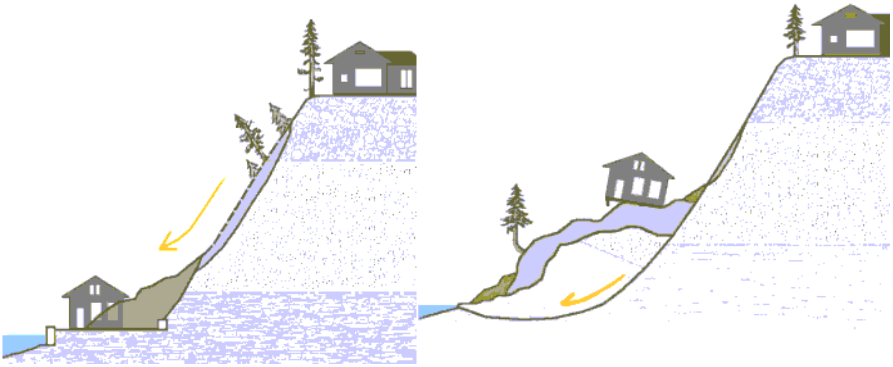


Figure 6. Sliding and deep slip surface slides

According to the type of movement of landslides, they can be moved by translating, rotation and complex modes of movement.

According to the shape of the sliding surface of the landslide, it can be divided into:

a) slides with a flat slip surface,
b) landslides with circular-cylindrical surface and
c) slides with a complex sliding surface.

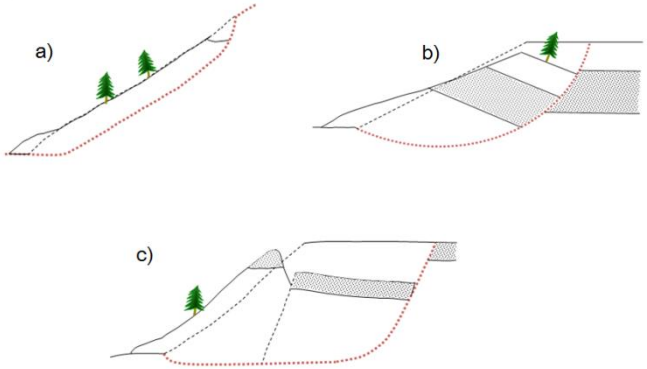


Figure 7 - Slip divide according to the shape of the sliding surface

Causes leading to skipping:

a) Causes leading to an increase in the shear forces in the sliding surface:

- additional load of slopes is the most common object,
- slope cutting (changing the geometry of the slope by making the road, by cutting the flow of the river),
- changes in the groundwater regime (rapidly lowering of NPV, increase of NPV along the slope of the slope, eg, slowing down of the river, abundant precipitation after long-term drought, drainage of water from the sewage, water supply, channels)

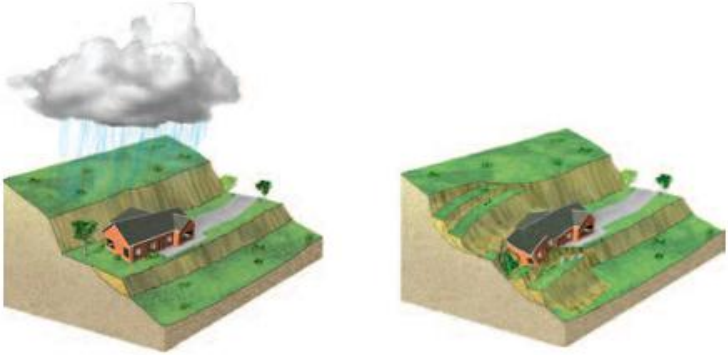


Figure 8. Sliding slope caused by the construction of the object [3]

Figure 9. Sloping slope caused by slope cutting [3]

Figure 10. Slope slope caused by the intersection of the river flow [3]

b) Causes leading to a reduction in shrinkage of soil strength:

- dynamic influences in incoherent soil,
- rapid loading of clay soil in the slope zone,
- deforestation on the slope,
- reducing the strength of the material in the slope,
- the effect of cold.

c) Simultaneous effects of the causes from the previous groups

4.4. Recognition of the landslide

In order to identify landslides in the field, it is necessary to visit a suspected area and to spot some of the phenomena on the surface of the terrain. It is often easy to see the signs of slipping, but it is sometimes made more difficult due to vegetation coverage.

Figure 11. Signs of the landslide outside the settlement: a) cracks, b) scars, c) soil fracture, d) sloping trees e) creeps (slow motion),f) cracks on the road and g) further development of the landslide on the road ,h) starting the support wall of the supporting wall along the dilatation joint

Outside the settlements, landslides are easily recognizable by cracks and scars on the surface of the terrain, curved by trees and pillars, new sources and polluted soil, deformations on roads, etc. In landslide settlements they are recognized by cracks on the surface of the terrain and on buildings located on the slip, deformations on fences, pavements, wells and other objects.

Figure 12. Landlords in the settlement: a), b), c), d) cracks on the walls of buildings, e) cracks on the sidewalk, f) deformed (shifted well)

In relation to the recorded starting position ("zero" state) on the horizontal bar, it is registered horizontally, and on the vertical bar vertical movement of the landslide on the measuring point.

Slopes can also be monitored by a number of modern methods: aerial photogrammetry, radar shooting, and today the most commonly used method is where the field equipment is installed on the slipway, from which it is possible to read the data on the movement of certain points. Using the obtained data on movements of points on the slide and registered scars it is possible to reconstruct the potential sliding surface, which is of prime importance in the landslide rehabilitation.

4.5. Prevention and repair of the landslides

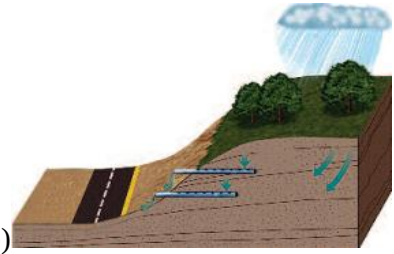
Depending on whether we want to prevent the activation of potential or rehabilitate already activated landslides, we take preventive or remedial measures. To prevent landslides, we include:

- unloading of the upper parts of the slope,
- alleviating slope inclination,
- load of the lower parts of the slope by the construction of supporting structures,
- regulation of surface waters on the slope including water from the gutters of houses,
- regular maintenance of water supply and sewerage network,
- regular discharge of septic tank,
- regular maintenance and cleaning of drainage channels,
- preventing the undermining of the coastal area,
- afforestation and restoration of vegetation cover.

If the sliding activation has occurred, we are undertaking sanitary measures that would prevent the further development of the landslide and minimize material damage. Depending on whether they are performed immediately after the registration of the landslide or after detailed geotechnical research of the terrain and the development of the rehabilitation project, they can be divided into emergency remediation measures and permanent sanitation measures. Emergency or emergency sanitation measures are carried out as interim measures and are implemented in situations when it is necessary to save people's lives, to enable traffic communication between settlements or to provide water, electricity and other supplies. These measures are carried out immediately after observing or reporting the occurrence of instability of the terrain, with the aim of eliminating further danger, i.e. slipping/ draining /snapping, which could lead to additional damage and catastrophic

consequences for facilities, infrastructure or human life [1]. Emergency sanitary measures in the widest sense can be:

- drainage of surface waters outside the body of the landslide by rapidly developing drainage trunks and channels or by installing horizontal drainage pipes,
- filling of clay fillings of cracks caused by slipping in shallow landslides (especially in the foreground of the landslide), overlapping of nylon to prevent further introduction of surface waters into the terrain,
- planning landscaping by moving material (redistribution of mass),
- urgent cleaning of the flaws if burials are buried with construction shots, waste or earth material, in order to allow torrential waters to flow freely to the existing basins so that mini-accumulation can not be created (this does not apply to well-designed anti-torque divisions)
- in shallow landslides, drilling wooden or steel huts in order to increase the resistance to slipping.

a)  b) 

c) 

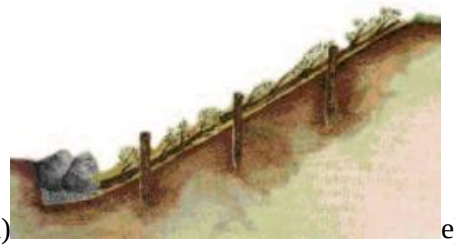
d)  e) 

Figure 13. Emergency measures for remediation: a) covering of nylon, b) positioning of horizontal drains and channels (c) mass redistribution, d) and e) kicking the knights

Permanent rehabilitation measures are a series of activities that are carried out after detailed geotechnical research of the terrain and the elaboration of the rehabilitation project with the aim of permanent stabilization.

As water is the most common cause of landslides, the most effective permanent sanitation measures involve the discharge of water from and from the body of the landslide. And here are very important sanitary measures that involve the development of drainage trunks and channels or the installation of horizontal drainage pipes, whereas in the first phase (emergency operation) only drainage channels can be made, and then, by setting drainage in them, they become permanent measures rehabilitation. In addition, permanent rehabilitation measures include various support structures: supporting walls of stone, concrete and reinforced concrete, reinforced soils, gabions, anchors, etc.

4.6. System of protection and savings in external situations in the Republic of Serbia

After several suggested variants, the Law on Emergency Situations in the Republic of Serbia was adopted, which was later changed in 2011 and 2012 [11]. By its adoption, conditions for the creation of a unique protection and rescue system have been created and that:

- adopt the necessary by-laws for the implementation of the Law,
- make assessment of vulnerability and plans for protection and rescue at the local, regional and republic level,
- introduce a unique emergency number 112,

- develop and promote international cooperation.

Based on the Law on Emergency Situations, the following bylaws were adopted:

- decision on the establishment of the budget fund for emergency situations,
- regulation on the composition and method of work of the emergency staff,
- regulation on mandatory funds and equipment for personal and collective protection,
- regulation on the content and method of drafting a plan for protection and rescue,
- regulation on the implementation of evacuation,
- decision on the education of the Republic Emergency Staff,
- decision on the education of the provincial emergency headquarters,
- decision on the appointment of authorized and qualified legal entities,
- rules on organization and method of use of specialized units C3.

Emergency management is organized so that emergency staffing staffs are formed for the coordination and management of emergency and emergency rescue operations, such as:

- for the territory of the Republic of Serbia - Republic Emergency Staff, formed by the Government,
- for the territory of the autonomous province - the provincial headquarters, formed by the executive organ of the autonomous province,
- for the territory of the administrative district - District Emergency Headquarters, established by the Republic Emergency Staff,
- for the territory of the city - city emergency headquarters, formed by the city assembly,
- for the territory of the municipality - municipal emergency headquarters, established by the municipal assembly.

The headquarters consist of the commander, the chief and members of the staff, and in the city and municipal staff and the deputy commander of the staff. The staff educates, as necessary, auxiliary expert-operational teams for specific protection and rescue tasks. The members of the headquarters are appointed representatives of the authorities in the field of transport, construction, energy, services, trade, directors of public utility

companies and institutions whose work is related to protection and rescue (Red Cross, Centers for Social Work, Health Centers, hospitals). In accordance with the Law, protection and rescue plans are also adopted. They are planning operational measures, entities, forces and means for implementing the protection and saving of life and health of people, animals, material and cultural goods and the environment from natural disasters and other disasters. They can be at the national level, the level of the autonomous province, the district or the local self-government unit. Plans of protection and rescue depending on the type of danger include the following elements:

- schematic representation of subjects engaged in protection and rescue,
- review of obligations (measures and tasks) of participants in protection and rescue,
- an overview of the strengths and availability of protection and rescue capabilities,
- other documents depending on the specificity of each hazard and level of planning.

4.7. Plans of protection and safety in the case of landslide, rockfalls and erosion

Plans of protection and rescue in the case of landslides include: evacuation, disposing, first and medical assistance, asanation and other civil protection tasks, depending on the need that is required by the given situation (implemented according to the Plan of measures and tasks of civil protection).

Plans of protection and rescue in the case of landslides also contain:

- tabular overview of endangered areas, towns or buildings with an overview of the number of endangered objects and the number of inhabitants that are estimated to be endangered;
- map with marked urban areas; elaborated operational procedures for the operation of protection and rescue forces. Units of local self-government, administrative districts, autonomous provinces and the Republic of Serbia in this part of the plan are obliged to provide expert teams of experts (designed to assess the safety of buildings after the landslide and slopes;
- removing parts of damaged objects;

- repair of landslides and landslides; disposing of the endangered population; acceptance and distribution of building materials; reception and distribution of food, water, sanitary and sanitary materials; organization and engagement of volunteers for rehabilitation assistance, etc.); organization of hygienic-epidemiological protection (carriers and activities); organization of food, water and medicine;
- organization accepts help in people and material and technical means.
- at the level of the local self-government unit, this plan also includes an overview of the locations for the disposal of waste building materials and other material collected during the clearing of the terrain.

In order to respond to any emergency situation, the forces of the protection and rescue system are responsible: emergency staffs, civil protection units, fire brigade units, police, the Serbian Armed Forces, and entities whose regular activity is protection and rescue, as well as companies and other legal persons, Red Cross of Serbia, Mountain rescue service of Serbia and associations that are trained and equipped for protection and rescue.

When it comes to companies and other legal entities engaged in emergency situations, these are most often public utility companies and other legal entities whose scope of work is important for the execution of tasks in emergency situations. These tasks are, for example, supply of water and food, rescue from ruins, maintenance of infrastructure and roads, flood and fire protection, terrain clean-up, maintenance of cleanliness, evacuation and transport, etc. In addition, the Red Cross and Social Welfare Centers, health care centers of health and hospital, etc. are engaged in the disadvantaged population and the provision of first aid.

With these entities contracts are concluded that regulate mutual rights and obligations and their work in emergency situations managed by the Emergency Situations Headquarters. Funds for reimbursement of expenses incurred by participation of these entities in protection and rescue in emergency situations are provided in the budget of the municipality (the Republic, the Province).

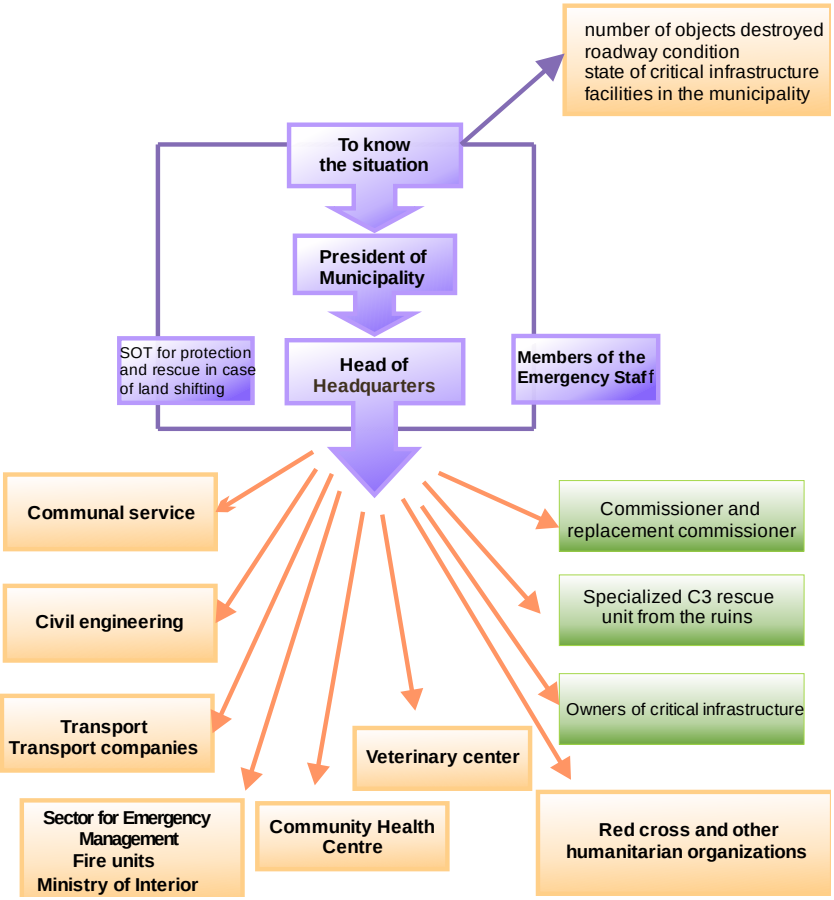


Figure 14. Schematic representation of entities engaged in the protection and rescue of the landslide and slip case [5]

4.8. Place and role of the uniter before and after the landslide and rockfall

Preventive action before the landslide [1]:

- Do not build near steep slopes, mountain sections, along the ravines and along them.
- You need to have an estimate of your assets and, possibly, to secure it.

- Contact the local authorities or state institutions (such as the Geological Survey of Serbia), professional associations (Serbian Chamber of Engineers and licensed engineers.) Slipsters are most commonly occurring in the areas where they were previously in the past, but also in new locations. are about landslides in your area and ask for an expert report for a detailed analysis of the location of your property, a recommendation for preventive measures that you can take if necessary.
- In heavy rain, observe the directions of torrential flow in your area and note where the surface waters are intensively watering. These areas should be avoided.
- Learn about emergency services and the evacuation plan for the area in which you live. Make your own emergency plans for your family and work.
- Reduce the vulnerability of your household by doing so:
  - use flexible connections for plumbing and utility pipes because they are much more resistant to fracture / interruption, in order to avoid cracking.
  - Plant different plants on the slopes. If you build support walls, make water sweeps and with a layer of filter straps behind the wall.
  - In areas of soil leakage, build channels or walls that will redirect the flow around the building, but by not diverting the neighbors.

Behavior if you live in areas that are susceptible to slippery and slippery events [9]:

- pay attention to strange sounds that can be indicators of sliding or slipping - such as breaking trees and the like;
- if you are near a stream or channel, be careful about increasing or decreasing water flow or blurred water;
- consider the possibility of abandoning an endangered site, provided you can safely do so;
- stay alert and alert - listen to radio and television alerts about possible heavy rains.

