Global Water Partnership Mediterranean

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Cross sectoral benefits from SFM practices and Good examples in soil and water protection from the region and beyond

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Capacity Building Workshop on

Forest Management and Water Regulation In the Drin river basin".

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CONTENT

1 - Cross sectoral benefits from SFM practices

1.1. Forest ecosystem services and benefits for other sectors

1.2. Forest management and water – protective forest in the region

1.3. Effects of Afforestation

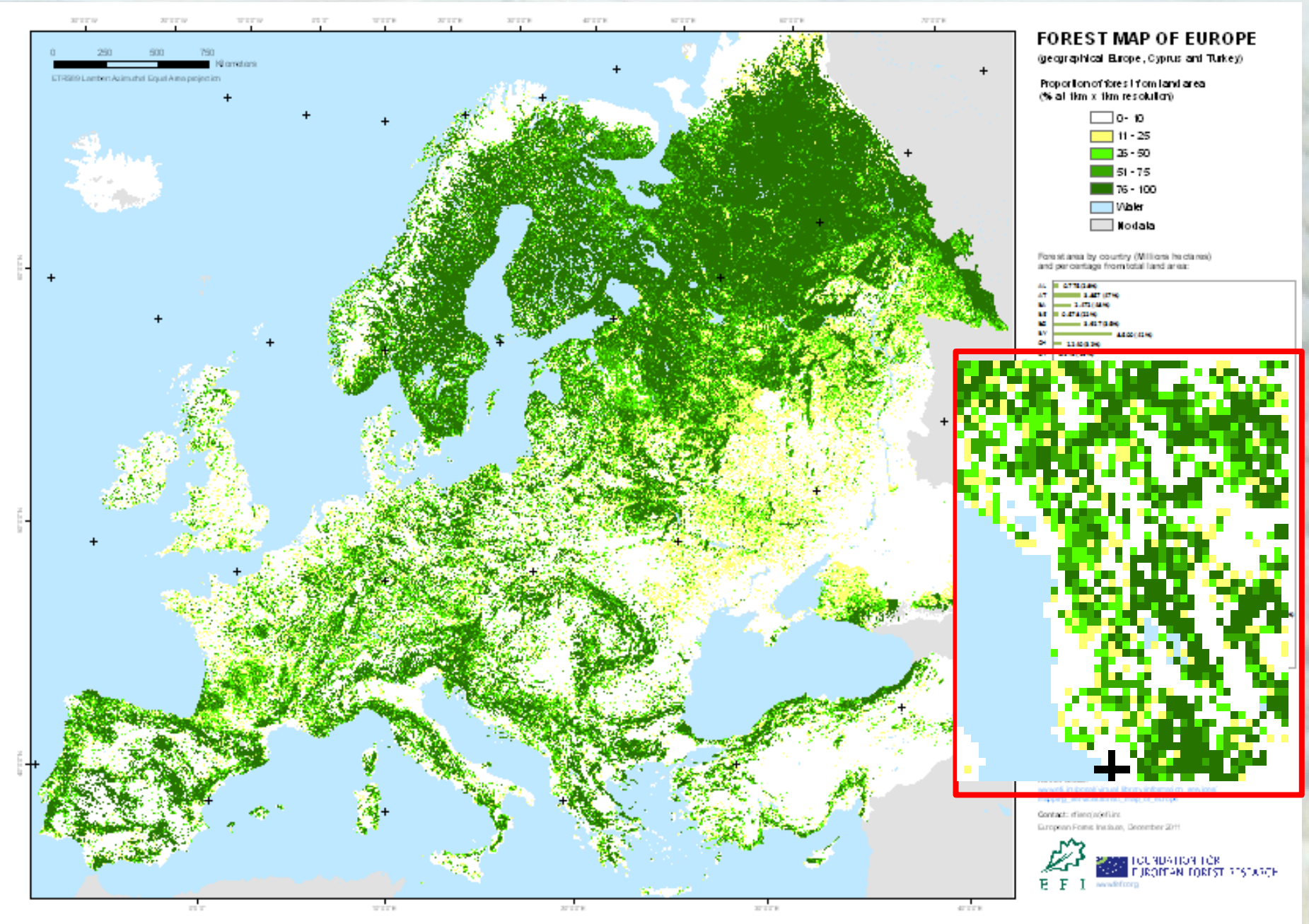
2 - Good examples in soil and water protection from the region and beyond

2.1. Erosion in Western Balkan Countries and Drim/Drini basin

2.2. Erosion and torrent control works In Western Balkan Countries and Drim/Drini basin

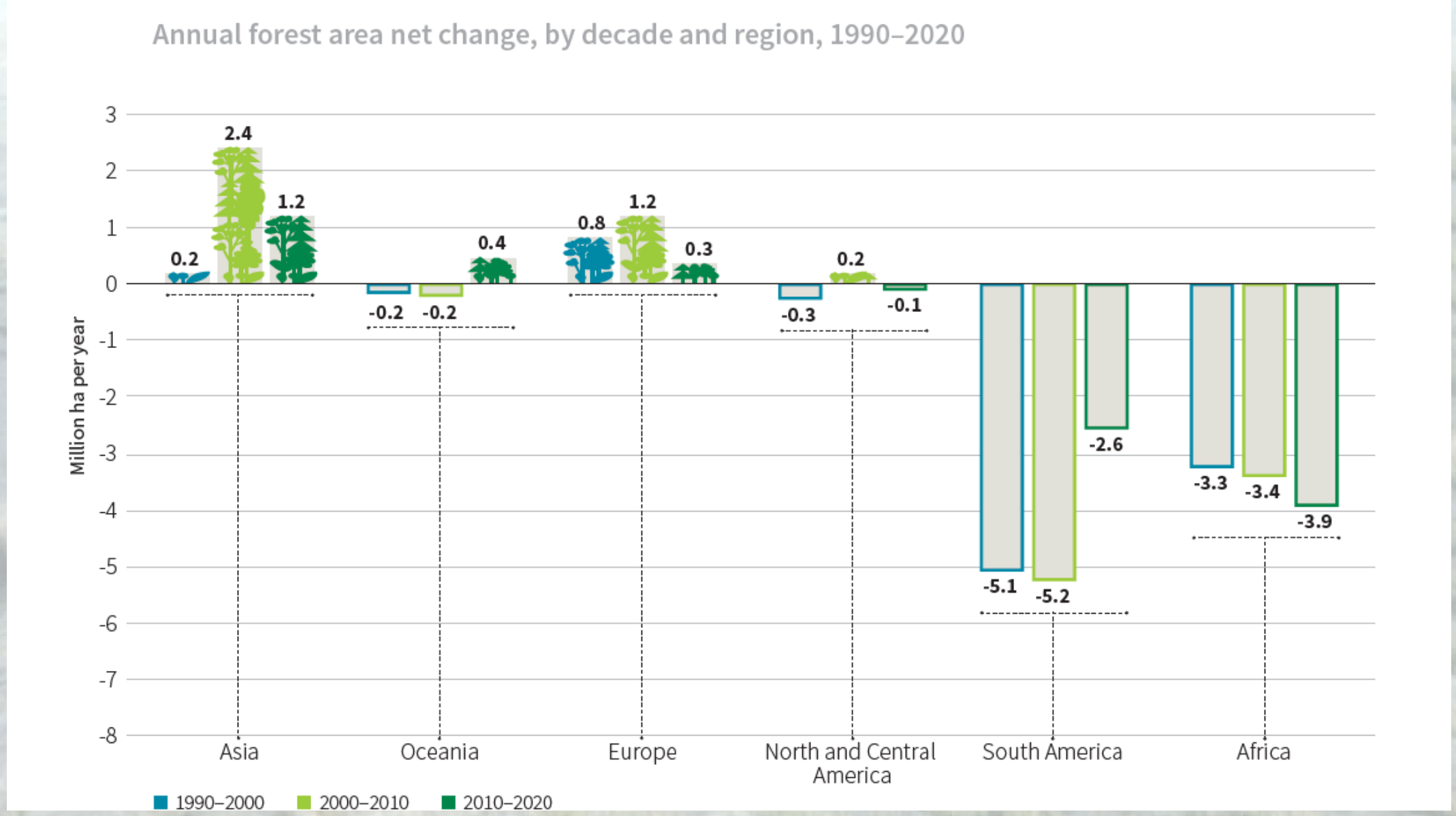
2.3. Effects of ETC works on Vodno Mountain - Skopje

Forest area



Forests in world - 4,06 billion ha

Forests in Europe – 1,00 billion ha 47% of land area



The world has lost 178 million ha of forest since 1990, which is an area about the size of Libya. Africa had the largest annual rate of net forest loss in 2010–2020, at 3.9 million ha, followed by South America, at 2.6 million ha

FAO - FRA report 2020

The importance of forests cannot be underestimated.

We depend on forests for our survival, from the air we breathe to the wood we use. Besides providing habitats for animals and livelihoods for humans, forests also offer watershed protection, prevent soil erosion and mitigate climate change. (WWF)

Economic value

The economic concept of value is that value is human driven (i.e., it is anthropocentric), meaning that goods and services are not considered to have value unless humans place value on them [willingness to pay].

From a strict economic perspective, there is no such thing as intrinsic or natural value.

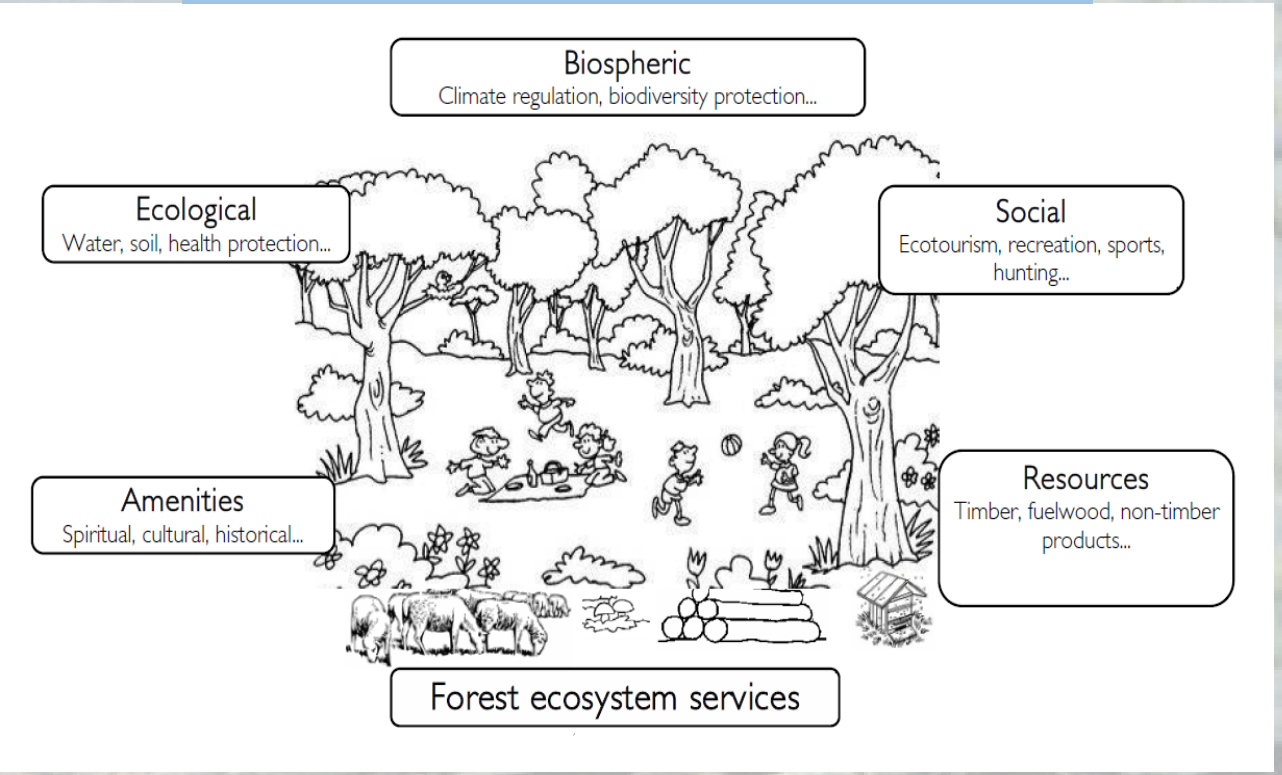
Participation of Forestry in national GDP in RNM is 0,9% !!!!