Remember that driving during heavy rains is dangerous. Be very careful if you drive - pay attention to damaged roads, mud, fallen rocks or other indicators.

If you notice the danger of landslides:

- notify the relevant service at number 93 or 985,
- Inform neighbors who may be affected by this danger and
- Get out of the landslide zone, as it is the best protection.

What to do after the landslide and landslide is created:

- Stay away from the area in which it lands, there may be a risk of additional shifts.
- If you are able to listen to radio and television news in order to keep up to date with the latest information.
- Make sure there are injured and captured people in the vicinity of the landslide and refer local services to these locations.
- Help neighbors who need help.
- Check and report to local authorities if there are broken electrical lines or damaged roads, railroads or other infrastructure.
- Check and report damages in the foundation of houses, on chimneys, wells, roofs.
- Plant trees again as soon as possible, since subsequent erosion of soil can contribute to further torrents and landslides.
- Look for expert opinion of geotechnical engineers in order to assess vulnerability from landslide, to propose preventive measures or remedial measures.

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5. DROUGHT

5.1. Introduction

Drought is a complex phenomenon that represents a long-term regional reduction in water availability, or a lack of water. The main cause of drought occurrence involves a reduced amount of precipitation over a longer period that is spread over a larger area. Drought is a natural phenomenon because it is directly caused by natural factors and represents the normal state of the climate, which causes serious changes in the water balance and has a detrimental effect on production [2].

Drought, although it involves large areas, is not universal but is a regional phenomenon. Its consequences depend on the area it takes - from its climate and hydrological characteristics. Although precipitation data are the main indicator of drought, other characteristics deriving from precipitation (soil, underground and surface water humidity) are also important. Air temperature, strong winds, low relative humidity, layout and intensity of rainy days in the vegetation period, the state of soil and plant cover have a significant role in the onset of drought [6].

Characteristics of drought

A major problem in the prediction and the drought prevention is the lack of a universal - generally accepted definition of drought. The reason is understandable because drought problems are being discussed by experts from different scientific disciplines who have significantly different criteria for definition and identification of drought. There are a plenty of definitions of drought that are regionally specific in professional literature, and include different physical, biological and socio-economic aspects related to a particular area, and it is therefore usually difficult to transfer definitions made for one region to another. One of the definitions of drought was given by Palmer, according to which "drought is the interval of time during which the actual supply of moisture is disturbed at the given site, and the state of humidity is constantly less than the climate-expected or climate-appropriate moisture supply" [12]. Common to all definitions of drought is that they, as the main attribute, include precipitation or lack of moisture.

According to Wilhite and Glantz (1985), all definitions of drought can be classified as conceptual and operational [15]. Conceptual definitions help to understand the nature of drought and play an important role in

establishing a drought policy, but do not usually provide quantitative responses to its intensity. Operational definitions help to identify the beginning, end, and degree of severity of drought, and usually compare the current situation with the average historical period (usually this is a period longer than 30 years).

Unlike other natural disasters (floods, landslides, earthquakes) that occur suddenly and have a relatively short duration, drought occurs gradually and can last very long (months, even years). Due to the nature of drought, it is difficult to accurately determine the onset of drought, because drought, unlike all other hazards, is not characterized by a sudden occurrence. The consequences of drought can be maintained for years after the ending of the event itself, and it is therefore difficult to predict accurately its completion.

Drought can cover large areas, more regions or states, and its spatial distribution is not easy to define in advance. Natural hazards affect most of the structural objects while the harmful effects of drought are unstructured - disposed on a large geographical area.

Types of drought

According to Wilhite and Glantz (1985) [15], drought can be:

- meteorological
- hydrological,
- agricultural and
- socioeconomic drought.

Meteorological drought occurs due to the lack or complete absence of precipitation over a long period of time in a given area. This deficiency is defined as the deviation of the average amount of precipitation from the normal i.e. the average established for a particular area and period. Meteorological drought precedes other types of drought and is most important for the occurance of agricultural drought.

Agricultural drought associates various characteristics of meteorological drought with agricultural impacts. The high value of evapotranspiration (caused by high air temperature and constant and strong winds) and the lack of moisture in the soil lead to the appearance of agricultural drought (Figure 1). Deficit of precipitation with the physical and biological properties of plants can cause a decline in yield.

Figure 1. Agricultural drought

Hydrological drought is associated with the effects of a lack of precipitation and with a high degree of evaporation and can lead to drying of navigable rivers and groundwater. The frequency and severity of hydrological drought is often determined on the basis of the impact on the river basin (Figure 2). Although climate is the main cause of this drought, other factors can affect the hydrological characteristics of the catchment, such as deforestation and soil degradation. Hydrological droughts often do not include the same weather periods as meteorological and agricultural drought.

Socioeconomic drought occurs when water shortages start to affect people, or when water requirements are greater than the ability to provide it with technical measures.

These types of drought are interconnected, although each of them has its own specific factors of formation and influence (Figure 3).

Figure 2. Hydrological drought

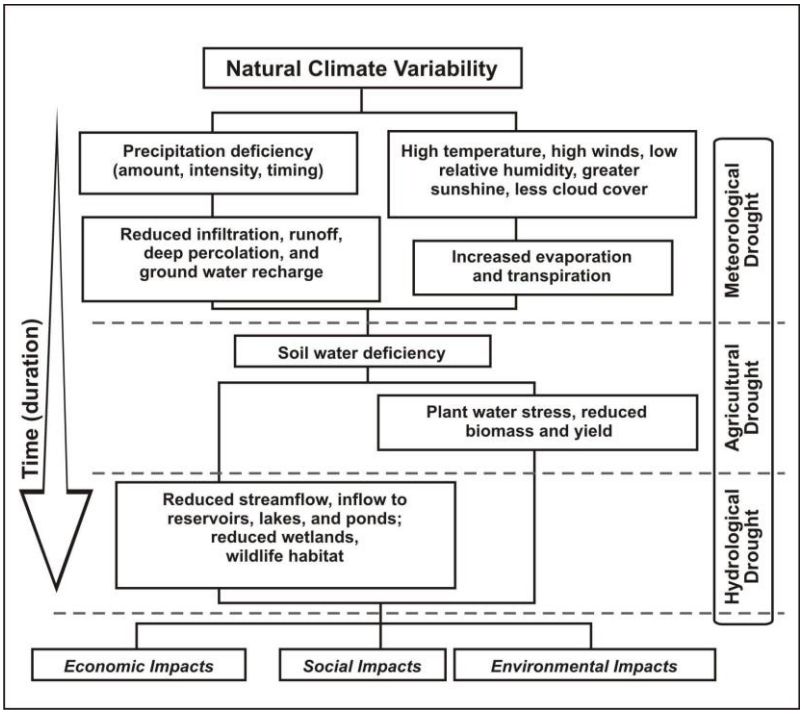

Figure 3. Connection between different types of drought (source: drought.unl.edu)

Drought indicators

For the quantitative determination of drought, numerous and diversemindicators are used. In order to determine the duration, intensity and frequency of drought, there are a large number of quantitative indicators, i.e., drought index. Drought indexes used numerous sizes: the amount and schedule of precipitation, water level and groundwater level, air temperature, evapotranspiration, wind, humidity. In practice, a greater number of indexes are applied and in monitoring of drought it is necessary to analyze in parallel several of them, as some indicators are better adapted to others for certain needs. The most frequently used drought indices are:

- SPI (Standardized Precipitation Index),
- PDSI (Palmer Drought Severity Index),
- SWSI (Surface Water Supply Index),
- SPEI (Standardized Precipitation Evapotranspiration Index).

5.2. Drought consequences

The effects of drought are mostly felt in densely populated areas where industrial and agricultural productions are developed. Droughts affect the resources of surface and ground water and can jeopardize water supply, deteriorate water quality, reduce crop yield in agriculture, cause reduced electricity production and disturbance of river traffic and recreational activities. In Serbia, drought affects agricultural production, river traffic and water supply.

The effects of drought can be classified into three groups (National Drought Mitigation Center; http://drought.unl.edu):

- economic consequences,
- environmental consequences and
- social consequences.

Economic consequences of drought include those damages and losses in industries that are directly or indirectly related to the precipitation deficit. Agriculture is usually the first affected and particularly endangered by drought and especially plant production [5]. The lack of water especially during the vegetation period affects plants that can not growth normally, which can cause their damage and wrinkles. Many branches of the economy are closely related to agriculture, and thus the harmful impact of drought transfers on them. Because of the lack of precipitation, forest

damage is caused by the appearance of various diseases, and forest fires are very important and their occurrence is in line with drought. The group of economic consequences of drought includes losses in the water supply of the settlements and in the energy sector.

Ecological and social consequences are more difficult to determine quantitatively because they are consequently related to economic damage from drought and it is difficult to see their full extent. The environmental consequences are primarily related to environmental degradation, and social to the endangering of life in it. Forest fires are a disaster that includes all three groups of consequences from drought, because in addition to economic losses that are reflected in the losses of timber materials, fire extinguishing and losses in tourism; ecological which includes soil erosion, reduction in biocenosis, water balance disorders; there are also social consequences caused by migration, stress and the disappearance of the living world.

Damages from drought

It is considered that drought is the most complex, but the least understood of all natural disasters, affecting more people than any other disaster. Bryant (1991) rated natural disasters on the basis of the following characteristics: strength, duration, spatial distribution, loss in humans, damage to the economy and longevity of impact, and concluded that droughts occupy the leading position among all natural disasters [3].

The drought analysis in Serbia, estimated on the basis of the six-month Standardized Rainfall Index (SPI), shows a higher incidence of droughts in the vegetation period for the period 1981 to 2012 compared to the period from 1961 to 1990. The worst droughts have been recorded over the last two decades (1990-2010), and especially in the northeastern and eastern parts of the country [8].

According to the World Meteorological Organization, three catastrophic droughts occurred in Serbia from 1992 to 2012, of which the largest damage occurred in agricultural production [16].

One of the major droughts in Serbia happened in 2007. The drought occurred in April, causing drying of the surface layer of the soil, which created major difficulties in spring crop sowing. The same year in July and August there were high air temperatures (up to 45 °C) and warm waves of 9 to 10 days, which again caused the appearance of drought [8].

Of the droughts that have occurred in recent decades in Serbia, it is worth mentioning the drought in 2012 when agricultural production suffered losses of 50 %. According to the drought index (SPI index), drought was classified as severe and extreme drought. The dry period followed by very high air temperatures began in June and lasted until October. The drought first began in the central part of the country, and then it hit the whole country, the most endangered areas affected by drought were Vojvodina and central Serbia [8].

Figure 4 shows the largest damage caused by drought in Serbia from 1999 to 2017 [8].

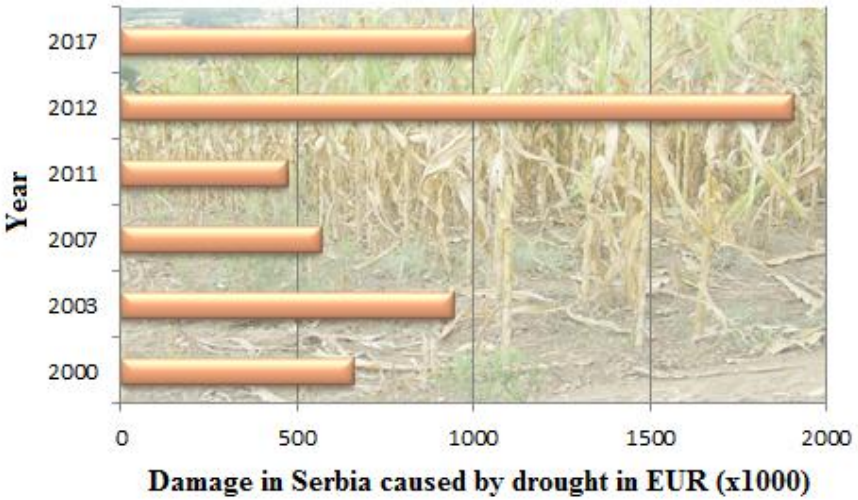

Figure 4. Damage in Serbia caused by drought [8]

5.3. Planning the drought mitigation

In the last two decades in Serbia, the frequency, intensity and duration of meteorological droughts have increased, as a result of increased temperatures, reduced summer precipitation and a greater number of longer drought periods, and it is assumed that this trend will continue especially in the southeast and east of Serbia [13]. Drought fighting in the past has been reactive, untimely and poorly coordinated. A common past practice was the establishment of crisis headquarters when a disaster had already taken place. The focus of the plans was on an urgent response to drought or crisis

management rather than crisis management. However, this approach to the mitigation of drought results only gives immediate results and does not affect the reduction of society's vulnerability to drought. Droughts were shifted without risk decreasing, but had the opposite effect.

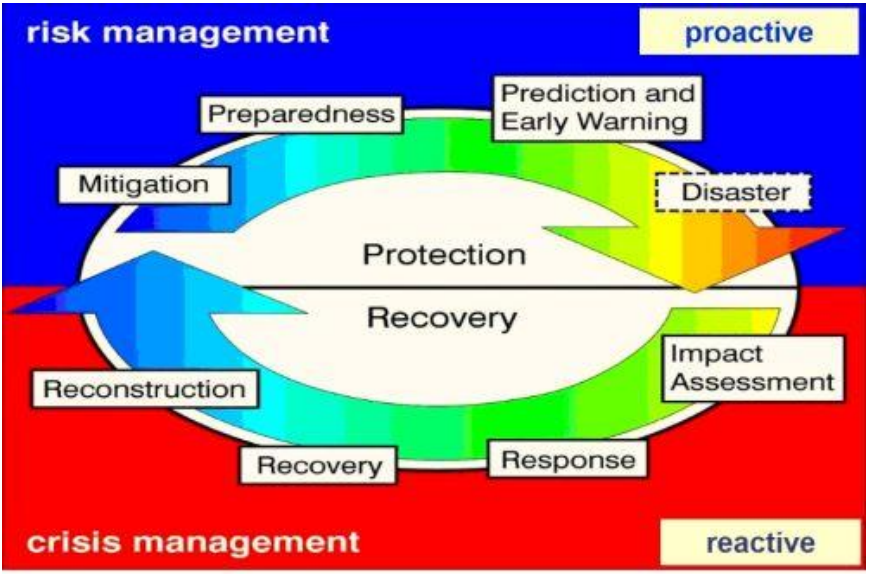

Figure 5. The Cycle of Disaster Management [14]

The great damage caused by the drought imposes the need to take appropriate measures in order to reduce the risk of drought. Drought is a natural disaster, it can not be avoided, but society can reduce its vulnerability through alleviation and readiness, or through risk management. Therefore, a systemic and institutional fight is needed to mitigate the effects of drought, that is, planning droughts as a response to the adverse consequences of drought. Figure 5 shows a disaster management scheme [14].

The proposed concept attempts to unify all components of disaster management in general and is commonly referred to as crisis management. The activities of this concept indicate that it is necessary to combine many scientific disciplines in the planning of drought to solve problems related to forecasting, detection, response and preparation for future droughts. According to [14], the disaster management process itself is divided into:

- risk management and

– crisis management.

The risk management process takes place before the onset of drought and presents preparatory - protective works for the occurrence of a disaster. This process consists of the following activities: mitigation, preparedness and foresight, and early warning.

The crisis management process occurs when drought occurs and represents the activities to be undertaken in order to achieve a faster and more efficient recovery from drought. Crisis management includes activities: drought impact assessments, institution response to drought, recovery and reconstruction.

In the past, the emphasis in managing disaster was mainly on the response and recovery of this cycle, which explains why society generally went from disaster to collision, with little or no attention to mitigation, readiness and forecasting.

5.4. Normative-legal framework in drought mitigation

The Legal and Regulatory Framework for Emergency Response and Risk Reduction is the Law on Emergency Situations (Sl. glasnik no. 111/09, 92/11 and 93/12) and the National Strategy for Emergency Response and Rescue (Sl. glasnik no. 86/11) [10,19]. Knowing that the impact of drought can be significantly reduced by proactive drought risk management, as opposed to previous emergency relief and recovery strategies, has led these laws to focus on risk management and preparation.

The international community noted the problem of land degradation caused by desertification and adopted the UN Convention to Combat Desertification in the Countries of Heavy Drought, ratified by the Republic of Serbia in November 2007. Pursuant to the Law on the Confirmation of the United Nations Convention to Combat Desertification in Highland and / or Desertification Countries (Sl. glasnik - International Agreements, no. 102/07), the National Action Plan for Mitigating the Effects of Drought and Land Degradation [8, 18].

The aim of the national action plan is to identify factors that contribute to desertification and to define the practical measures necessary to combat desertification and mitigate the effects of drought. Strategic guidelines for strengthening the land management system, as well as the activities for curbing soil degradation in Serbia, have been implemented in the action plan. One of the fundamental goals of the National Action Plan is the

strengthening of the legislative and institutional framework for land protection.

The Public Investment Management Office adopted in December 2014 the National Risk Management Program of Natural Disasters [9]. This program aims to provide a general framework for the development of a comprehensive protection program and to build a long-term system of risk management from natural disasters. The program is based on prevention, early warning and risk management.

The Action Plan for Implementation of the National Program for Managing the Risk of Natural Disasters (2016-2020) aims to ensure that Serbia is more resistant to natural disasters by 2020 and is capable of quickly returning to a state that preceded the natural disasters [1]. The Action Plan has analyzed in detail the activities for all components of the National Program. For each activity, the general and specific goal, indicators, responsible institution, duration of activities and financing method are emphasized.

One of the most important normative acts in the fight against drought is the Law on Meteorological and Hydrological Activity (Sl. glasnik, no. 88/10) [17]. This law provides a framework for the implementation of an early warning and alert system that forms the basis of a national drought-fighting plan and includes: monitoring, early announcement, risk assessment and mitigation and response. Early drought information is used to make decisions about drought risk management, as well as decisions on the introduction of a program for mitigating consequences and emergency interventions, which are part of the drought preparedness plan. The warning system must be a continuous service both during the drought and in the period when it does not exist.

The Republic Hydrometeorological Service of Serbia (RHMZ), as a key institution within the Law on Meteorological and Hydrological Activities, is qualified to define the beginning, intensity and distribution of drought as well as to anticipate the potential impacts of drought.

5.5. Measures for preventing and reducing the effects of drought

The legislation of the Republic of Serbia recognized the new concept of the fight against drought, where the emphasis was placed on the prevention. According to the Law on Meteorological and Hydrological Activities, the Republic Hydrometeorological Institute (RHMZ) performs systematic

monitoring, research and forecasting of weather, climate and water [17]. Based on the established systems, the RHMZ provides forecasts, early announcements, a warning about the occurrence of disasters and disasters, and mapping the risk of drought.

In our country, the greatest amount of agricultural drought occurs that occurs immediately after the meteorological drought. As agriculture is closely linked to other branches of the economy, drought damages are directly transmitted to them.

Measures to combat agricultural drought can be divided into three groups [11]:

- selection-genetic measures, aim to create plants resistant to water deficiency,
- geographical measures, give recommendations for determining the distribution schedule for plants depending on the characteristics of drought (crop rearing) and
- agricultural measures, represent various types of land treatment.

The aim of the agro-technical measures is to provide moisture in the dry season, ie to create good conditions for collecting precipitation, accumulating water and to allow for its rational consumption [4]. In agrotechnical measures, the fight against drought includes [7]: irrigation, seedlings, precursors, sowing structure, soil cultivation, fertilization, muddying, weed control and semi-protected forest belts. Irrigation is the most effective measure that eliminates the impact of drought [4]. This measure is the safest and most successful but also the most expensive, and special conditions are needed such as the appropriate site, quantity and quality of water. It should be emphasized that irrigation, used only as a tool in the fight against drought, has no justification. Irrigation is an agens of intensive agriculture that requires modern technology, in order to achieve high and high quality yields.

Part of the measures for preventing and mitigating the effects of drought (which are undertaken before drought) are contained in the National Program for Risk Management of Natural Disasters and the Action Plan of that program. The national program consists of 6 components [1]:

- First component - Institution building and development; represents the base step in the Program and pervades all other components. A disaster risk management system must be established at the national level through cooperation between different institutions.

- Second component - Identification and monitoring of risks related to natural disasters; provides the basis for reducing the risk of disaster and managing them. Activities under this component should accelerate efforts to identify major obstacles in existing capacities and improve the monitoring and forecasting system.
- Third component - Structural and non-structural risk reduction; this component divides all activities into two sets of measures whereby structural measures provide for infrastructure interventions while non-structural measures envisage the inclusion of risks into land use plans and urban planning.
- Fourth component - Early Warning and Readiness Systems; an effective Early Warning System must include, in addition to the legally authorized and indebted RHMZ and various national agencies, local self-government and the population. The activities of this component should reduce the risk of disaster within the readiness to respond and ultimately to create a disaster-resistant community.
- Fifth component - Risk financing strategy; the activities of this component include the development of a financing strategy in order to strengthen the capacity of the Ministry of Finance from the point of view of securing funding in case of risk and they promote other means of securing funds, such as insurance against natural disasters.
- Sixth component - Efficient Recovery; presents guidelines for managing the post-disaster recovery process at the national and local levels. Also, this component defines the development of personnel at all levels within the institutions of the Government, the private sector and civil society.

A successful battle against drought requires involvement of the local community in the implementation of drought mitigation measures, as it represents the first line in the fight against drought. In order to carry out risk management actions to reduce the risk of drought, the local community should identify the most vulnerable groups of people and sectors, raise awareness of drought and water supply problems during the drought periods. In order to achieve this, usually, presentations, trainings, workshops and seminars are used. Formation of public awareness of drought will help the community to understand the problems that arise

during drought and are primarily related to water supply and which techniques of rational use and conservation are in a drought period.

5.6. Procedure in case of drought

Protection and rescue in case of emergency situations is regulated by the Law on Emergency Situations and By-Laws [19]. The law regulates the functioning, proclamation and management of emergency situations. Also, this Law prescribes a system of protection and rescue of people, material and cultural goods and the environment from natural disasters. The decision-makers and decision-makers are defined as well as other factors that can play a significant role in responding to an emergency situation.
This law defines the adoption of the National Strategy for Protection and Rescue in Emergencies, which set out strategic goals [10]. The decision to declare an emergency situation, on the proposal of the competent Emergency Situation Headquarters for the territory of the municipality, shall be made by the mayor and for the territory of the Republic of Serbia, on the proposal of the Republic Emergency Situations Headquarters.

Responsible institutions are Headquarters for Emergency Situations (Republic, Province, District, and City), which manage and coordinate the work of the subjects of the protection system. The subjects of the protection and rescue system are [19]:

- state administration bodies and local self-government units,
- companies, legal entities and entrepreneurs and
- citizens, groups of citizens and associations.

Entities constitute a unique system of protection and rescue on the territory of the Republic of Serbia.

The present law defines the role of the Ministry of Interior, through the Sector for Emergency Situations organizes and conducts activities to protect the life, health and property of citizens. In order to successfully implement these activities by the Ministry, as well as the laws, drafted by-laws such as the draft national strategy for the protection and rescue in emergency situations, the draft long-term plan for the development of the protection and Proposal of the National Plan of protection and rescue in emergency situations.

Local governments educate staff for emergency situations, the plan and program development of the system of protection in the territory of local self-government.

The place, role, rights and duties of citizens in the event of an emergency is determined by the Law on Emergency Situations. Citizens participate in protection and rescue, train for personal, reciprocal and collective protection, carry out prescribed and ordered measures and execute civil protection tasks. Citizens are obliged, in the event of an emergency situation, to carry out material obligations for the needs of protection and rescue. Citizens are obliged to give the competent authority the use of vehicles, machinery and equipment when required by the needs of protection and rescue.

5.7. Conclusion

Drought as a natural disaster can not be prevented. However, adverse impacts on the economy, the environment and the social areas can be significantly mitigated by preventive measures and organized adequate measures during drought.

In the majority of cases in the past, drought responses were reactive, that is, aid was timely, inefficient and poorly coordinated. This was a form of crisis management that was replaced by the principle of risk management. Risk management builds community resilience to the crisis more than reacting to the crisis. The core activity that puts more emphasis on risk management and drought mitigation actions is the drought planning process, primarily the monitoring system and the early warning of drought.

A particular problem in the difficulty of planning drought is the fact that there is very little documentation on the effects of drought in the past. Data on historical droughts play a key role in the assessment of drought vulnerability and their disadvantage causes failures to address all drought impacts. An analysis of the impact of drought in the past would contribute to the perception of systemic weaknesses and their elimination in preventive measures in the fight against new drought.

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6. EPIDEMICS AND EMERGENCIES

6.1. Introduction

Epidemiology is a scientific discipline that deals with the study of factors that influence the occurrence, frequency and distribution of infectious and other mass diseases in the human community, all with the aim of preserving and improving health[1]. Although the epidemiology deals with the study of mass diseases and damage to health, its development is mainly related to the spread of infectious diseases primarily in wartime conditions. And the eradication of infectious diseases, especially in cases of war, natural disasters and emergencies, remains one of the most important areas of its research today[2]. According to scientific estimates, there are about 2-3 million different microorganisms, potential causes of the disease in nature, and to date only 5% have been identified. According to the World Health Organization (WHO), diseases caused by microorganisms are classified in the top ten leading causes of mortality in the world. Infectious diseases are a product of the interaction of the two worlds, the world's microorganisms and the world of human physiology. The world of microorganisms is known to be unpredictable, adaptable, and perfectly organized in the form of plankton and sedentary communities (biofilms), which allow it, invasion of host cells and tissues, protection against antimicrobial substances, gene exchange, and the emergence of new pathogens. On the other hand, the defense system of immunocompetent people, with its molecular and cellular elements, provides relatively good protection against infection. However, from infectious diseases every year about 15 million people die on the planet, as well as more than 50% of children under the age of five. In the first place among these diseases are respiratory infections of which about 4 million people die annually, followed by HIV / AIDS with about 3 million deaths, diarrhea (annual mortality of 2 million people), tuberculosis from which die up to 1.6

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million people, malaria that causes the death of 1.3 million lives every year, and the percentage of mortality from viral hepatitis, other sexually transmitted diseases, hemorrhagic fevers and other infectious diseases is not negligible. It is also believed that more than 15% of all malignant diseases of infectious etiology. The highest percentage of occurrence of infectious diseases is recorded in underdeveloped countries, while in developed countries, despite the progress in eradicating traditional ones, new infectious diseases have emerged, with a completely new clinical picture and causative agents[3].

Excessive, uncontrolled use of antibiotics and other antimicrobial drugs in medicine, as well as agriculture, leads to more and more resistance to the same in microbial populations, and it is thought that as a result, 700,000 people die every year in the world. According to WHO estimates, unless we manage to solve the problem, by 2050, antibiotic resistance could take 10 million lives annually. In relation to the problem of antibiotic resistance, the United Nations addressed the General Assembly in the past year, and it was only the fourth time in history that there had been a discussion of a health problem, indicating its significance and dimensions. G20 leaders also signed a global health declaration that includes combating resistance to antibiotics. So it is a great challenge that world leaders will have to deal with seriously.

The occurrence and development of infectious diseases are influenced by various factors, including climate change. Due to the effect of global warming, the average air temperature in the 20th century increased by 1.3 ° C; pollution of water and air is increasing, as well as the lack of drinking water, food and energy, which especially favors the development of various infectious diseases and inevitably leads to endangering natural habitats and natural life cycles. Taking into account the pathways of transmission of infectious diseases, it can be concluded that they are particularly susceptible to the influence of time and climate, since climate change affects all participants in the transmission cycle: pathogens, vectors,

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reservoirs and people, and thus represent a significant factor in the development of various infectious diseases and their incidence in the human population (e.g. malaria, hemorrhagic fever, viral encephalitis, etc.)[4].

The constant migration of the population, like those we encounter in recent years, also allows the migration of microorganisms. According to official estimates of the WHO and the EU, there is no increased risk for the incidence of infective disease in Europe due to the influx of a large number of people from the area of high epidemiological risks, and the possibility of importing contagious diseases is no greater than the danger posed by international exchange of people and goods, but health risks still exist. Infectious diseases are primarily associated with poor living conditions and poverty, and many of them, such as AIDS, viral hepatitis, syphilis, tuberculosis, leishmaniasis, malaria and other diseases, which are present in a significantly higher percentage in the areas from which migrants come in relation to European territory. Also, there is an objective risk for the occurrence of diseases that were not prevalent in our geographical area or are present in a negligible percentage, while these diseases are endemic for the area from which migrants come (Denga hemorrhagic fever, yellow fever, West Nile virus, MERS, SARS, Zika, Ebola). Among the migrants in transit through Serbia there are no registered health conditions that could endanger the local population, but it has been found that more than 9,000 of them do not have information on the received vaccines against infectious diseases, although so far in our accommodation centers there are no infections of poliomyelitis, tuberculosis, salmonellosis, cholera, malaria ... So, there are risk factors for the emergence of epidemics of infectious diseases among migrants in our country, which requires adequate prevention and preparation for timely response[5].

Throughout human history, from biblical to our day, infectious diseases have had a major impact on humanity and have significantly changed the geopolitical image of the world (plague, smallpox, Spanish flu, etc.). These

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diseases still have enormous significance because, as noted above, despite significant scientific progress, there is still no solution or adequate response to many diseases caused by microorganisms. In the fifties of the last century it was believed that the battle with infectious agents was finally won thanks to vaccines and powerful antibiotics, and that, according to Mac Farlan, was the end of one of the most important social revolutions in history which outcome was the elimination of infectious diseases as a significant factor of social life. However, this thesis did not endure the exam of time, and the infectious agents (new or old and re-emerged) still affect the geopolitical shaping of the world today.

The emergence and spread of infectious diseases and the change in their epidemiological, ecological and clinical characteristics are significantly influenced by the properties of the pathogens themselves, the ecological characteristics of endemic areas, the distribution of reservoirs and transmission vectors, pathways of transmission, immunological status and genetic predisposition in the population, weather and climatic conditions, urbanization and globalization with all the negative impacts for human health and ecological balance. Namely, the rapid transport of people and goods, it is estimated that around 800 million people travel each year, allowing any material to be transported to any other point in the world within 24 hours, enable the possibility of rapid transfer of microorganisms and their potentially vectors, via direct transfer or through infected individuals. People's movements are very common and fast, which increases the possibility of unimpeded and quiet spread of infectious diseases, especially those with a longer incubation period. The globalization of the production process, especially in the food industry and food biotechnology, also facilitates the spread of various infectious agents-bacteria, viruses, parasites, prions.

Given the medical, environmental, economic and political consequences of possible epidemics and pandemics of infectious diseases the same can be seen as a special security challenge and risk, as evidenced by the fact that this issue is specifically considered in the National Security Strategies of the most developed countries of the world, as well as collective security organizations (UN, NATO, ODKB, EU). Possible use of microorganisms for terrorist purposes can also be viewed as one of the leading security threats in today's world of global contradictions, and this issue is particularly actualized since the 2001 anthrax campaign in the US, as well

as the later epidemics of SARS, avian influenza, Ebola and Zika viruses, and swine flu pandemics with all the controversies that followed them.

Therefore, it is undisputed that microorganisms are realistic and ubiquitous threat, with the incalculable consequences for health, the environment and society, thus posing a serious security risk by themselves, while the unlimited possibilities of manipulation that science and technology provide in this domain today arouse a real fear of their abuses and applications in war and bioterrorist acts, especially in the context of the contemporary accumulated civilization contradictions.

Epidemics of infectious diseases are often the natural companion of emergency situations, especially natural disasters that are increasingly occurring. Over the last ten years, natural disasters in Europe have been thought to have affected more than seven million people and have caused damage estimated at around 60 million Euros. The most significant health consequences of natural disasters include death and injury as well as subsequent disturbance of ecological balance, destruction, pollution of water, food products, which can lead to deterioration of living conditions and as a consequence - the emergence of an infectious diseases epidemics, poisoning, psychological disorders and deficit in nutrition. In this regard, the organization and preparation of health services for dealing with such situations (immunization, sanitation, good disposal of waste materials and corpses, adequate water quality, safe food) is of crucial importance[6].

In the past period, no significant epidemics have been recorded in the Republic of Serbia. Some diseases occur sporadically every year, but this has not significantly affected the population of humans and animals. However, there is a permanent risk of the introduction of certain agents which may endanger the health and life of humans and animals and / or lead to major health, social and psychological and economic damage to the state. In this context, as has already been said, large population migrations from the zone of epidemiological risks should also be taken into serious account. Also, year after year there are new and more dangerous infectious diseases of animals that can significantly endanger the health of people and animals and / or shake the economy. The essence of the problem is that we must be aware that the danger of such a phenomenon exists and that we must prepare for the prevention of them.

[6] Friis, R. H., & Sellers, T. (2013). *Epidemiology for public health practice*. Jones & Bartlett Publishers.

Defense against pathogenic microorganisms in our country represents a complex and continuous activity of the whole society, followed by a series of regulations, the most important of which is the Law on Population Protection against Infectious Diseases, which came into force on March 4, 2016. This law regulates the protection of the population against infectious diseases and special health issues, determines infectious diseases that endanger the health of the population of the Republic of Serbia and whose prevention and suppression is of general interest to the Republic, the implementation of epidemiological surveillance and measures, the manner of their implementation and the provision of funds for their implementation, exercising supervision over the enforcement of this law, as well as other issues of importance for the protection of the population against infectious diseases[7].

6.2. Epidemics which have changed the courses of history

Many epidemics devastated the planet in the past, changing the course of history and shaping the geopolitical architecture of the world. In the natural form, most of the troubles have been caused by the smallpox and influenza. Viruses are the simplest microorganisms that are the smallest and most abundant. They are replicated only in a living cell, and are considered to be energy parasites. The incredible power of these nano-particles has evolved repeatedly in human history. Viruses were always intriguing to use in the form of biological weapons. Smallpox virus was used in the British soldiers' war against American Indians in the period from 1754 to 1767. In the epidemic caused by the "humanitarian distribution" of contaminated blankets and tissues, more than 50% of affected population died. And within the Japanese biological weapons program, during the Second World War, viruses had a special place in monstrous experiments in which thousands of people were killed. The influenza, smallpox, tick-meningoencephalitis virus, and many others were used. During the Cold War and the biological weapons development race, even after the signing of the Biological Convention, both the greatest superpowers of that time paid much attention to exploring different viruses that could been used as

[7] Закон о заштити становништва од заразних болести („Службени гласник РС”, бр. 125/04 и 36/15) Law on the Protection of Population from Infectious Diseases ("Official Gazette of RS", No. 125/04 and 36/15) (In Serbian)

weapons. The Japanese cult Aum Shinrikuo was also interested in and trying to obtain numerous viruses, including Ebola virus.[8] Due to the discovery of new viruses, their number and importance among potential biological agents is increasing. Also, genetic engineering and biotechnology have opened the door to the possibility of modifying existing and creating new viruses whose effects would be unimaginable. As potentially biological weapons, these microorganisms are becoming more and more important because the genome of most viruses is known that facilitate their detection, but at the same time opens a wide field of possible manipulations. For most virus-induced diseases, there is no adequate therapy, no specific protection, while the diagnosis of the virus is complicated and difficult and requires the application of high biosafety standards.