1. Cross sectoral benefits from SFM practices

1.1. Forest ecosystem services and benefits for other sectors

Forests provide a wide range of goods and services to the society.

Economic services and goods



Some of them are *tangible*, e.g. Wooden forest products (WFP) (e.g. timber and firewood) are often the first to come to mind and the **non-wood forest products** (NWFP) such as: cork, mushrooms, game, honey, aromatic and medicinal plants, etc.,

Some of them are *intangible*:

-the regulation of water and nutrient cycles,
- protection of watersheds and soils,
-sequestration of carbon and mitigation of climate change,
-protection and conservation of biodiversity,
-cultural and historical heritage value and place for outdoor recreation and leisure

(Stenger *et al.*, 2009).

Socio-economy aspects

- **Over 2 billion people rely on forests**
- Forests provide us with shelter, livelihoods, water, food and fuel security. All these activities directly or indirectly involve forests. Some are easy to figure out - fruits, paper and wood from trees, and so on. Others are less obvious, such as by-products that go into everyday items like medicines, cosmetics and detergents.

- **Employment,** processing and trade of forest products and energy – and investments in the forest sector. Maintaining and enhancing these functions is an integral part of sustainable forest management.
- **Forests provide jobs for more than 13 million people across the world**
- In addition, 300 million people live in forests, including 60 million indigenous people. Yet, we are losing them. Between 1990 and 2015, the world lost some 129 million ha of forest, an area the size of South Africa.
- https://wwf.panda.org/discover/our_focus/forests_practice/importance_forests/

Forest for production

- About 30 percent of all forests is used primarily for production.
- Globally, about 1.15 billion ha of forest is managed primarily for the production of wood and non-wood forest products.
- In addition, 749 million ha is designated for multiple use, which often includes production.
- Worldwide, the area of forest designated primarily for production has been relatively stable since 1990 but the area of multiple-use forest has decreased by about 71 million ha.

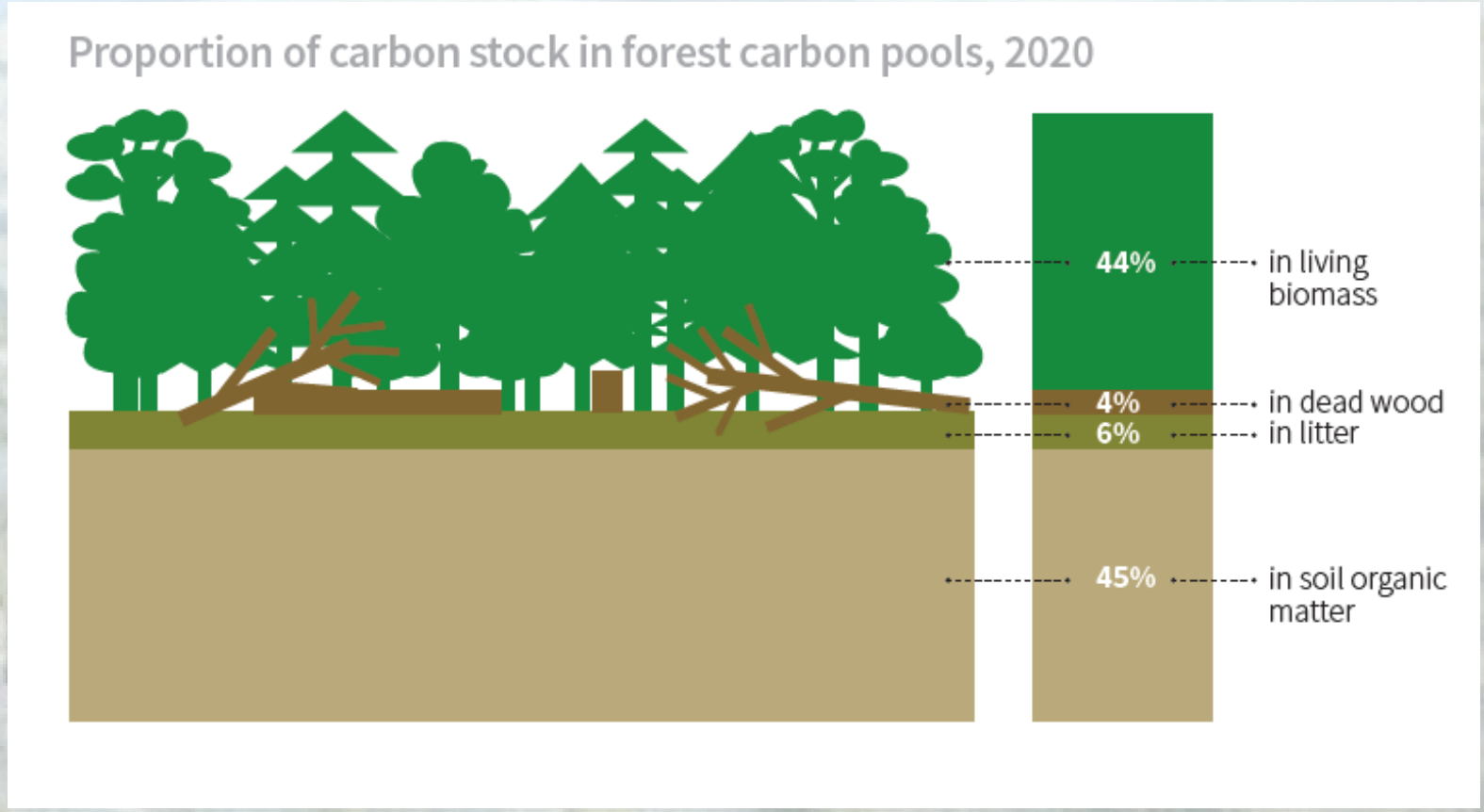
Other Social benefits of forest (cultural and historical heritage, recreation and leisure)