Filoviruses, whose main representatives are *Marburg* and *Ebola*, are filamentous in appearance, 660-790 nm in length and 60-80 nm in width. They are very pathogenic. Their reservoirs are not known, and interhuman transfer makes them particularly dangerous. They cause severe hemorrhagic fever with a mortality of up to 90%. *Marburg virus* was first described in the German city of Marburg and Belgrade in 1967 among laboratory staff infected from green monkeys imported from Uganda to prepare a vaccine against childhood paralysis -poliomyelitis. *Marburg virus*, according to the testimony of ***Ken Alibek***, took a significant place in the biological weapons development programs in the USSR, and researcher ***Nikolaj Ustinov*** accidentally got infected when working with this virus. Soon he began to show signs of severe illness. As a true scientist, he kept a diary on the development of a disease that led him to safe death, due to intense bleeding, even from the skin's pores. From his mortal remains, a deadly viral strain was isolated and purified, which has been used as an aerosol in experiments with animals confirming his deadly effects. Ebola virus was first described in 1975, the first epidemics were recorded in southern Sudan and Zaire, and after that the presence of the virus was detected in other parts of Africa. The virus can be obtained by touching the blood or body fluids of infected people or animals. Men who have survived the disease can transmit it through sperm for up to two months. Ebola is not

[8] Ristanovic E. (2015) Bioterrorism:prevention and response. Library Military Book No.1392, Odbrana Media Center: University of Defence, Belgrade, ISBN 978-86-335-0458-4

transmitted by aerosols. Patients with signs of hemorrhage die very quickly in the acute phase, before the onset of antibodies[9]. In the Ebola epidemic in West Africa in 2014, which, according to estimates, is the biggest in the history so far, according to WHO, in Guinea and Sierra Leone, 17,223 people have been affected. The presence of the virus was laboratory confirmed in 12,025 persons, while 6,475 people died. There were 10,672 ill people in Liberia and 4,808 people died. In Nigeria, 20 people were ill, 1 in Senegal, and 8 in Mali, but no further spread of the disease has been reported. Imported cases were recorded in Great Britain, Italy, Spain (one in each) and the USA (4 patients, 1 deaths). And this epidemic has caused numerous speculations, including those on a possible bioterrorist background. The researchers officially came up with promising results about an Ebola vaccine.[10] However, the drug for this virus is not yet available [11]. The Ebola virus was very attractive to carriers of the biological program during the Cold War, and experiments were carried out on its crossover with the virus of the variola, in order to increase the efficiency and killing of this weapon.

Smallpox virus belongs to the family ***Poxviridae***, its size is 400nm. The genome of the virus is a linear two-strand DNA containing information for the synthesis of about 200 proteins. Due to the size of the genome, it is difficult to make a synthetic copy of the virus. The virus has a complex symmetry and structure, and on the surface there is a lipoprotein coating. It is transmitted through aerosols and air drops by direct contact with an infected person, as well as through contaminated water, food and articles. Variola is a highly contagious disease. Incubation period takes 12-14 days. The illness begins suddenly, with flu-like symptoms, and after that there occurs a characteristic rash, first on the face, hands and forearms, and then on the hull. These lesions also occur on mucous membranes, passing through several stages, from maculopapular rash, through vesicles to crustaceous changes - scars. The two most common forms of the disease are *variola major* (severe clinical form, mortality up to 30%) and *variola minor* (milder clinical course, mortality lower than 1%), while the heaviest

[9] Groseth, A., Eickmann, M., Ebihara, H., Becker, S., & Hoenen, T. (2001). Filoviruses: Ebola, marburg and disease. *eLS*.

[10] Centers for Disease Control and Prevention. (2014). Ebola outbreak in west Africa.

[11] Zhdanov, K. V., & Holikov, I. V. (2015). Disease caused by the Ebola virus&58; from theory to practice. *Žurnal Infektologii*, *7*(1), 5-17.

forms are hemorrhagic and malignant varieties. Illness cannot be transmitted from an infected person during incubation. Contagiousness is greatest at the time of temperature rise and during the first week of rash occurrence. Symptomatic therapy, as well as vaccination, is used to treat the smallpox. Otherwise, the vaccine against variola was the first vaccine in history. It was made by the late 18th century by English farmer ***Edward Jenner***. The method of Jenner opened the way to the vaccination launched in the 20th century by the WHO, thanks to which variola was officially eradicated in 1979. It is necessary to point out that the anti-variola vaccine can be applied and post-exposure, which is very important in providing protective immunity. The level of protection is the highest in the first five years after primo-vaccination, and after the third dose is maintained for up to 30 years. Compulsory vaccination was discontinued after eradication.

Otherwise, variola is considered one of the most deadly diseases in human history. It first appeared in China and the Far East 3000 years ago. Pharaoh Ramses V died from variola in 1157. BC. It appeared in Europe in 710. At a time when Spanish conquistadors conquered the New World, variola was powerful biological weapon for the subjugation of the mighty empires of Aztecs and Incas. When Hernan Cortes landed on the coast of Mexico in 1519, he led only 600 concavisters, but on board with them were the goods infected with variola, and the epidemic that killed nearly half of the indigenous population was buried. Similarly, Francisco Pissarro conquered the Inca Empire. In 1531 Pissarro landed on the coast of Peru with only 168 soldiers, but it had incredible "luck" because variola arrived by land in 1526 and killed the majority of the population. At the beginning of the 18th century, variola was the deadliest disease of the Old Continent and killed about 400,000 Europeans a year, including five rulers. Among the lucky ones who suffered from the disease were American statesmen George Washington and Abraham Lincoln, but also the famous composer Wolfgang Amadeus Mozart who got infected as an 11-year-old boy during the 1767 epidemic. Between 1896 and 1910 in the great epidemics in Serbia 38,953 people died from variola. It is assumed that between 300 and 500 million people died from variola in the 20th century. In 1967, the WHO adopted a plan for disease eradication, and the last case was recorded in Somalia in 1977. Global eradication was confirmed officially in 1979.

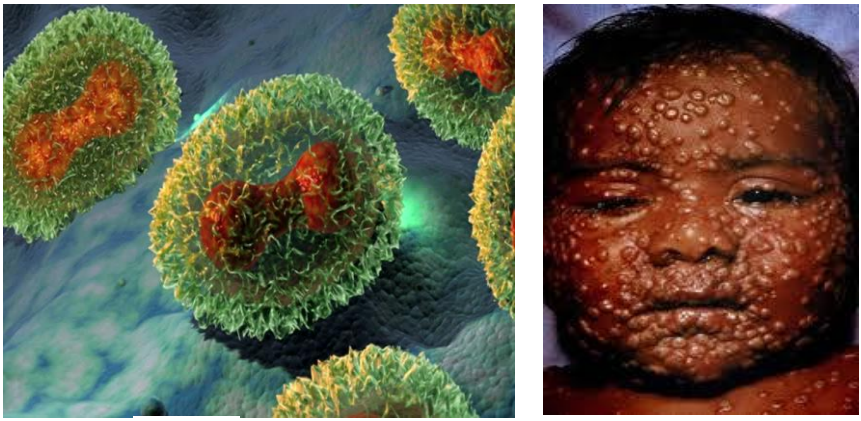

Figure 1. Smallpox virus and clinical picture of the disease

The epidemic in Yugoslavia in 1972 is the largest post-war smallpox epidemic in Europe. And there were doubts and speculations that it might have been a bioterrorist attack on Tito's Yugoslavia, although scientific facts do not support this claim. In the epidemic, a total of 175 people were infected and 35 people died (20%). Among the patients there were 99 (56.6%) men and 76 (43.4%) women. Most of them were in the Republic of Serbia (174 people were infected, 124 of them in the province Kosovo and Metohija (K&M), and 1 in Vojvodina; 35 people died, 26 of which in K&M and 1 in Vojvodina), and 1 person in Montenegro. The epidemic was discovered on March 14, 1972. Since the last case of variola in Yugoslavia was recorded as early as four decades before this epidemic, in the 1930s, doctors had no practical experience in diagnosis, nor did they have sufficient knowledge about epidemiology and combating against this disease.

Therefore, the diagnosis of the disease was established late, although most patients in the first generation had a typical clinical picture of the variola. An epidemiological and serological study found that a disease was introduced by a pilgrim - Hadji Ibrahim Hoti from the village of Danjane near Djakovica, who had visited Mecca and Medina (Saudi Arabia) with 24 Hajiyah from K&M, and returned by bus through Iraq, visiting the Dervish Shrine in the vicinity Basra and Baghdad where there were more cases of variola in that period. Upon returning to the village, Mr. Hoti, in his own words, suffered from a clinically undiagnosed illness (fatigue, anger, trembling), while on his face he had several smaller pimples. During the

medical exam, a month later, on his face and body were found neither scars, nor the traces of vaccination, although it was done in December, 1971 at the Institute for Health Protection in Skopje (Macedonia), about which there is a document. All pilgrims were vaccinated against variola by lyophilized vaccine produced in the Immunological Institute in Zagreb (Croatia), as well as against cholera. Success of vaccination was not controlled. By testing the sera of pilgrims who travelled by bus in which was Mr. Hoti, it was found that 20 of them did not have a satisfactory titer of vaccinal antibodies, which opened many issues related to vaccination failures. Otherwise, the measures for controlling passengers coming from the infected areas were implemented, in line with the WHO estimates. Pilgrims were regarded as a particularly risky group, and there was a request to go on pilgrimage in organized manner, by plane, with previous sanitary treatment, health control during the trip, as well as medical supervision upon return, which was mainly done in agreement with the Islamic community, but there were also private arrangements, as that in which traveled the person who had the disease.

The circumstance that in the WHO report Iraq appeared for the first time as an infected area in the first half of March 1972, and that the disease existed two months earlier, had a negative effect on the epidemiological research of the tracked groups, as well as the fact that the first case of illness or the index case was atypical. All pilgrims stated that they were healthy during the trip. They were all revaccinated at the time of the epidemic. Serological examinations were carried out subsequently at the Institute "Torlak" in Belgrade, the reference national laboratory for variola, and confirmed in the laboratory of CDC in Atlanta (USA). The epidemic developed in the K&M region in three generations. The number of secondary illnesses from one source of infection was closely related to the length and intimacy of contact between patients and vulnerable people, and it depended on the clinical form and stage of the disease. It was noted that one patient, Ljatif M. who had a hemorrhagic form of the disease, in direct contact caused a total of 38 diseases, which is the largest recorded number until then. The average incubation during the entire epidemic was 11.3 days. Differences in incubation incidence between vaccinated and non-vaccinated were not observed. Of the 175 patients in the epidemic, 105 (60%) were previously vaccinated, 66 (37.7%) were no vaccinated, while for 4 (2.3%) of them the vaccinal status was unknown. Here it is necessary to point out a large difference in the lethality level between previously

vaccinated (8%) and non-vaccinated people (35%). Totally, 52% or 91 diseased people were infected outside the hospital, while 84 patients or 48% were infected in hospitals. The exception to this percentage is the focal point in the province of K&M where the number of outpatient cases were twice as high. Otherwise, the common feature of the postwar epidemics of variola in Europe is that most of the patients were infected in hospitals, while in the case of the Yugoslav epidemic, the situation was reversed. The other specific characteristic of the epidemic in the primary focus, in KiM, concerned the fact that the focal point for intra-hospital infections in this area, other than the infectious, or congenital department, was not established, although the exact method of introducing the virus into the maternity hospital was not established. Otherwise, the epidemic's characteristic was a large percentage of diseased infants, 14% and 8% of the total number of patients, the highest number of diseased children of this age in all post-war epidemics of the variola in Europe. The first vaccine started on March 16th, immediately after the diagnosis of the disease. By the decision of the competent authorities, the Federal Epidemiological Commission, the vaccination was extended to the entire population of Yugoslavia, so that this measure included a total of 18 million people. The other specific characteristic of the epidemic in the primary focus, K&M, concerned the fact that the focal point for intra-hospital infections in this area, besides the infectious was also maternity department, although the exact method of introducing the virus into the maternity hospital was not established. Otherwise, the epidemic's characteristic was a large percentage of diseased infants, 14 (8%) of the total number of patients, that is the highest number of diseased children of this age in all post-war epidemics of the variola in Europe. The vaccination started on March 16th, immediately after establishing the diagnosis of the disease. By the decision of the competent authorities, the Federal Epidemiological Commission, the vaccination was extended to the entire population of Yugoslavia, so that this measure included a total of 18 million people. All health institutions in the country have taken adequate measures to combat variola. Health surveillance of the focal areas in the province of K&M included day-to-day sightseeing, temperature measurement and checking of skin and mucous membranes. In the search for contacts, only in Belgrade were performed about 3,000 surveys. Contacts were taken care of in special quarantine facilities, but there were also quarantines of individual households and entire villages. Restrictions on population movements from infected areas,

control of the success of vaccinations and the ban on public gatherings were widely applied. Relatively rapid extinguishing of the epidemic was also greatly contributed by the efforts of specially formed anti-epidemic units at all levels, good organization of health services, support of the Yugoslav National Army (JNA), as well as international solidarity and WHO assistance. Otherwise, the epidemic of the variola occurred before the beginning of the tourist season, so its rapid suppression was extremely important from that point of view. The health service in former Yugoslavia was seriously prepared for the case of variola virus importation within the organization of the fight against quarantine diseases, and the relevant experts stayed for several months in laboratories that dealt with the diagnosis of this disease in England and West Germany. After that, the Laboratory for Variola was established at the Institute of Immunology and Virusology "Torlak" in Belgrade, material preparation was carried out and state of the art diagnostic methods were established. The laboratory did not have a separate building, but it was housed in the Arboviruses department, and in the building for the whole virusology, including the production of viral vaccines. The entire staff of the virological sector has been vaccinated against variola. Laboratory one to two times a year tried out the methodology of work, updated positive sera and control antigens and repeatedly intervened, examining the material, in case of doubt about the variola introduction. The effectiveness and results of the work of the National Laboratory during the epidemic have been highly evaluated by WHO experts. Since the first days of the epidemic, the public has been informed by the competent experts about the onset and spread of the disease and the measures to be taken, and the relevant reports are published in the daily press. The WHO was informed of this, and the competent experts of this organization were invited to coordinate and objectively inform the world public. Otherwise, the work and coordination of all management bodies and state administration bodies in charge of health in Yugoslavia were at an enviable level. The Federal Executive Council (SIV) monitored the work and gave full support to the Federal Staff for the Fight Against Variola whose task was to collect and publish data on the movement of diseases, coordinate the work of the republic and provincial headquarters, procure and distribute vaccines and other resources and make other measures on the basis of an assessment of the epidemiological situation. Headquarters in the republics and provinces were the organs of the secretariats or executive boards, or municipal assemblies. The Army’s

medical service with all its capacities represented an integral part of the response of the health service and the society as a whole. Apart from all the problems that occurred during the work, without neglecting organizational, professional and other weaknesses, as well as the lack of practical experience, it can be said that the Yugoslav health service quickly and efficiently performed the task of suppressing the epidemic of variola, which was large and in the number of cases (175) and by geographic spread (25 focal points) and caused serious disorders of life and economy throughout the country. Failures that occurred during the eradication of the epidemic are related to the unintended introduction of variola (inadequate health and sanitary control), late detection of the virus(only at the beginning of the second wave, when there were already 11 patients in 6 focal points) and inadequate implementation of the prescribed vaccination of certain category of population that facilitated the spread of the epidemic (46% of those who were in the category that should be protected in the regular vaccination, and 8% among the staff of health institutions). The problem was also the fact that the basic anti-epidemic measure - the vaccination in the focus was not quickly implemented, and the lack of a single doctrine regarding quarantine, volume, control and restriction of population movement from and into infected areas - as well as within them. In this regard, there were also notifications that, in order to train a health service for the effective fight against quarantine and other infectious diseases, it is necessary to develop a unique medical doctrine, to strengthen the capacities for rapid laboratory diagnostics, to provide isolation and treatment facilities and special hospital departments for quarantine diseases, to strengthen the capacities of the health care institute with the training of mobile teams for field work, with the constant strengthening of the hygienic-epidemiological service and the sanitary inspection service, monitoring of the epidemiological situation in the world and the latest achievements in science, as well as conditions for their implementation. It was emphasized that a special point should be given to education and training of staff, as well as health education of the population.[12]

Although the virus has been eradicated, according to official data it is kept in only two laboratories- in CDC, Atlanta, USA, and in the Russian

[12] Ristanovic E, Gligic A, Atanasievska S, Protic-Djokic V, Jovanovic D and Radunovic M. (2016) Smallpox as an actual biothreat:lessons learned from its outbreak in ex-Yugoslavia in 1972. Ann Ist Super Sanita Vol.52 No.4 p.587-597 DOI: 10.4415/ANN_16_04_21

State Center for Virology and Biotechnology (VECTOR) in Koltosovo, near Novosibirsk, Russia. However, fears of its use as a potential biological agent is growing since it is a highly contagious agent, where one infected person can transmit the infection to 10 to 20 others, and therefore require special care measures for patients (rooms-insulators with negative air pressure and associated protective equipment that prevents the spread of infection) as well as in microbiological work with samples of materials (laboratories with the highest, fourth level of protection). Everything would cause enormous problems in the work of both health and all other public services. In addition, the virus is well genetically explained and can be easily genetically altered in order to prevent the functioning of the vaccine or increase virulence, it is easy to cultivate, and in a relatively short time it is possible to produce large amounts of virus,that is very resistant to the environmental agents, so it can survive for years and months. It also creates stable aerosols. Its applying as a biological agent would be also supported by the fact that a large part of the world's population is sensitive to this virus, since the vaccination has stopped immediately after eradication, that mortality is high, and that there is no specific therapy. The fact that the variola use as a potential biological agent is seriously taken into account today is the fact that in the last years of the 20th century in the USA and some other countries of the world started intensive production of vaccine against variola.[13]

Human immunodeficiency virus (HIV) belongs to the family of retroviruses, and causing the so-called syndrome of acquired immunodeficiency known as AIDS. This unusual syndrome was observed in 1981, and the virus itself was identified and isolated after four years. The existence of two types of viruses is confirmed: a highly virulent HIV-1, the main AIDS causative agent in the world and less virulent HIV-2, which is localized to parts of western Africa. However, both types of virus originate from central, sub-Saharan Africa, from the SIV (simian immunodeficiency) virus that causes the immune deficiency of African green monkeys. It is believed that the evolutionary leap of virus from species to species took several hundred years. The targets of HIV virus attack are CD4 + T lymphocytes, very important parts of the immune system. The virus leads

[13] Ristanovic E. (2015) Bioterrorism: prevention and response. Library Military Book No.1392, Odbrana Media Center: University of Defence, Belgrade, ISBN 978-86-335-0458-4

to their ultimate destruction, and thus to a complete weakening of the immune system, which opens the way to invasion of the viruses, bacteria, fungi and parasites, but also the appearance of malignant tumors. HIV particles bind to CD4 receptors on the target cell, allowing their penetration into the cell. However, they need another coreceptor, which is a CCR5 or CXCR4 molecule, also found on the membranes of these cells. It is believed that the people to whom these receptors are missing or have been changed are resistant to the AIDS. HIV can be transmitted through body fluids, by sexual contact, by transfusion of blood and blood products, using a needle of intravenous drug use addicts, through placenta (between mother and fetus), breastfeeding (from mother to infant) or accidentally by sting. The HIV virus has an envelope made up of proteins and fats that makes it susceptible to disinfectants and solvents, and is also highly resistant to the external environment, as well as at elevated temperatures.

The global AIDS epidemic is a major problem today. According to WHO estimates, at the end of 2015, about 37 million people worldwide were infected with HIV in 119 countries, and 1.5 million people died. Since the onset of the epidemic, 78 million people have been infected with HIV, while 35 million people have died of AIDS. The epidemiological situation is particularly severe in sub-Saharan Africa, where every 20 people are infected. In this area practically live 71% of the world's infected people. While science sought an explanation of the origin, pathways of transmission, and methods of treatment, almost the same speed as the virus itself spread the conspiracy theories about him, including those that the challenger side was created in the laboratory as a biological weapon for the destruction of the black race and homosexuals, that behind the onset of HIV are the financial interests of the pharmaceutical industry that is made to earn on drugs for people who are extremely expensive. An effective vaccine against HIV does not exist.[14]

Influenza (flu) is an infectious disease caused by viruses from the ***Orthomyxoviridae*** family. It is most commonly characterized by severe general-state disorders mainly with upper respiratory tract problems. It is transmitted through aerosols or in direct contact with contaminated hands and surfaces. The influenza virus consists of a genetic material surrounded by a protein and lipid coat from spring up the hemagglutinin (N) and neuraminidase (N) proteins, which are key antigens of the virus. There are

[14] McInnes, C. (2006). HIV/AIDS and security. *International Affairs,82*(2), 315-326.

three types of influenza virus: **Type A** is the most dangerous, attacks many mammals and birds, causes most of the disease in humans, mainly causing epidemics and pandemics, **type B** can also cause epidemics, while **type C** only causes mild disease and does not cause epidemics. Due to the genome structure consisting of 8 segments, RNA types of A and B viruses are constantly changing by either small changes caused by spotting mutations (antigenic drift) or major changes (antigenic shift) that involve recombinant alteration of the genetic segments of hemagglutinin or neuraminidase, resulting in the emergence of new virus subtypes. The antigenic shift occurs in influenza A type of virus, probably because this type of virus circulates in the animal and bird population, while for types B and C are characteristic only antigen drift changes. Inflluenza usually occurs in smaller or larger epidemics, while at the intervals of around 30 years appear the world pandemics. Every year, millions of people worldwide suffer from this disease, and about 250,000 people die. Mortality is less than 1%. he Economic consequences of influenza epidemics are significant because the emergence of a large number of patients requires high medical costs annually, as well as non-medical loss related to absenteeism, sick leave, etc. According to some calculations, economic losses caused by the epidemic amount to $ 1-3 billion. Experts believe that all influenza viruses come from viruses in wild ducks and other aquatic poultry. Some of them have crossed over to people thousands of years ago. There are historical data on major influenza epidemics in Europe in 1510, 1557 and 1580. This latest epidemic has spread to Africa and Asia and has grown into the first known pandemic. Pandemics also appeared in 1729, 1732, 1781, 1830, 1833, and 1889. This latest, known as the "*Russian flu"* because it came to Europe from the East and represents the first detailed pandemic described. In the 20th century, pandemics were recorded in 1918, 1957 and 1968. Pandemic 1918/1919 was the most destructive in recent history. It started at the end of the First World War and took 40-50 million lives, twice as much as the war itself. It is not certain where it started, but it was called the ***"Spanish flu"*** because of the first major consequences it brought to Spain. It is caused by influenza A virus H1N1. The disease was extremely deadly, and people aged 20-40 years also died, which is unusual for the flu. Pandemics of the ***"Asian Flu"*** in 1957 caused by the H 2N2 virus with about two million deaths and the ***"Hong Kong Flu"*** caused by the H 3N2 virus that took millions of lives are also known. In addition to tens of millions of people suffering and millions of deaths, each pandemic has also trigerred the

socio-economic collapse of the society, with a recovery that lasted for several years. The consequences of the pandemic were catastrophic, due to the unpreparedness of governments to face and respond rapidly to the emergence of a large number of diseased and dead people in a very short period of time. As a result, all countries of the world maintain and improve systems for influenza surveillance, especially in the light of the International Health Regulations. The twelfth and first century began with the pandemic of H1N1 swine flu, which is a result of mutation of human, avian and pig virus. The pandemic was declared in 2009. According to WHO statistics, in this pandemic, 18,000 people died, although the number is considered to be larger and ranging to 284,500 because the previous figure refers only to those laboratory confirmed cases. However, given that many of the unknowns about the structure and immunological status of patients who died of this flu, the rapid finding of the vaccine and all the economic and other impatients that followed the vaccination process, various speculations have been awakened, especially in the context of the often mentioned fact that each pandemic in human history had a *"socio-political background",* as well as a scientifically verified and published fact that several years before the swine flu, in 2005, the corpse of a woman who died from Spanish flu was exhumed in Alaska. Spanish flu H1N1 genome was reconstructed from its sample, which was later the subject of various manipulations and recombinations with other types of influenza viruses. Otherwise, the influenza virus is good candidatefor possible use in the context of bioterrorist actions due to the possibility of aerosol transmission, high virulence and the possibility of genetic alterations that are facilitated by the segmented genome structure as well as due to economic, medical and other consequences caused by potentially outbreak.

Cholera is an acute intestinal infection caused by the *Vibrio cholerae*. The massive epidemic in India, which represents the endemic foci of the disease, has been recorded since the 6th century BC. until the beginning of the 16th century. At the beginning of the 19th century, cholera is spreading to all continents in pandemic proportions. In the Balkan and World War I, more than 15,000 Serb soldiers and officers died from cholera, and the disease was also affected by the civilian population. The last epidemic in Europe was recorded in 1922 in Russia. In World War II, within the biological program, the Japanese produced 100 kg of biomass per month. Until the adoption of the Convention, all countries had cholera in biological weapons arsenals. Otherwise, cholera is a low-lethality disease. It can be

disseminated by contamination of water or food. Interhuman transfer is possible. Vaccination with live or dead vaccine of variable efficacy is used in prevention. Treatment is performed symptomatically, including rehydration and the use of antibiotics. [15]

Rickettsioses are zoonoses caused by bacteria of the order of *Rickettsiales*, demanding microorganisms and potential biological agents. The *Rickettsiacae* family includes spotted fever (> 20) and typhus-causing agents (most notably *R. prowazekii*). Vectors of these diseases can be flies, mites, mites, ticks. Symptoms and signs of rickettsioses are a sudden occurrence of high temperature, myalgia and headaches, skin changes with an inoculation lesion, and a characteristic rash. Timely antibiotic treatment is generally successful. Today, rickettsiales are widespread, and thanks to the advancement of molecular biology, new pathogens are constantly being discovered. On this basis, it is right to ask whether it is a matter of emerging diseases or an old, but still current problem. But let's start in line. Epidemic typhus is known and described even in ancient Greece in the 5th centuries BC. In the New World, it was first described in Mexico in 1517. In that area, 2,000,000 Indians died of typhus. It was widespread in Europe, especially in wartime. In Russia, in the period 1918-1922. 3,000,000 people died from typhus. The first epidemic in the Balkans was recorded in the 16th century. During the First World War in Serbia, about 150,000 people died from this disease, and all the doctors that our country had sick then. This epidemic of typhus in Serbia in terms of the number of victims is among the largest that the world knows. Intensive discussions are still underway as to whether it was only poor sanitary conditions in the war that contributed to the onset of the disease, which throws a new light on the consideration of major epidemics as security challenges and risks. That is why it is important to conduct extensive research in the context of today's knowledge, referring to the credible sources of Serbian doctors and allied missions that were at that time in our area. Of course, several important facts should be taken into account. Namely, public health studies in Serbia at that time showed that in 1912 there were no patients with typhus in the territory of Serbia. The pediculosis was suppressed and constant controls were carried out. On the other hand, in the Austro-Hungarian army, the problem of combating the typhus spread in wars was a constant task, due to the hotspots in Poland and parts of Bosnia and Hercegovina (the Tuzla

[15] Barua, D. (1992). History of cholera. In *Cholera* (pp. 1-36). Springer US.

District Command). Military bonds lived in a local area carried the disease with them, spreading far from their homeland, and the Austro-Hungarian military authorities registered this disease as a permanent phenomenon. In the late autumn of 1914, Austro-Hungarian soldiers began to show symptoms of disease, and their command collected all the sick and wounded in a war hospital in Valjevo. After the victory in the Kolubara battle, Serbian soldiers liberated Valjevo and pierced a terrible picture in the hospital, where wounded and diseased were together, under the care of some Czech physicians and some nurses left with them. In the basement of one house, Serbian nurses found one hundred and fifty dead bodies of people with typhoid fever who were not buried for several days. Additionally, a large number of Serb refugees flocked to Valjevo where there was not enough place for their care and adequate hygiene protection, which led to the appearance of pediculosis, and the first cases of typhus appeared. The relocation of refugees to the interior of the country has been favorable to the emergence of a epidemic in Serbia. Physically exhausted Serb soldiers and refugees, women, children and elderly people, due to lack of laundry, unhygienic accommodation and inadequate nutrition, massively became ill in the epidemic, and a large number of people died. The few Serbian doctors, mostly educated in the most prestigious medical centers of the then Europe, have made superhuman efforts to care for the sick and the wounded in such conditions, pointing to the need for emergency assistance. At that time, there was only a Russian surgical team led by ***Dr. Sofoterov***, who arrived in Serbia in August 1914 to help care for the many wounded in the Battle of Cer. The Serbian authorities turned to allies for help and soon a French medical mission arrived with about a hundred members. The twenty-five-member UK mission, headed by ***Colonel Dr. Hanter***, came to Serbia with the government's mandate to study exclusively the typhus epidemic and find measures to prevent the spread of disease. Upon the recommendation of Dr. Hanter, a "Serbian barrel" was created and two medical trains for preventive disinfection and bathing were formed in order to prevent the spread of the disease into the interior of the country. The successful implementation of these measures halted the epidemic wave in two weeks. ***Dr. Richard Strong***, head of a US medical mission, citing an example of a surgical hospital with 400 beds and 1,600 patients, of which 1,100 patients with typhus, testify that such a large number of patients could not give any care or attention, and concludes that *"The epidemic of the typhus that happened in Serbia in 1915 was one of the most horrible the*

world of modern times knows." Dr. William Hunter, noted that it was known that 1,000 ill people could be seen in a year, but that he had never read that 1,000 ill people can be seen in one day and pointed out that the epidemic of typhus in Serbia in 1914/15 was the most suddent epidemic in emergence, the fastest in spreading, the highest in intensity and the fastest stopped from all epidemics in history. This British also wrote that "the epidemic of a in Serbia is an example of an unwanted bacteriological war, because the army of the monarchy from Bosnia had a huge number of carriers of the cause of the disease and that there is evidence that the patients were poorly cared in a hospital in Valjevo".[16]

Figure 2. Typhus during World War I: "inadvertently" bacteriological war against Serbia

The ending of the epidemic was the result of a brilliant medical decision on preventive measures, but also the engagement of authorities to implement the given measures as well as the responsibility of the entire population. And in the Second World War, the typhus also left a large number of victims among the fighters and the people.

[16] Ristanovic E. (2015) Infectious Agents as a Security Challenge: Experience of Typhus, Variola and Tularemia outbreaks in Serbia. (In English) Original Scientific Papers. UDK-343.326:616.9(093.2)(497.11) Bezbednost. Beograd.Časopis MUP RS, Godina LVII, No.2 p. 5-20

The occasional phenomenon of rickettsioses in war time is certainly affected by poor hygienic and sanitary conditions. Nevertheless, the use of these agents for the purpose of biological warfare has always brought special attention. Japanese biological weapons researchers in the period from 1935 to 1945. carried out intensive research on rickettsiae, and for this purpose experiments were performed with aerosol dispersion of insects, possible vectors of rickettsioses, mites cultivation, etc. Soviet and American experts believed that rickettsioses were the most suitable for operational use as biological agents, and their use was also suspected during the Corean War. The rickettsiosis causative agents - *R.prowazekii, R.typhi, R.rickettsii, O.tsustugamushi* are nowadays officially classified in class B of potential biological agents. According to WHO estimates made in 1970, a hypothetical aerosol dissemination of 50 kg of typhus-causing agent to a city of 500,000 inhabitants would cause death of 19,000 and disable 85,000 people. Otherwise, the lethality of this disease is up to 30% in untreated patients, mainly as a result of generalized sepsis. High infectivity and contagiousness, diverse pathways of transmission - through arthropod vectors, blood and aerosols, lack of ability to quickly identify rickettsia always and everywhere, clinical manifestations that often resemble other diseases and the absence of effective vaccines, except for the feverish typhus, make the rickettsioses causative agents potentially effective biological agents. In this area, very intensive research efforts are in place to develop effective recombinant vaccines.[17] As we have already said, *R.prowazekii* and the diseases it causes - typhus and its recurrence, Brill-Zinsser's disease is registered and documented in our geographical area, especially during wartime. The presence of other rickettsiales has not been investigated so far, although it is necessary, especially since each year a large number of patients with symptoms typical of rickettsioses (rash, hemorrhage) have been reported and endemic in the south of Serbia, K&M, Montenegro, with etiologically unconfirmed the presence of viral haemorrhagic fevers, which are transmitted by ticks, ans rodents as their reservoirs. Therefore, a few years ago, a study of the seroprevalence of rickettsioses in Serbia began, and the first results speak in favor of a marked presence of these bacteria, so research should be intensified in

[17] Ristanovic E. (2015) Bioterrorism:prevention and response. Library Military Book No.1392, Odbrana Media Center: University of Defence, Belgrade, ISBN 978-86-335-0458-4

order to study their distribution. *Coxiella burnetti*, Q-fever causer and potential B-agent, does not belong to the *Rickettsiaceae* family anymore, although it has previously been classified into the same. Q-fever can be acute or chronic. Its reservoirs are mammals and birds, and vectors are usually ticks. A person is mainly infected with inhalation of contaminated dust, and Q-fever represents the most common occupational disease of people working with infected animals and their products. The disease begins after an incubation period of 1-3 weeks, with high temperature, fever, preorbital headache, muscle aches. Atypical pneumonia develops, and the main target cells are the alveolar macrophages. It can also develop hepatitis and endocarditis. The disease is often subclinical and asymptomatic. Expressed extracellular stability, greater resistance to chemical compounds, the possibility of parasitization in different hosts and the ability to transmit to humans by aerogenic pathways, low infective doses and high contagiousness make this bacterium a potential biological agent.

Legionary disease. The bacterium *Legionella pneumophila* was first detected after a 1976 epidemic of pneumoniae broke out in a Philadelphia hotel, among US legionnaires gathered to celebrate the 200th anniversary of the Declaration of Independence. It was 221 ill people, and 34 died. Today, in the United States and Canada, about 18,000 people suffer from legionary disease every year. However, in our country this disease remains often unrecognizable and is likely to be found in a group of atypical pneumonia without a proven cause. The disease occurs when the bacteria with small droplets reach the lung alveoli. In the defense of infection, the cellular immunity plays a decisive role, but if the organism fails to defend itself, it can result in atypical pneumoniae called a legionary disease, or a milder form similar to the flu (Pontian fever). Incubation lasts from 2 to 10 days. Pneumonia is the main clinical feature of legionary disease. When it occurs in severe clinical form, apart from the lungs, liver, kidney, digestive tract and central nervous system may also be affected. Unlike legionary disease, the Pontiac fever is an acute respiratory disease without pneumonia. Although the disease caused by this bacterium occurs throughout the year, it is much more frequent in summer time due to higher exposure of humans to bacterial sources. Among them are air humidifiers, air conditioners and pools. So far, there has been no systematic investigation of legionary disease in our country, which is why it is little known to us about it. It is assumed that the number of patients is higher and

that a number of reported cases of so-called summer flu and atypical pneumonia caused by legionellae. Natural habitats of legionelles are rivers, lakes, streams and warm, polluted waters. The bacteria can survive in a wide range of ambient conditions: at a temperature of 0 ° C to 63 ° C and a pH range of 5.0 to 8.5, it is tolerant to chlorine and resistant to the process of chlorination of water. It is also widespread in water reservoirs and can colonize the water distribution network, which is an important pathway to spread legionella, which in this way can come to hospitals, recreational centers, households, our shower cabins. Aerosols, contaminated with bacteria, whose inhalation can transmit infection, can also be from air conditioning devices. Facilities that are generally air-conditioned, such as hospitals, hotels, or pensions, can be places where legionella infection spreads easilly. The sources are often fountains, waterfalls, hydrotherapy installations, air humidifiers, pools with turbulent water flow, and even ice-floating. The primary task during prevention is the control and disinfection of the reservoir of the infection, especially the water distribution network. Due to the diverse paths of transmission, aerosolization and difficulty in recognizing the disease, legionary disease is a suitable biological agent that could be used in terrorist attacks. According to the claims of the former Soviet biological weapons researcher ***Sergei Popov***, even genetic manipulations were carried out, so the mortality rate caused by this modified bacterium in infected animals was increased to almost 100%. Popov worked as a leading researcher at the Vecor Institute in Novosibirsk from 1976 to 1986, then in Obolenskaya until 1992, when he moved to the West, and settled in the US where he discovered many details from the Soviet biological weapons program.