- They also include the hosting and protection of sites and landscapes of high cultural, spiritual or recreational value.
- An area of 186 million ha of forest worldwide is allocated for social services such as recreation, tourism, education research and the conservation of cultural and spiritual sites.
- The area designated for this forest use has increased at a rate of 186 000 ha per year since 2010

Protection and conservation of biodiversity,

- **Habitats for biodiversity and livelihood for humans**
- Forests provide habitats to diverse animal species. They are home to 80% of the world's terrestrial biodiversity, and they also form the source of livelihood for many different human settlements, including 60 million indigenous people.
- About 10% of the world's forests is allocated for biodiversity conservation. Globally, 424 million ha of forest is designated primarily for biodiversity conservation. The rate of increase in the area of forest designated primarily for biodiversity conservation has slowed in the last ten years.
- Within the Drim basin in North Macedonia there are 3 national parks: NP Mavrovo (1/2 of the area is covered with forest), NP Galicica and part of NP Pelister (proclaimed previously because of unique forest stands of Pinus Peuce – Macedonian Pine) .

Sequestration of carbon and mitigation of climate change,



- Total forest carbon stock is decreasing.
- Most forest carbon is found in the living biomass (44 %) and soil organic matter (45 %), with the remainder in dead wood and litter.
- The total carbon stock in forests decreased from 668 gigatonnes in 1990 to 662 gigatonnes in 2020;
-

Forest for soil and water protection (Protective forest)

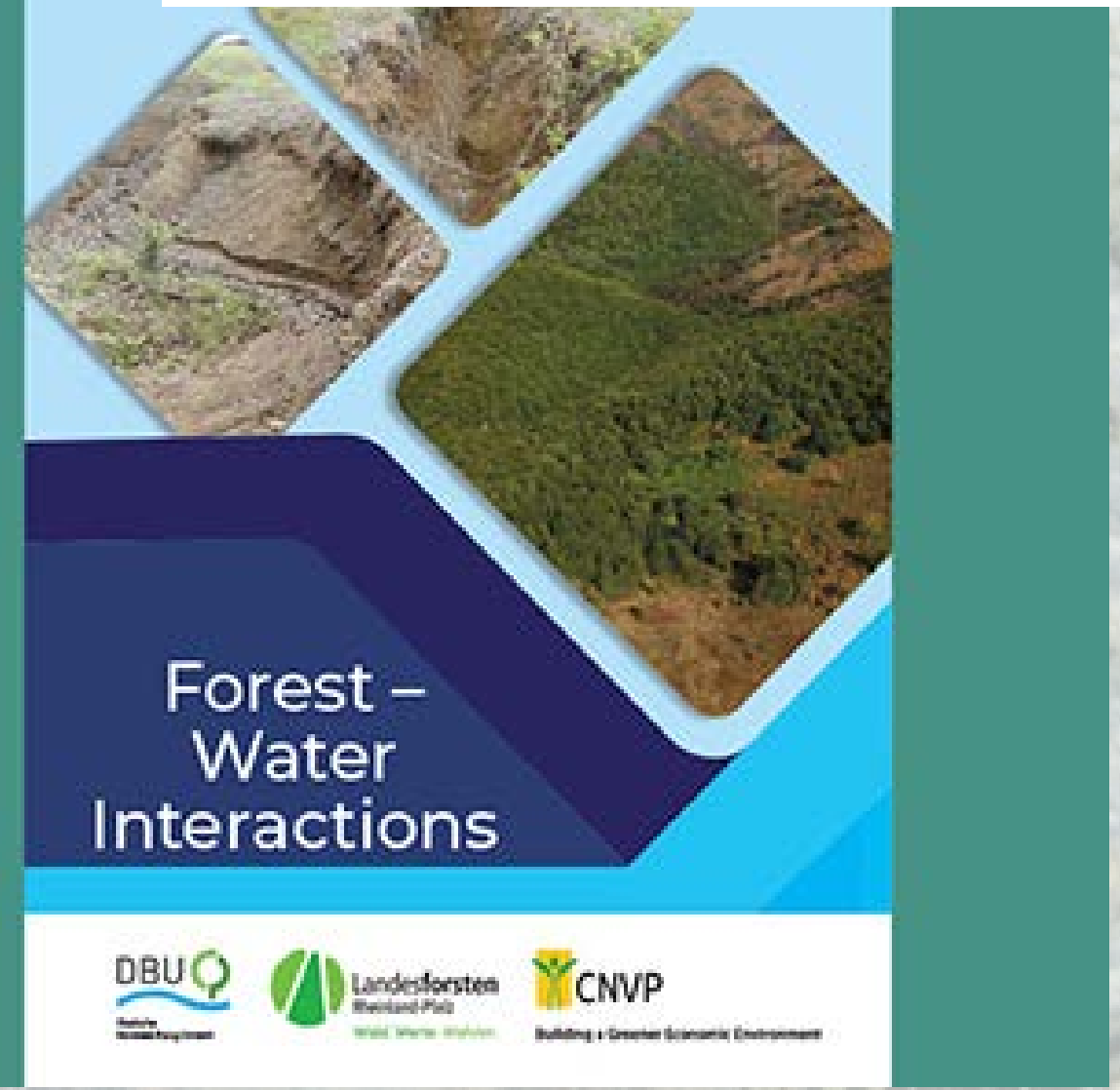
Sub-categories

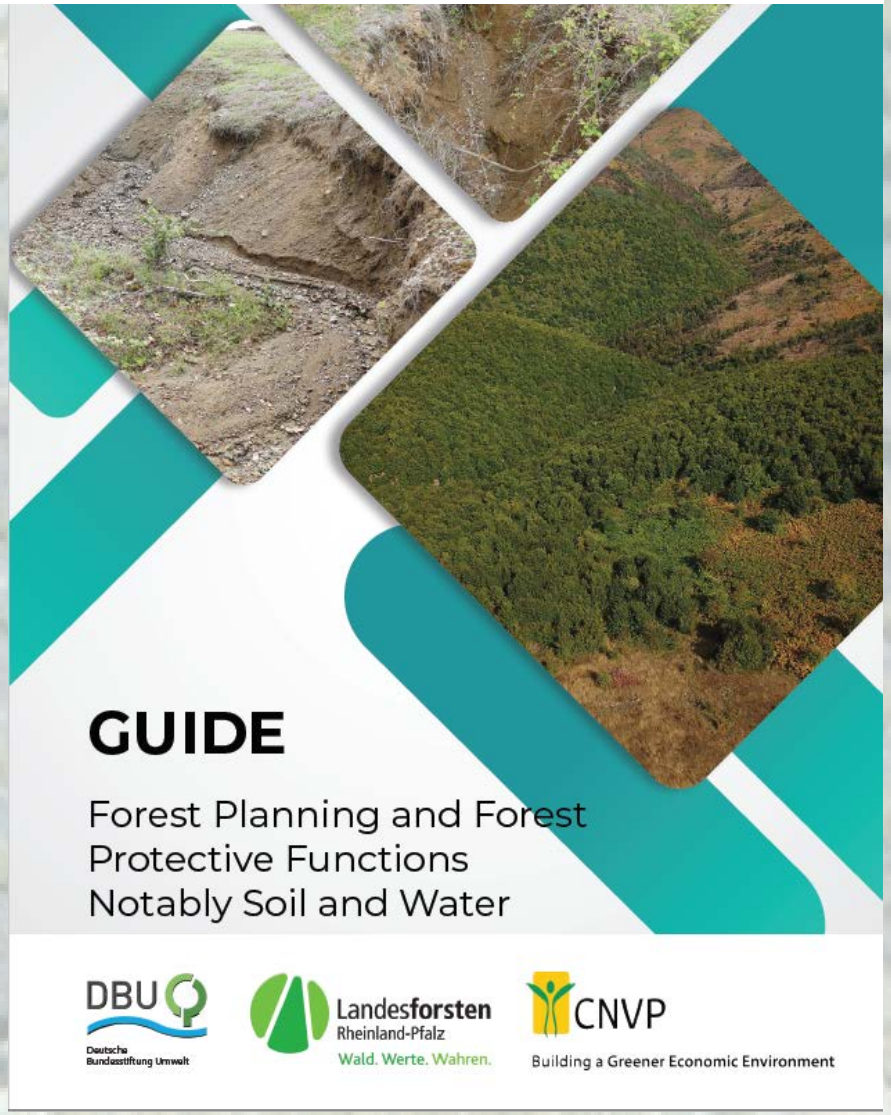
- Production of clean water
- Erosion, flood protection
- Desertification control
- Avalanche control
- Coastal stabilization
- Reducing flood risk
- Otter soil and water

- An estimated 398 million ha of forest is designated primarily for the protection of soil and water, an increase of 119 million ha since 1990.
-
- The rate of increase in the area of forest allocated for this purpose has grown over the entire period but especially in the last ten years.

1.2 Forest management , soil and water

https://gembalkans.org/documents/





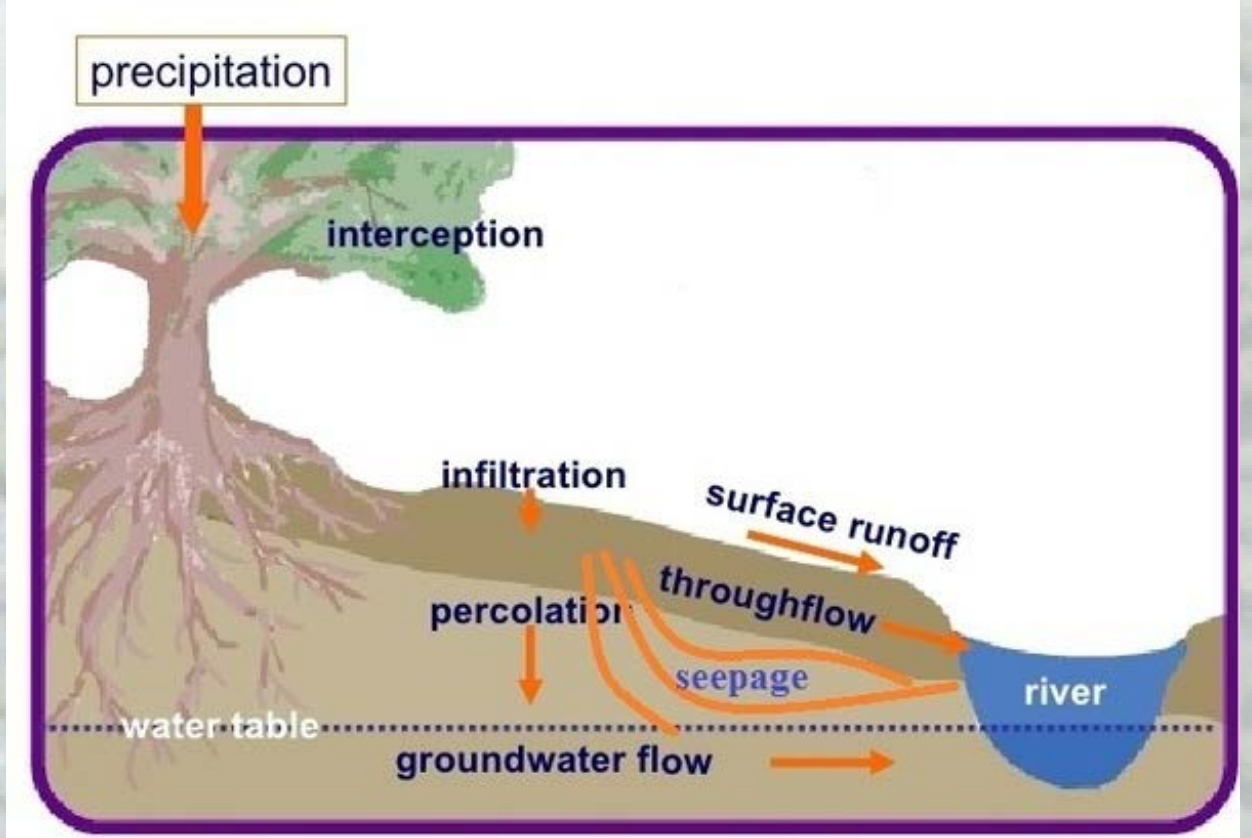
Water movement in forest ecosystems

- In forest ecosystems this complex process is directly influenced by various factors.