6.3. Basic concepts related to infectious disease outbreaks

Epidemiology is a medical discipline that deals with the study of factors that influence the occurrence, frequency and distribution of infectious and other mass diseases, taking into account the ecological triage: the host. agent and environment. Epidemiology was profiled primarily as a science based on the study of contagious diseases in wartime conditions, and the

occurrence of these in wars and emergencies remains today its dominant field of study.[18]

An epidemic (Greece: epi- on, along, demos-people) of infectious diseases is the appearance of an infectious disease that, by its time and place of origin, and the number of affected persons, exceeds the normal condition and requires urgent action. There are always several conditions for the emergence of an epidemic: poor general hygienic conditions (housing, inappropriate food, inappropriate water supply, disposal of waste materials), unplanned migration of the population, especially natural and other disasters (floods, earthquakes, emergencies and war). In all listed situations, there is a disturbance of the state and appearance of the ecological environment, especially pollution of drinking water, disruptions of the distribution of waste materials, deficient food and unhygienic living conditions. According to epidemiological assessments, during the natural and other disasters, epidemics of infectious diseases can occur even ten times more often than during normal occasions.

A pandemic is essentially a major epidemic of an infectious disease, which spreads rapidly in people, on large spaces, to several states or continents. **Endemic** is a permanent presence or the existence of an infectious disease in a human community, which is always more pronounced in relation to other human communities in regions where there is no endemic disease. **Epizootics, panzootics and enzootics** are the appropriate concepts and manifestations of the spread of infectious diseases in domestic animals, while the concepts of **epiphytia, panepiphytia, and en epiphytia** relate to identical phenomena in cultivated plants.

An infected area is considered an area where there is one or more sources of infection as well as conditions for the emergence and spread of infection. **A threatened area** is considered an area where infectious disease from the infected area can be transmitted and where there are conditions for the spread of infection.

The most important concepts related to the frequency and distribution of infectious diseases in the human population are:

1. **morbidity** indicating the number of persons infected with a contagious disease in a particular area over a specific time period per 100,000, 10,000 or 1,000 inhabitants;

[18] Toole, M. J., & Waldman, R. J. (1997). The public health aspects of complex emergencies and refugee situations. *Annual review of public health*, *18*(1), 283-312.

2. **mortality** represents a relative number that shows the number of deaths from infectious diseases per 100,000, 10,000 or 1,000 inhabitants;

3. **lethality** is a number that shows how many out of 100 people have died of an infectious disease and are expressed in percentage,

4. **prevalence** is the number that shows how many infectious diseases are on 10,000, or 1,000 checked-outs of a group or inhabitants of a settlement.

In order for the emergence and spread of infectious diseases to occur, it is imperative that there are certain interconnected conditions, which are graphically marked as Vogralic chain links. Those are:

1. **source** of infection involving the host organism, the environment or material from which the causative agent can be directly transmitted to other susceptible hosts causing infection or disease. People and animals are sources of infection from the moment of infection, during illnesses and as convalescents, carriers and corpses of dead of infectious diseases. The reservoir of microorganisms is its natural host, in which pathogenic microorganisms are maintained and multiplied,

2. **pathways of pathogen transmission** are air, water, food, contact, soil, insects and animals,

3. **entrance or infection sites** are places through which the pathogenic microorganisms penetrate and inhabit the system of a new host (wounds, respiratory organs, skin, digestive organs),

4. **the number (dosage)** and **virulence (aggressiveness)** of pathogenic microorganisms are extremely important for the emergence and spread of infectious diseases (10-25 microorganisms of Tularemia and Q-fever causative agents are enough to cause infection, while 100,000 microorganisms are required to induce abdominal typhus).

5. **disposition** and **immunity** signify the organism's susceptibility to infection by pathogenic microorganisms [19].

Pathogenic microorganisms and their toxins cause people's diseases only if they penetrate all the links of the Vogralic chain. The basic forms of the

[19] Јовић, Р. Ц., & Савић, А. (2004). *Биотероризам, биолошки рат, биолошко оружје*. Институт за политичке студије, Центар за истраживање безбедности и тероризма. Jovic&Savic (2004) Bioterrorism, biological warfare, biological weapons. Institute for Political Studies, Center for research in Security and Terrorism (In Serbian)

dynamics of the infectious diseases spread are: explosive, turbulent (diseases that are caused by air, food and water, as well as in the application of biological agents) and gradually, quietly (diseases that are transmitted by contact or by soil). By increasing the number of patients, the number of sources of the disease is increasing simultaneously, and the constant increase in the number of infected and affected people causes an adequate reduction of the number of sensitive people to some pathogenic agent. Infectious diseases include a large number of diseases with very different symptoms, often specific depending on the causative agent. Symptoms of the disease can occur very quickly after infection, in a few days, several months or years, (e.g., hepatitis and AIDS), sporadically, in a smaller or higher number (epidemic), involving multiple countries and continents (pandemic) or occur only in a specific geographical area (endemic). Infectious diseases occur in people of all ages and both sexes, while some are more common in children, and some in adults or older.

An epidemiological surveillance, according to the WHO presents a continuous collection, analysis and interpretation of health related data for the planning, implementation and evaluation of public health practices and originally emerged in the form of epidemic registration. Records of the epidemic of plague in Egypt were found during the First Dynasty of Pharaoh, about 3180 BC. In the 5th and 4th centuries BC. Hippocrates described the disease as possibly sporadic, endemic, and epidemic. He considered that the diseases did not occur with the will of the gods and supernatural powers, but they are already conditioned by the characteristics of the individual person, the time and the environment in which he resides, which is today the basis of the analysis of data collected in the control system. In the mid-20th century, control over individuals (infectious disease patients and their contacts) grew into the control of the movement of the disease in a particular population (20). In 2005, the WHO announced the International Health Regulations adopted by all of its member states, that include commitments at the national level to establish key monitoring capabilities and appropriate interventions to prevent the spread of disease at the international level (21). The criteria that a health event should fulfill in order to become subject to surveillance are: the incidence of disease occurrence in the population and the consequences caused by it, lethality, the contagiousness, the epidemic potential, the public attitude towards the disease, the international implications, the possibility of prevention and suppression, and the economic consequences. Reporting contagious

diseases in accordance with legal and sub-legal acts is the oldest form of traditional approach to epidemiological surveillance (34).

Infectious diseases over which epidemiological surveillance is carried out and against which the measures for prevention and suppression are applied are in the sense of the *Law on the protection of the population against communicable diseases* divided into:

1) **diseases that can be prevented by immunization:** diphtheria, infection caused by *Haemophilus influenzae* group B, influenza A including influenza A (H1N1), morbili-varicella / smallpox-variolla, parotitis / mumps, pertussis / large cough, polyomyelitis / paralysis, rubella, tetanus;

2) **sexually transmitted diseases:** chlamydia, gonococcal infections, HIV-infection, syphilis etc.

3) **viral hepatitis:** hepatitis A, hepatitis B, hepatitis C

4) **food or water-borne diseases** that are transmitted by food and water and through the environment: anthrax, botulism, campylobacteriosis, cryptosporidiosis, lambliasis, infection caused by enterohemorrhagic *E. coli*, leptospirosis, listeriosis, salmonellosis, shigellosis, toxoplasmosis, trichinelosis, yersinosis.

5) **other diseases such as those transmitted by unconventional agents** (infectious spongioform encephalopathies, variant of Crojcfeldt-Jakob disease), air (legionellosis, meningococcal disease, pneumococcal infections, tuberculosis, severe acute respiratory syndrome (SARS)), zoonoses - other than the above brucellosis, echinococcosis, rabies, Q fever, tularemia, avian influenza in humans, infections caused by the Western Nile virus, hemorrhagic fever with renal syndrome), imported diseases (cholera, malaria, plague, viral emoragične fever), diseases that are transmitted vectors (tick encephalitis);

6) **special health issues: hospital** infections, antimicrobial resistance.

Hygienic and prophylactic measures are all measures and procedures that are organized, implemented and used to prevent the occurrence of infectious diseases in peace and war, as well as the improvement of human health. The term **"preventing the occurrence of infectious diseases"** means a set of measures that are continuously carried out to prevent the occurrence of an infection or contagious disease, while **the control of the infectious disease** refers to a set of measures that are being taken against an already present infectious disease in order to reduce its frequency. The

system of hygienic and prophylactic measures includes: health education and raising of general health culture and hygienic habits, hygienic control of the population's supply of healthy drinking water both during peace and in emergency situations and war, especially in different types of temporary accommodation, organized and professional remediation of the terrain and removal of waste materials, specific measures for protecting human health through regular and emergency vaccinations, seroprophylaxis and immunoprophylaxis, permanent hygienic-epidemiological and radiological-biologicall-chemical reconnaissance and surveillance on the basis of which the estimation of hygienic and epidemiological situation may be defined as good, uncertain, adverse or emergency. **Immunization** is a preventive measure of protecting people against infectious diseases by administering vaccines and / or immunoglobulins of human origin, immunobiological preparations containing specific antibodies and monoclonal antibodies. **Hemioprophylaxis** is the supply of medicines to healthy people in order to prevent the development of an infectious disease.

Elimination of a particular infectious disease is the absence of clinically manifested disease in a particular territory under the conditions of the existence of an agent, while carrying out surveillance to detect the introduction of this infectious disease from other countries and measures to prevent its transmission. **Eradication** of a particular infectious disease is the complete absence of the disease and the causative agent of the disease in a given territory, and the surveillance is carried out to detect the input from other countries. **Anti-epidemic measures** are undertaken with the aim of extinguishing the outbreak of infectious diseases, indicating help to the sick and disposing, ie, protection of uninfected and implying active detection and isolation of patients, establishing accurate diagnosis and urgent taking of care and treatment, a plan for breaking the link of Vogralic lancation of infectious diseases, conducting a survey on the way and conditions that preceded the occurrence of infectious diseases, quarantine and observation for healthy people , the implementation of supplementary vaccination, seroprophylaxis and chemoprophylaxis, as well as informing of competent centers on measures to combat the epidemic.

6.4. Actual epidemiological situation in the Republic of Serbia

In 2016, the data on the Public Health Institute of the Republic of Serbia "Milan Jovanovic Batut", in the territory of our Republic, without data from Kosovo and Metohija, was reported in 267,746 persons infected with infectious diseases, while 285 persons died. In the overall disease, the respiratory disease group participates with 89.15%. Regarding the epidemiological situation of seasonal influenza, in addition to well-structured epidemiological surveillance and adequate virological support, it is important to emphasize the importance of influenza vaccination as the best preventive measure, especially in groups of the population at increased risk of developing severe forms of illness (elderly, chronic patients, persons with impaired immunity, etc.). During 2016, there were 837 reported cases of all forms of tuberculosis. In other words, the WHO estimates that 10.4 million people are suffering from tuberculosis in 2015 in the world, of which about 1 million (10%) of children, and that 1.8 million people have died of this disease, which makes tuberculosis among 10 leading causes of death. The countries with the highest burden on the world are India, Indonesia, China, Nigeria, Pakistan and South Africa, which together account for 60% of the world's tuberculosis.

A great problem today is the multiresistant tuberculosis whose high rates in a large number of countries in Eastern Europe and Central Asia pose the greatest challenge of controlling tuberculosis in Europe. Intestinal infectious diseases are most often transmitted by contaminated foods, and their occurrence can be prevented by the use of very simple measures (hand hygiene, adequate application of food safety measures). In spite of this, about a million people around the world suffer from these diseases annually. In 2016, 15,334 persons with intestinal infectious diseases were reported in the Republic of Serbia and 79 people died. In this regard, it is necessary to improve their epidemiological surveillance, as well as the laboratory diagnostic capacities, but also to continuously carry out education of the population on ways of transmitting these diseases and prevention measures. According to the WHO, it is estimated that about 75% of new diseases that have occurred in the human population in the last 10 years of zoonotic character, i.e. caused by an infectious agent originating from animals or products of animal origin. In 2016, a total of 484 people with zoonosis were reported in our country. Two deaths were recorded in tetanus patients, while one death was recorded in people with

hemorrhagic fever with renal syndrome and leptospirosis. Although the rates of illness and death from zoonoses in Serbia are not high compared to other groups of infectious diseases, they are important because of health and economic consequences. It should be noted that these diseases are insufficiently investigated, as well as the problems related to the diagnosis of these diseases, due to the variety of clinical manifestations and the lack of reagents for serological testing, so it is necessary to provide adequate laboratory capacities, but also to organize primary health care doctors' education in order to raise awareness about the importance of this group of diseases. It is also necessary to institutionalize the cooperation between human and veterinary medicine in order to better control and more effectively prevent the disease of both humans and animals. The WHO estimates that in the group of infectious diseases, vector diseases account for 17%, causing more than a million deaths a year. The distribution of these diseases depends both on the environmental factors and on the social factors. Over the past years, globalization and climate change have a significant impact on the transmission of these diseases. Thus, some diseases, such as dengue, chikungunya viral infection, WestNile fever, appear in countries that have not previously been registered. The diseases of this group pose a particular challenge for the European Center for Disease Control and for national public health authorities due to the biological complexity of the transmission cycle of the causes of these diseases. In recent years, the emergence and spread of new, invasive species of mosquitoes on the territory of Europe has been evident, which increases the likelihood of the epidemic occurrence of new diseases transmitted by the vectors. In 2016, in the territory of the Republic of Serbia, a total of 618 cases of diseases from this group were reported, which is an increase of registered cases of illness by 18% compared to 2015. 24 cases of imported malaria were registered. Lyme disease remains the leading disease in the vector disease group, with a 95.95% share in the disease structure. One case of tropical virus encephalitis has been reported. There is no registered epidemic occurrence of West Nile fever. In order to improve the control of the diseases in this group, it is necessary to strengthen laboratory capacities and establish a vector control system, as well as to establish an integrated vector control system, as the most effective measures for the prevention of people's diseases. Scabies is the only parasitosis that is a subject to mandatory reporting. Every year, about 300 million people in the world have a registered scabies in all categories

of the population, regardless of age, sex, race and socio-economic status, but disease more often occurs in children and young people. In 2016 we reported 9399 scabies cases, 17 epidemics, 9 of them in the collective with 112 patients and 8 family outbreaks with 37 diseased persons. WHO estimates suggest that nearly 400 million people aged 15-49 in the world each year had one of four sexually-transmitted infections (chlamydiae, gonorrhea, syphilis, vaginal trichomoniasis). Infectious diseases that are sexually transmitted (STD), excluding viral hepatitis B and C, with registered 1211 cases, participate with 0.45% among all registered cases of communicable diseases in the Republic of Serbia in 2016. The trend of the STD movement in the period 2012-2016 shows a decrease in the number of registered cases of chlamydia, while the number of cases of syphilis in 2016 (159 cases) is 9% higher than in 2015 (146 cases); gonorrhea is in third place in this group of infectious diseases with registered 103 cases, 18% more registered cases compared to the previous year. According to the data from the central registry of the sick and dead from AIDS in the territory of the Republic of Serbia, since the beginning of the epidemic, in 1985 to the end of 2016, 1846 cases of AIDS disease were registered (53% of all registered HIV positive persons). Also, in the same period 1,096 people died of AIDS. In 2016, 56 people were newly registered, while 10 people died. During 2016, 262 epidemics of infectious diseases were registered on the territory of the Republic of Serbia, with 29,768 diseased persons. The number of reported epidemics increased by 7.6% compared to the previous year. In the epidemics of infectious diseases, 11 people died - 9 people in the influenza epidemic, and one in the nosocomial epidemic of sepsis and one in the epidemic of varicella with complications. According to the route of spread of the causative agent, the most frequent were contact epidemics, then alimentary epidemics, airborne and the epidemics in which the path of transmission was not determined. The water-borne epidemics and those that are transmitted by inoculation were the rarest[20].

The epizootiological situation in the Republic of Serbia in the past period can also be characterized as favorable due to the good organization of the veterinary service and the ongoing surveillance that is carried out, which has a favorable impact on the reputation of the whole country, as

[20] Институт за јавно здравље Републике Србије "Милан Јовановић Батут" (2017). Извештај о заразним болестима у Републици Србији за 2016.годину Serbain Public Health Institute Annual Report about infective diseases in 2016 (In Serbian)

well as the potentials of the development of livestock and food industries. However, the continuous strengthening of the capacity of this service and improving cooperation with the health service as well as industry and manufacturers is a permanent task and a permanent challenge in view of the possibility of some eradicated diseases appereance, an increase in the prevalence of endemic diseases and infections, especially zoonozes that have great importance as potential biological agents and the emergence of new exotic diseases such as lumpy skin disease and African swine fever. In the field of emergency situations and field relief after the same, importance of the veterinary service is extremely important[21].