- Part of the water that reaches the soil surface is infiltrated into it, and part run on the surface.

  Part of the infiltrated water penetrates deeper into the soil , and part of it run subsoil.

- The rest of the soil that deeply penetrates the soil feeds underground releases and causes underground swells.



$$P = Fst + Ei + Es + Et + Fov + Fg \pm \Delta S(mm)$$

P – Precipitation [mm] **P = Pv + Ph + Fst** **Pv – vertical precipitations, Ph - horizontal precipitation, Fst – leaking along the tree branches and stem**

Ei – interception - evaporation of the water retained on the crown and stems, Es - evaporation from the soil, Et – transpiration , F - general water runoff (mm) F = Fov + Fg, Fov - surface runoff, Fg - ground runoff

Management practices	Objectives
Choice of tree species and structure	Improvement of water quality and quantity (hydraulic conductivity)
	Health of forests
Thinning	Biomass harvesting
	Recharge of aquifers
	Wood quality
	Increase of sturdiness of leaving trees
Clear-cutting, whole tree harvesting	Biomass harvesting for energy
Change in rotation	C storage
No management	Biodiversity, sustainability
	To preserve existing water quality and quantity
	Health of forests
	C storage
Fertilization	Increase of wood production
	Improvement of nutritional status
	Health of forests
	C storage
Site preparation	Improvement of regeneration and initial growth of seedlings
Ditching	Drainage
Prescribed burning	Forest fires prevention, fertilization, improvement of regeneration
Change in rotation	C storage

Common forest management practices and their objectives (V.Novak et al, 2005)

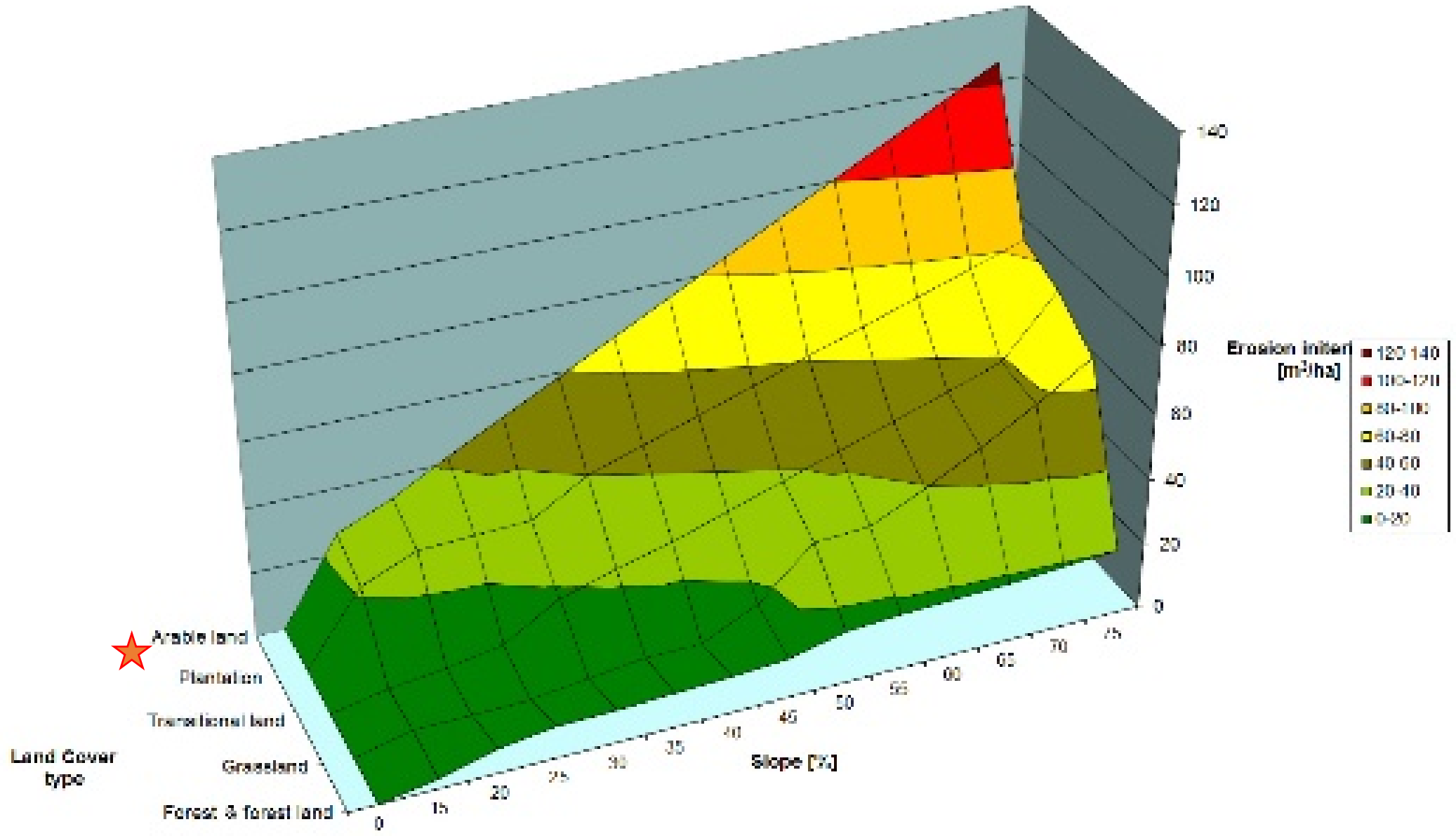
Runoff coefficient

cover	Slope of terrain in [%]			
type	17,5	36,5	57,7	83,9
grassland	0,82	0,9	0,95	
scots pine	0,17	0,25	0,33	0,48
spruce	0,03	0,05	0,08	0,34
beech	0,02	0,03	0,04	0,05

According το Schaffhauser (1982)
Forest stands - almost 0
bushland - 0,017
grassland - 0 0,187
Ski-trail - 0,364
Meadow with grazing – 0,601

Hydrological element	Selective Cut	Shelterwood logging	Clear Cut
Interception in crown (% of total precipitation)	8	5	0
Retention in the forest floor (% of precipitation)	10	7	4
Infiltration (% of precipitation)	76	63	53
Surface runoff (% of precipitation)	6	25	43

Erosion as a function of slope and land cover [m³/ha]



FM and drinking water

- Different forest management practices have different impact rate on selected drinking water quality and quantity indicators.