The health condition of agricultural plants can also be compromised by the causes of plant diseases, pests and weeds, as well as numerous meteorological, physical and chemical abiogenic factors. The problems of protecting plants and plant products are very complex, especially from the aspect of the number of plant diseases and pests that have an extremely large number of available data (about 10,000 species of insects, 1,500 species of parasitic (pathogenic) fungi, about 1,500 species of nematodes, mites, about 200 species of parasitic (phytopathogenic) bacteria, viruses and viroids, mycoplasmas, parasitic plants of flowerbeds, weed plants and dozens of types of harmful rodents). Therefore, the protection and rescue of plants and plant products from infectious diseases and pests by taking appropriate measures of agro-technology and the application of protective agents is of great importance in terms of public health, agricultural production, nutrition, economy, as well as the stability of the country, but also from the security aspect. the problem of agro-terrorism today as one of the leading security challenges because an agriculture is a soft target, easily vulnerable, and hardly defensible.

6.5. Conclusion

Infectious diseases are a significant health and socioeconomic problem and one of the leading security risks of the modern era. Most natural and other disasters (earthquakes, floods, droughts, etc.), as a rule, lead to violation of the hygienic conditions of the life of the population, which

[21] Plavsic B, Glisic M, Uzelac J, Petrovic M.(2016). Epizootiological situation in Serbia in 2015. Book of abstracts. XVIII simpozijum epizootologa i epidemiologa. Kraljevo.p. 13-16 (invited lecture)

increases the possibility of the occurrence and spread of a large number of diseases in an epidemic form. The preparation and implementation of a plan to prevent the spread of infectious diseases in such circumstances is particularly important, as well as permanent strengthening of the capacity and resources of the medical service for early detection, assessment, reporting, fast public health response (diagnostics, transport, isolation, treatment) and taking preventive measures to prevent spread and reduce the burden of disease (hygienic measures, vaccination, therapy, as well as disinfection, disinction, pest control). It is important to establish cooperation with veterinary institutions in order to timely exchange relevant information related to zoonoses, animal diseases transmitted to humans. Education of health workers for crisis management (planning, resource allocation) including crisis communication as well as education of the population on the prevention of infectious diseases are also important, as well as multi-sectoral approach, communication and coordination of the public health sector, civil protection, police, army, media, as well as non-governmental structures, which are included in these cases, such as the Red Cross and other humanitarian organizations in cooperation with the civil protection headquarters.

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7. FIRES AS NATURAL DISASTERS

7.1. Briefly about fires - general terms, causes and conditions of their occurence

Fire is any useless and uncontrollable combustion. Fires as natural disasters can occur when large forest complexes are involved. Special weather conditions-high temperature, strong wind and dry weather influence the occurrence and spread of forest fires which can endanger residential, public and commercial buildings.

Forest fires of catastrophic proportions can cause very harmful consequences for the environment, human health, material and cultural goods (Figure 1).

Figure 1. A disastrous fire which has the potential to significantly endanger natural and manmade values

There are three conditions for the occurence of ignition process with fires and these are: combustible material (fuel), heat and oxygen (figure 2).

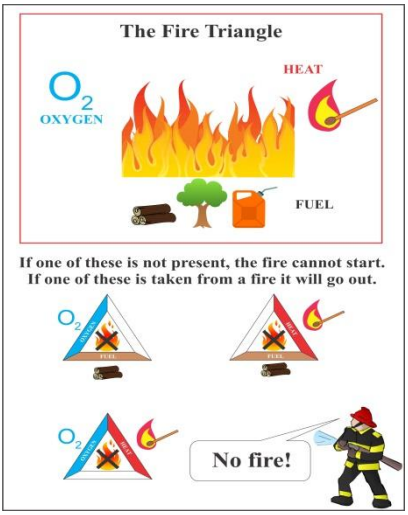

Figure 2. The conditions necessary for the occurrence of

The ways in which the ignition (creation / source of required heat energy - ignition energy) of combustible matter and fires occur can be systematized into the following groups:

- a direct contact of combustible material with the flame (a lit match can burn the curtain), glowing matter (a cigarette butt or cigarette glow in the plastic basket) or incandescent matter (incandescent particle/ spark in autogenous welding);
- self-ignition and chemical reactions (fats and oils, materials of plant origin - hay, cotton, coal, dust, various chemical substances, eg phosphorus, potassium and sodium under the influence of water);
- explosion (mechanical - pressurized vessels, due to structural errors, inadequate maintenance and faults in handling and manipulation, etc., chemical-explosive substances, gases and vapors of flammable liquids and dust);
- electricity converted into heat energy (heating of electrical conductors; short circuit; large transient resistance; sparking; overloading of electrical conductors; electrothermal devices; - iron, cooker, electrical heater; heating devices - boiler, glowing fiber);
- atmospheric discharge of electricity (lightning);
- static electricity and potentials of cathodic protection;

- mechanical causes (friction, pressure, impact, grinding, sparking - mechanical energy is converted to heat, e.g., a spark is created which ignites the combustible substance);

- natural causes (solar heat / rays - directly when the sun rays are accumulated, and indirectly, for example, the sun rays, a vessel containing flammable gas is heated by the sun rays, the gas is heated and the pressure in the vessel is increased, the vessel bursts and the liquid explodes and causes a fire);

One of the most significant causes of fire is a person who can cause a fire accidentally or unintentionally (Figure 3) and arson, when a fire is deliberately caused by a person.

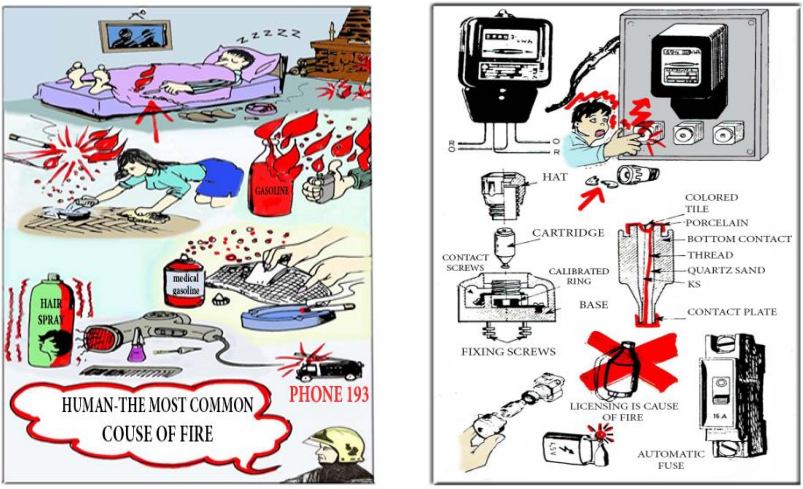

Figure 3. The most common causes of fire (Source: Arnautović, 2007).

7.2. Normative - legal framework for the engagement of protection system entity and rescue in case of large scale fire

The basic legal act that sets the institutional framework for engaging the protection and rescue system entity in case of large scale fire is the Law on Fire Protection ("Official Gazette of RS", No. 111/09 and 20/2015). However, in addition to this law, the system of fire protection, rights and obligations of state authorities, authorities of autonomous province and of local self-government units, companies, other legal and civil entities,

organization of fire service and other issues of importance to the fire protection system, are set by the Law on Police ("Official Gazette of RS", no.6 / 2016), by The Law on Emergency Situations ("Official Gazette of the Republic of Serbia", No. 111/09 and 92/11) and the regulations adopted in accordance with these laws. The Law has established that the Fire Protection Strategy will provide the basis for more efficient protection of people and material goods. The overall goal of the Fire Protection Strategy for the period 2012-2017 (Official Gazette of RS, No. 21/2012) is the promotion of fire protection by preventive action through the undertaking and implementation of safety measures of all entities and information of citizens.

Fire protection system includes a set of measures and actions for planning, financing, organizing, implementing and controlling measures and actions for fire protection, preventing fire occurrence and its spreading, fire detection and fire fighting, saving people and property, protecting the environment, identifying and removing causes of fire, as well as for providing assistance in removing the consequences caused by fire.

Fire protection entities are state authorities, authorities of autonomous provinces and local self-government units, companies, other legal and civil entities. Fire protection is realized by: 1) organization and preparation of fire protection entities for the implementation of fire protection; 2) providing conditions for implementation of fire protection; 3) undertaking measures and actions for the protection and rescue of people, material goods and the environment in the event of fire; 4) control over the application of fire protection measures. The main goal of the prescribed fire protection measures is to protect the lives of people, physical integrity, material goods and the environment. The realization of fire protection is based on the principles of prevention, continuity, awareness increasing, publicity, cooperation, solidarity and responsibility. The prevention of fire protection is ensured by planning and implementing preventive measures and actions in order to prevent the occurence of fire as efficiently as possible, and in the event of a fire, the risk to human life and health and material endangering as well as environmental degradation are reduced to the minimum and to limit the fire at the place of the its occurence. Fire protection is organized and continuously implemented in all places and in all facilities that are exposed to the risk of fire. Fire protection entities encourage, direct and provide awareness increasing on the importance of fire protection through the education system, scientific research and technological development, training in the process of work, and public

information. State authorities, authorities of autonomous provinces and local self-government units, companies and other legal entities are obliged to inform the public about the state of fire protection and make the necessary information available in accordance with the law. Fire protection entities are obliged to exchange information of importance for fire protection and harmonize activities of importance for fire protection, whereby this cooperation is also realized with other countries and international organizations. Fire protection entities are obliged to help one another in removing the consequences of a fire. Responsible people in state authorities, authorities of autonomous province and local self-government units, companies and other legal and civil entities are responsible for the implementation of fire protection measures.

Firefighting units are established for the purpose of implementing fire protection, rescue of people and property, preventing and suppressing other technical and technological accidents and natural disasters. The fire brigade units are obliged to cooperate with one another and provide assistance to each other in the event of fire and emergency situations. For the purpose of extinguishing the fire and rescuing people and property endangered by fire, a fire brigade may provide assistance to fire brigades of neighboring countries, or seek assistance from them, in accordance with the Government decision and international cooperation agreements.

During firefighting and protection of people and property endangered by fire and other interventions, the manager of the fire extinguishing action, that is, the head of the intervention, has the right to: 1) prohibit unauthorized people from accessing the place of fire or other incident, as well as to stop the traffic along that place; 2) order the evacuation of persons and property from endangered territories, premises and facilities; 3) terminate the supply of electricity, gas and liquid fuels; 4) order the use of water and other fire extinguishers used by legal and civil entities if the required amount of water or other fire extinguishing means can not be provided otherwise; 5) order the use of vehicles of legal and civil entities for transporting the injured, evacuation of people and property and delivery of fire extinguishers; 6) order the removal of vehicles and other objects which are on the fire track or near the hydrant, which prevents or makes it difficult to access the fire extinguishing point or to use a hydrant network; 7) order other legal and civil entities to put at their disposal the tools, transport, technical and other means necessary for fire fighting and rescue of people and property endangered by fire; 8) order the partial or complete demolition of objects or parts of objects that are not affected by fire, in case

otherwise fire cannot be distinguished or saving of people provided; 9) take measures to secure the evacuated property; 10) take measures and actions in order to provide traces and objects relevant for determining the cause of the fire; 11) order the violent opening of a locked building or room due to fire fighting and rescue of people and property; 12) order working-age people, who live in the immediate vicinity of the fire place, as well as people who find themselves on the site of the fire, to provide fire fighting assistance and save people and property; 13) request assistance from other fire brigades and all other services that can be engaged in firefighting and rescue operations of people and property.

A citizen who notices an immediate danger of fire or detects a fire is obliged to remove the danger, that is, to extinguish a fire if he can do that without danger to himself or to another. If a citizen cannot extinguish the fire himself, he is obliged to inform the nearest fire brigade unit or police department without delay.

False reporting of fires and other technical and technological accidents is prohibited. The expenses of the firefighting-rescue unit's intervention by false repoprting of a fire shall be borne by the person who falsely reported the fire.

It is forbidden to burn old home things, fuel materials and low vegetation, after the cleaning of residential, courtyard and agricultural areas.

It is forbidden to start an open fire in the forest and at a distance of 200 m from the edge of the forest, except in certain and marked places, in accordance with the prescribed fire protection measures.

A person who, when providing fire fighting assistance or fire fighting training, is injured or ill, and therefore is absent from work or becomes incapable of work, has rights in health, pension and disability insurance under conditions determined for the police officer. If in the provision of this type of assistance the person loses his life, his family has pension rights, as well as the family of a police officer who has lost his life in performing or on the occasion of performing his duties.

A person who makes fire extinguishers and fire extinguishing equipment available on the orders of the fire-fighting director or the intervention manager has the right for compensation of pecuniary damage.

7.3. Preventive measures for fire protection and rescue

One of the essential preconditions for preventing fire is preventive measures whose implementation does not allow the occurrence and spread of fire, that is, we remove the causes of fire in the environment where we live and work.

Manager of the protected areas established under the regulations governing the protection of nature is obliged to determine the area of preventive fire protection measures in accordance with the management plan (or plans for fire protection), according to the size of the protected area, type and use of land or buildings it manages.

A person who performs welding, cutting and soldering works, uses an open flame or a tool that is not specially adapted for the job, or at a distance of 200 m from the edge of the forest is obliged to organize a fire guard (person professionally trained).

During the harvesting work, special measures should be taken to protect the crop from the fire (eg: organizing the permanent guard, organizing the observation service, organizing the connection and information service, equipping the machinery with the appropriate fire protection equipment, controlling firefighting equipment, checking the correctness of mechanization, controlling the storage of crops.

Proper use of technical devices in the apartment according to the instructions of the manufacturer, then of electricity, combustible and explosive materials reduces the conditions for the formation of a fire (Figure 4).

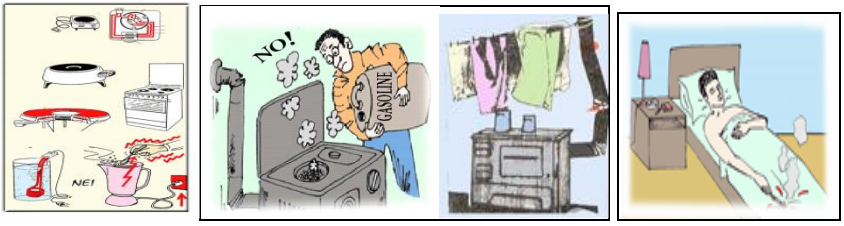

Figure 4. Improper use of technical and flammable assets (Source: Arnautović, 2007)

If your house is located inside or near the forest, you need to cut a low vegetation at a diameter of 20 m around it, remove dry leaves and branches (branches must not touch the house), provide fire extinguishers, tanks -

water containers, non-electric water pumps and a tap with a hose that can reach the boundary of the protected area.

In order to avoid fires in residential buildings, the following preventive protection measures must be observed:

- When using electrical appliances, do not leave them unattended, and when leaving the apartment, check that all electrical devices are switched off, that is, in case of a long absence, switch off the power;

-Electric appliances should be periodically inspected and serviced by a qualified person (for example, a a water heater every 2 years, an aspirator filter when greased, etc.);

- Before the start of the heating season, clean the electric heaters from the accumulated dust collected in the area around the fan and electrical conductors, check and clean the "smoke" installation, and check the installation and operating mode according to the manufacturer's technical instructions;

- Keep the electric heater away from the curtains and furniture at least 1.5 m, electric furnaces 0.5 m, and hot plates should be kept on a brick, ceramic or marble;

- Put the solid fuel stove on the protective sheet, and electric stove on the stand with wheels;

-Do not light fire in stoves on solid fuel with petrol, oil, alcohol and other flammable liquids;

- Do not mend the fuses with wires but replace them with original fuses with appropriate amperage (recommended preventive installation of automatic fuses);

- Permanently maintain appliances and installations for propane-butane gas, when replacing the empty bottle it is necessary always to replace the sealant rubber on the regulator and do the inspection of the valve on the bottle and the rubber hose (test the permeability of the joints with soap).

When you finish using the propane butane device, first replace the valve on the bottle and the button on the device, and keep the spare bottles in separate rooms with the possibility of ventilation - a pantry, a bathroom (maximum capacity up to 30 liters - eg 3 bottles of household gas per 10 liters). If you feel the presence of gas in the room (the gas leaking has a distinctive odor and sometimes burning sound), do not turn on a light, light a match or a lighter, but immediately open the doors and windows for ventilation, close the valve on the bottle and call the expert;

- in the case of natural gas installations, control the regulation sets in the shared lounge and taps in the appartments, ie, if there is a special branch

with a measuring set for the central boiler room for the preparation of consumable hot water);

- Keep wood, coal, paper, plastic, textiles, chemicals and other combustible materials away from radiators, stoves, cookers, heaters, furnaces, etc.;

- Do not wash and clean clothes with gasoline in a closed room, and do not use the large amount of spray and hair sprays;

- Prevent children from playing with matches, lighters, candles, flammable and other dangerous substances, from staying alone with a New Year's Christmas tree with lamps and candles. Do not turn on iron, heater, cooker, gas consumer, do not change the fuse in front of small children to avoid the possibility that children can imitate you doing these things and cause a fire;

- Throw the cigarette butts in an ashtray that should be held at han;

- Do not cover the illuminated bulb with paper or textiles and do not keep flammable material near it (preferably install the LED lighting).

- It is forbidden to keep any material in a hall and on staircases, in front of flats, in residential buildings, (flammable or non-flammable, a wardrobe, shoe shelf, etc.). They must always be clean and passable.

- - In case of fire, LIFTS MUST NOT BE USED, but should be immediately turned off by an authorized person. This also applies in case of smoke in the elevator.