- Impact of forest management measures on drinking water quality and quantity indicators

(I.Pilas et al)

Forest management measure/Indicator	Concentration of pollutants in the water	Nitrogen content in the water	Sediment loss (erosion)	Runoff	Water temperature
Clear cut area	*	***	***	***	***
Frequency, intensity, technique of harvesting	***	*	**	**	*
Tree species composition	**	***	**	***	*
Crown density, cover percentage	*	***	***	***	**
Distribution of growth classes	*	**	**	**	***
Vertical and horizontal stand structure	*	**	**	**	*
Forest regeneration, ground vegetation	*	**	**	**	*
Coarse woody debris	*	**	*	*	*

* – Low impact ** – Medium impact, *** – High impact

Table 2 - Comparison of the Status of protective forest in the Republic of North Macedonia, with neighboring countries and selected countries in the world

	Serbia		Bulgaria		Albania	N. Macedonia
Designation function	1000 ha		1000 ha		1000 ha	1000 ha 1
Forests	**2720**	**100,0**	**3738**	**100**	**772**	**998**
Production	1787	65,7	2387	63,9	611	N/A
Protection of soil and water	598	21,9	439	11,7	131	N/A
Conservation of biodiversity	163	6,0	572	15,3	40	N/A
Social services	164	6,0	220	5,9	N/A	N/A
Multiple use forest	8	0,3	120	3,2	N/A	3N/A
Other woodland	**508**		**23**		**262**	**143**
protection of soil and water					24	N/A
Protection of soil and water	**598**	**100**	**427**	**100**	**796**	**0-zero N/A**
production of clean water	39	6,5	227	53,1	N/A	N/A
coastal stabilization	0	0	0	0	N/A	N/A
desertification control	33	5,5	0	0	N/A	N/A
avalanche control	0	0	0	0	N/A	N/A
erosion, flood protection reducing flood risk	466	77,9	200	46,8	N/A	N/A
of which other soil and water	60	10,0	0	0	N/A	N/A

Delineation of protective forest started in 2020

Data source: FAO – Global Forest Resources Assessment, 2015 http://www.fao.org/3/a-i4808e.pdf

1.3. Effects of afforestation

- Afforestation is planting trees on bare lands or on an area where in distant past there were trees and forest. Reforestation is the process of planting trees in a forest where the number of trees has been decreasing or trees were cut in recent past.

Advantages of Afforestation

- A constant supply of forest products. ...
- Provision of employment and economic opportunities.
- Stabilizes the climate. ...
- Has the potential of reversing global warming and climate change. ...
- Better quality air. ...
- Preservation of wildlife. ...
- **Prevents soil erosion. ...**
- **Improve watershed. ...**

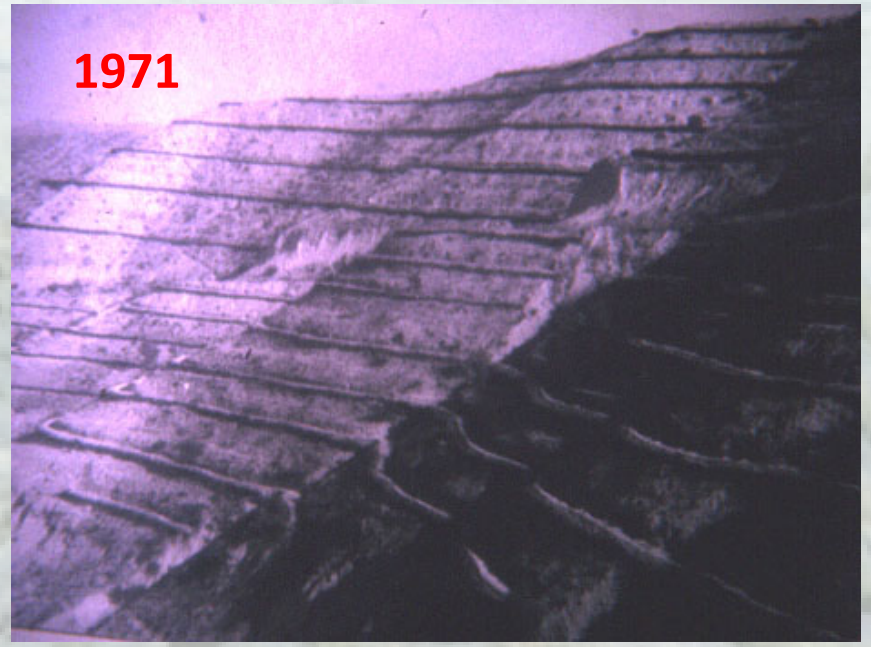
Disadvantages of Afforestation

If not properly managed, afforestation can result in a

- reduction of local biodiversity,
- the modification of particular biomes,
- the introduction of non-native and potentially - invasive species,
- reduced stream flow, and
- lost revenue from agriculture.