- Doorways, doors and other openings should always be kept closed. Replace the broken glass immediately. Chimneys must always be clean according to the regulations of the chimney service (once a year). Do not keep inflammable materials and stuff (woodwork, old furniture, paper, clothes, etc.) at a distance of one meter. Fireplace should be provided with handy fire extinguishing agents: sand, shovel, barrel and bucket with water. REMEMBER! - The chimney fire is not extinguished with water. Leave the soot burning, taking precautions to prevent the fire from spreading to neighboring objects. Close the opening with a wet blanket (the oxygen is removed and the fire extinguishes itself).

-If there is no electric illumination in the basement, it should be entered with indoor lighting (flashlight, etc.). Do not light matches, lighters, and do not smoke. Do not keep unnecessary piled things in the basement (paper, cloths, crates, old furniture, etc.). It is dangerous to keep flammable liquids (gasoline, petroleum, oil), propane-butane gas bottles and other dangerous substances in the basement. Coal can be kept in the basement, but only if

the basement has plenty of air. Beware, coal can ignite by itself when it is kept in large piles.

- All tenants in multi-storeyed buildings must know whether there are fire stairs, where they are located, how to get there, whether they are passable and usable and who is obliged to take care of fire protection in the building.

- It is necessary to know that all rescuing is done through the terrace, mostly, and in most cases a fire staircase passes through the terrace. Therefore, the terrace must not be used for storage.

- The garage should not be used for the storage of various waste and inflammable materials, such as: greasy rags, used oil, petrol, paper, boards, etc..

- We recommend that you have a fire extinguisher C-1 or C-2 in your vehicle. Its value is negligible according to the value of the vehicle. Do not use faulty electrical installations or devices, as you can cause fire and accidents.

- Do not burn old things, garbage, grass, low vegetation in the backyard, the field and the picnic area and take care when grilling near the woods or using a cigarette when harvesting. Do not leave garbage in the forest due to the possibility of self-ignition.

- When the fire is extinguished, exit the house and immediately extinguish the remaining fire points nearby, and then ensure the monitoring for the possibility of subsequent fire.

7.4. Fire extinguishing agents

For the purposes of this Handbook, fire extinguishing agents are divided into fire extinguishers, hydrants, extinguishers for forest fires, crops and agricultural holdings, and hand tools for fire extinguishing.

Fire extinguishers can be portable and mobile. Portable devices are easily transfered, easy to operate and serve to quickly and safely extinguish small-initial fires, while for larger-scale fires use mobile, or considerably larger transport devices. With portable devices, the following fire extinguishing agents are used: water, chemical or air foam, carbon dioxide, dry powder and halons. In transport vehicles, the extinguishing agents are: chemical foam, dry powder and halons.

All appliances must have labels at the front, with an inscription on the type of the device, charging contents and activation data - illustrated pictures, what can and should not be extinguished with the apparatus,

discharge time, jet range, operating pressure, temperature range of operation and that it was made in accordance with the prescribed standards. The manufacturer and later the service also points out a special card indicating the time of charging, that is, the control of the appliance to determine its correctness. The test is performed every 6 months, in accordance with the manufacturer's instructions.

Hand-held dry powder "C-6" is used to extinguish the initial fires of solid combustible materials, flammable liquids (gasoline, benzene, alcohol, ether, paints, varnishes, oils, fats, etc.),fires of gaseous materials (propane, city gas, etc.), fires of low-voltage and high-voltage electro-materials, fires of valuable documents and other fires. The appliance is used as follows:

Bring the fire extinguisher to the point of fire (using the handle for carrying and activation) and lower it as far as possible (taking into account the surrounding high temperature, flame direction and possible mechanical particles spraying from the flash point). A hose is taken for a plastic nozzle in one hand, and it is directed toward a fire, and then:

A) with conventional two-stage appliances the activation lever is pressed and released with the other hand; after 3-5 seconds, the handle is pressed again and the agent is released;

B) with single-stage automatic machines, the activation lever is pressed with the other hand and the agent immediately starts to exit the bottle. Powder is thrown onto the flame with left-right movements until the final extinguishment.

The plastic nozzle is held until the fire is extinguished, or until the appliance is emptied. Interruption of the powder stream can be done by optional release of the handle, then pressing again, etc. The burning oil or gas in the open container is not extinguished with full powder spray, from above, but the powder cloud is slowly placed above the burning surface.

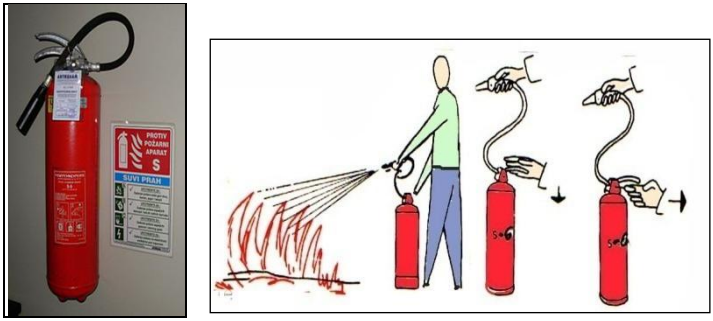

Figure 5. Appearance and method of use of the fire extinguisher "S-6"

Handbook fire extinguishers with carbon dioxide are used for extinguishing flammable liquids (gasoline, oil, benzene, oils, varnishes, etc.) and for extinguishing fire, primarily of electrical devices and low and high voltage installations.

The fire extinguisher is brought to the point of fire as close as possible (taking into account the surrounding high temperature, the direction of the flame and any mechanical spraying particles.) Separate the hose by taking only the ribbed part of the plastic nozzle The appliance is put into operation by unscrewing the valve rollers to the left end or pressing the movable handle down if the valve is fitted with a handle. When activating the appliance, the nozzle is directed toward the fire. By moving left and right throw the gas onto the flame to the final extinguishing.

It is allowed to keep these devices at places where the temperature does not exceed 40 ° C.

Figure 5. Appearance and method of use of the fire extinguisher " CO_2"

Fire extinguisher with water and air foam "VP-15" is intended for extinguishing initial fires of solid combustible materials (wood, paper, coal, straw, textile) and when foam is used, it extinguishes fires of inflammable liquids (petrol, lacquers, oil). It is not intended for extinguishing electrical appliances.

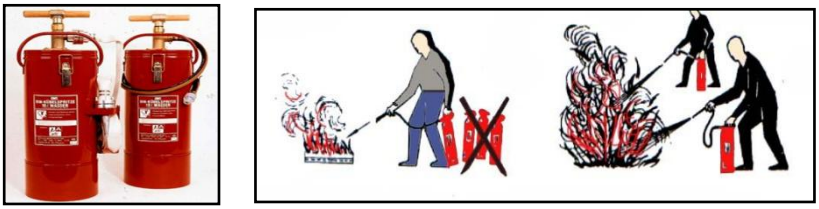

Figure 7. Appearance and method of use of the fire extinguisher "BP 15"

The appliance is used as follows:

- bring the device to the place of fire,
- unfold the hose,
- put the leg in the appropriate opening,
- take the nozzle with one hand and point it towards the fire, and pump with the other hand by pulling the handle up and down. If two people extinguish the fire (which is much easier), one directs the nozzle towards the fire, and the other pumps water.

The flames and smoke disrupt the extinguishing and therefore we should stand in the direction of the wind and extinguish back and forth. In case of a larger fire do not extinguish by yourself and do not place more appliances behind one another.

Hydrants. There are three types of hydrants: underground (placed on streets or sidewalks, underground), overground (installed in factories and streets) and wall (installed in factories and residential buildings, in sealed red metal cabinets - Figure 8).

Figure 8. Appearance and method of use of the hydrant

For working with a hydrant, two people are needed - operators (in case of emergency one person can do it alone)tenants: one tenant connects the coupling from one end of the fire hose to the nozzle and goes to the place of the fire, straightening the fire hose, and the other tenant connects the other coupling to the slanted valve in the hydrant cabinet and waits for the command to release water. The tenant with the nozzle comes to the place of the fire, as close as possible, but not too close, when ready, takes a stable position of the body and shouts loudly. The tenant by the hydrant cabinet, slowly releases the valve wheel and releases water.

Extinguishing agents for forest fires, crops and agricultural holdings (field fires) include backpacks, scrapers, hand tools and water containers (Figure 9).

Figure 9. Appearance and method of use of agents for extinguishing forest and field fires

The handy extinguishing agents include: water, sand, shovels, brooms, wet blankets, ordinary buckets of water, pumps, garden hoses and so on. The method of using these agents is shown in Figures 10 and 11.

Figure 10. Covering the opening with a wet blanket

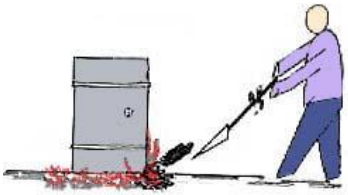

Figure 11. Covering the leaked burning fluid with the sand

7.5. Procedures in the event of fire and its extinguishing

Procedures in the event of fire are: localization, rescue, evacuation, reporting and call for assistance, fire protection and rescue measures.

For the purpose of effective and efficient fire fighting (localization, neutralization) it is necessary to know the fire classes and fire extinguishing agents (Table 1), as well as the correctness and the procedures that are implemented in these conditions.

Table 1. Fire classes and types of fire extinguishers

Fire class/ Type of extinguisher	A	B	C	D	F
	Solid organic materials, burning with embers (wood, paper, textile, coal, PVC, leather, sugar, tire, etc...)	Liquid matter and solid water in liquid form (wax, lubricants)	Flammable gases (butane, acetylene, natural gas and methane)	Flammable metals (aluminium, magnesium, lithium, pottasium, etc.) Extinguished by special appliances.	Vegetable and animal fats and oils
Water	The best	No	No	No	No
Dry powder "C"					
Special dry powder				The best	
Carbon dioxide					The best
Foam		The best			

For the purposes of this handbook, we will present the procedures for fire fighting in residential buildings:

- Remember, in residential buildings, electrical appliances and electrical installations must not be extinguished with water, because the water conducts electricity. Also, there is no effect of extinguishing gas, oil and grease with water, and it is dangerous to use water for extinguishing the carbide, because then flammable and explosive gas ACETILEN is

produced. Therefore, it is important to recall the basic rules and procedures of fire fighting - fire localization during fire fighting (Figure 12).

Figure 12. Basic rules and procedures for fire extinguishing (Source: Arnautović, 2007).

In case of fire, calmly and without panic immediately try to extinguish the fire. Keep in mind the saying: "In the first minute, sometimes a glass of water is enough to extinguish the fire, and in the third tank will not be enough." To prevent the fire from spreading rapidly, close the doors and windows so that there is no flowing air, because it can cause a fire. Close the gas pipeline, remove bottles with propane-butane gas and containers with flammable liquids, disconnect the electrical installations by removing the fuses from their bearings on the distribution cabinet, or turn off the automatic fuses or main switch at the staircase or in the hallway;

- Do not allow yourself to be occupied by some of the material things you would want to protect from fire, but act calmly, because first of all you should save human lives. Also, it's important to stay calm and reasonable and try to put out the fire together with your neighbors.

- If there is a fire in the apartment, and you cannot extinguish it, go toward the stairs and **we repeat**, do not leave open doors and windows, as this would allow the fire and smoke to spread to the staircase, thus preventing the evacuation of occupants from higher floors. In such conditions, smoke is a special danger, and then it is necessary to use a wet towel or a nose and mouth cloth as a handy respiratory protection device.

- In case of a large-scale fire, do not waste time, immediately call the fire service on 193, and give them accurate information about the exact location of the fire, what is burning and if possible, indicate the direction of the fire. Do not end the call until you provide all the necessary information.

- When there are safe conditions, engage other occupants and neighbors and extinguish the fire with hydrants. Do not let the fire spread. When firefighters arrive, explain them what and where it burns and whether there are endangered people;

- If it is not possible to descend the staircase in the hallway, use a staircase leading to the terrace, and if there is no one, go out to the terrace and try to attract the attention of passers-by or firefighters;

- Use a hand-held flashlight that should each apartment - building have- for lighting at night.

- If your clothes is on fire, you need to wrap yourself in a cloth - a blanket, a cover, sheets, a coat ... or by rolling on the ground or floor you can prevent more severe injuries.

- Enter the rooms when it is possible to extinguish the initial fire, to save the endangered and to remove the hazardous substances. To enter a room that is affected by a fire, get bent, protect your mouth with a tissue dampened with diluted vinegar or water, which is also necessary when leaving the residential premises (Figure 13). Also, when leaving the residential premises it is necessary to take pre-packaged "personal and material supplies for survival" (Figure 14).

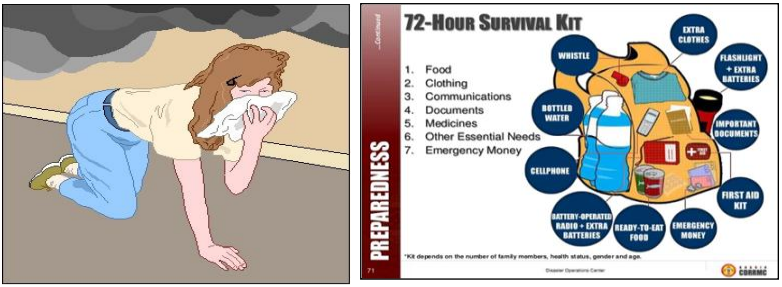

Figure 13-14. Way of movement in the fire area and a complete survival kit.

Evacuation and rescue of vulnerable ones: It is advice that the evacuation is carried out only in extreme emergency in directions that are not threatened by fire and according to previously adopted and approved plans by the competent service. First rescue endangered people (with

priority given to children, pregnant women, sick and elderly people), and immediately remove all inflammable objects that may be affected by fire. Inspect all rooms, look under the bed, in the closets and other places where the children could hide. Weapons and ammunition should be removed as soon as possible, so as not to be affected by fire.

Economic, public and residential buildings (especially larger residential buildings) must have an evacuation plan, which should be used for periodical probation exercises for evacuation and rescue (with the help of the Sector for Emergency Situation of the Ministry of Interior of the Republic of Serbia).

In principle, the Evacuation Plan of a residential building contains:

- basic characteristics of the building (position - proximity to the firefighting unit, access to the building, distance from other facilities, building characteristics, types of existing installations, critical sites / with increased risk of occurence and spread of fire, security staircases, etc.)
- list of people in charge of evacuation, with telephone numbers (one person for 3 - 4 floors),
- list of people who have basement keys el. installations keys, etc.
- list of people responsible for the exclusion of elevators, gas and electric installations in the event of a fire,
- telephone numbers of firefighting and rescue unit (193), police (192) and ambulance (194),
- alarm, how it is done, who does it - hand signals or notifications - the responsible people,
- a list of the sick, the elderly and the people with special needs in the apartments, who should be evacuated first, - - the direction of movement for leaving the building - the main and the alternative ones,
- a list of openings for smoke extraction in the corridors and floors,
- possibility of self-rescue in case the planned routes cannot be used - corridors, fire staircase
- handy tools: ropes, sheets, ladders, etc. (evacuation through the terrace and the window is difficult to perform),
- *The graphic representation of the evacuation plan* is an integral part of it (Figure 15 - top left) which, together with the instructions for behaviour in case of fire and the instructions for using the initial fire extinguishers and hydrant handling, is placed in the parts of the common space in the objects (Figure 15). When leaving an object, it is important to follow the evacuation markings that are green (picture 15 - to the top right).

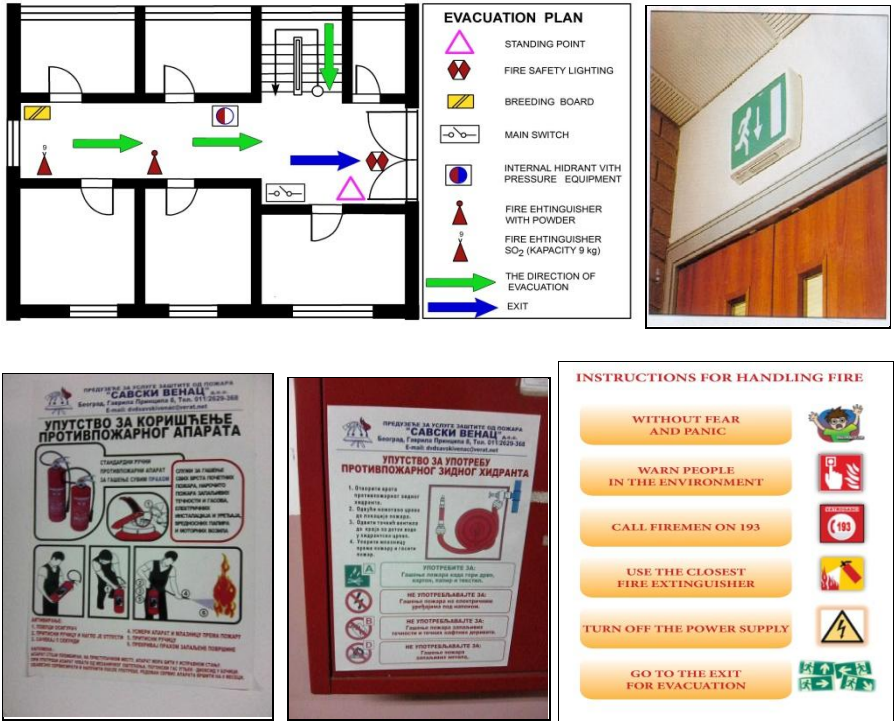

Figure 15. Appearance of a graphic appendix of the evacuation plan (above) and instructions for behaviour in the event of a fire (below)

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This handbook is created under Erasmus+ project:
Development of master curricula for natural disasters risk management in Western Balkan countries (NatRisk)
Project Number: *573806-EPP-1-2016-1-RS-EPPKA2-CBHE-JP*

Co-Funded
by the Erasmus+ Programme
of the European Union