Result of afforestation

ROMANIA



TURKEY

1895

FRANCE

1992

1958

2005

SERBIA

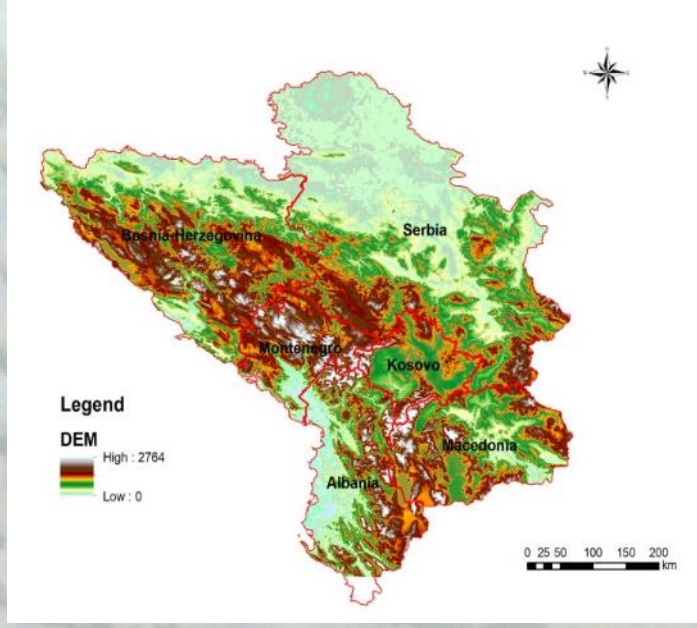
1958

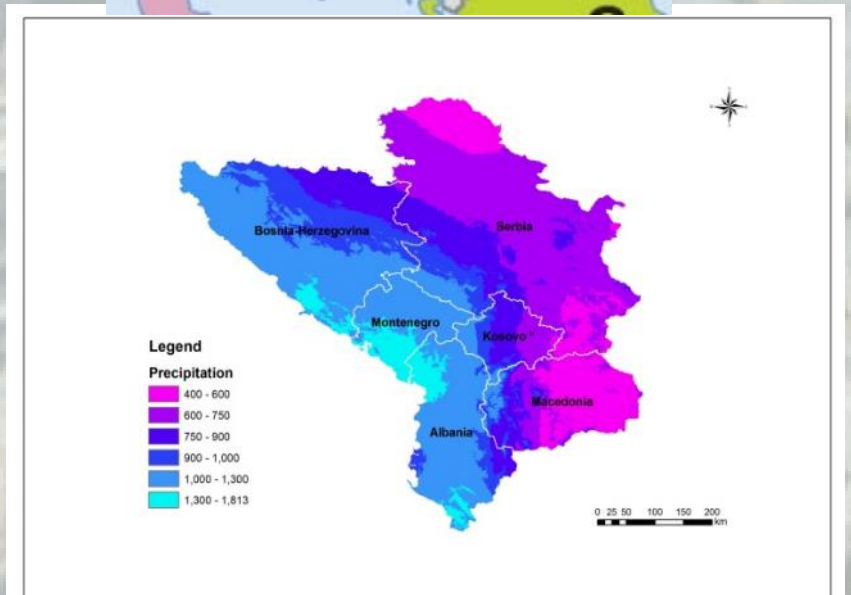
2005

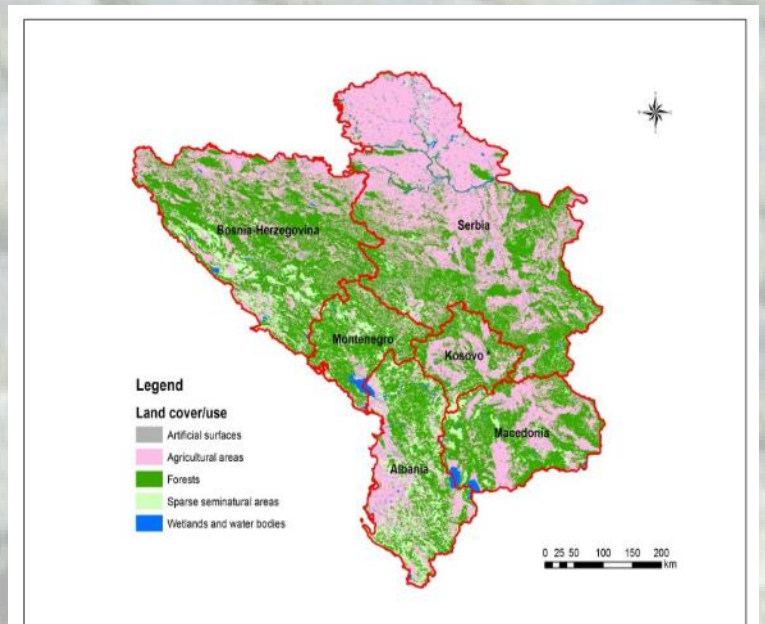
2 - Good examples in soil and water protection from the region and beyond

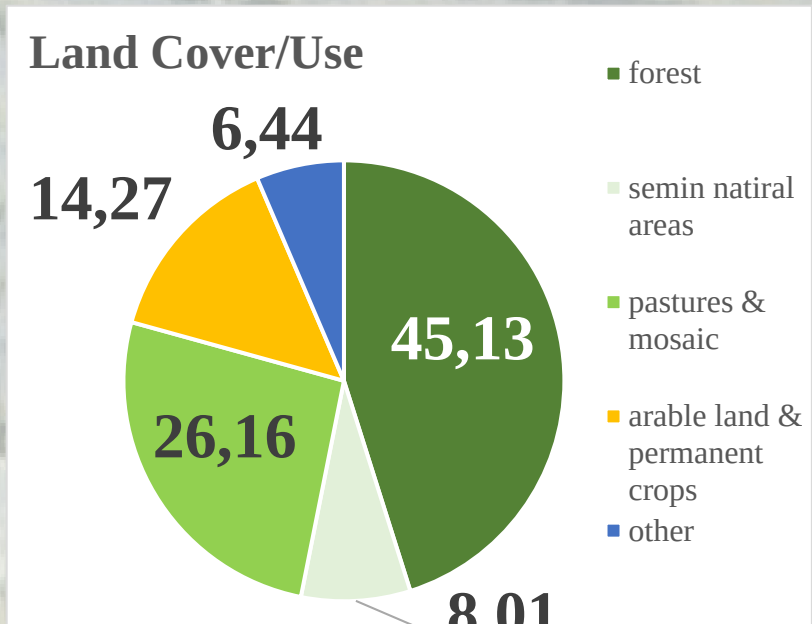
2.1. Erosion Control works in Western Balkan Countries

Source: Blinkov et al 2020





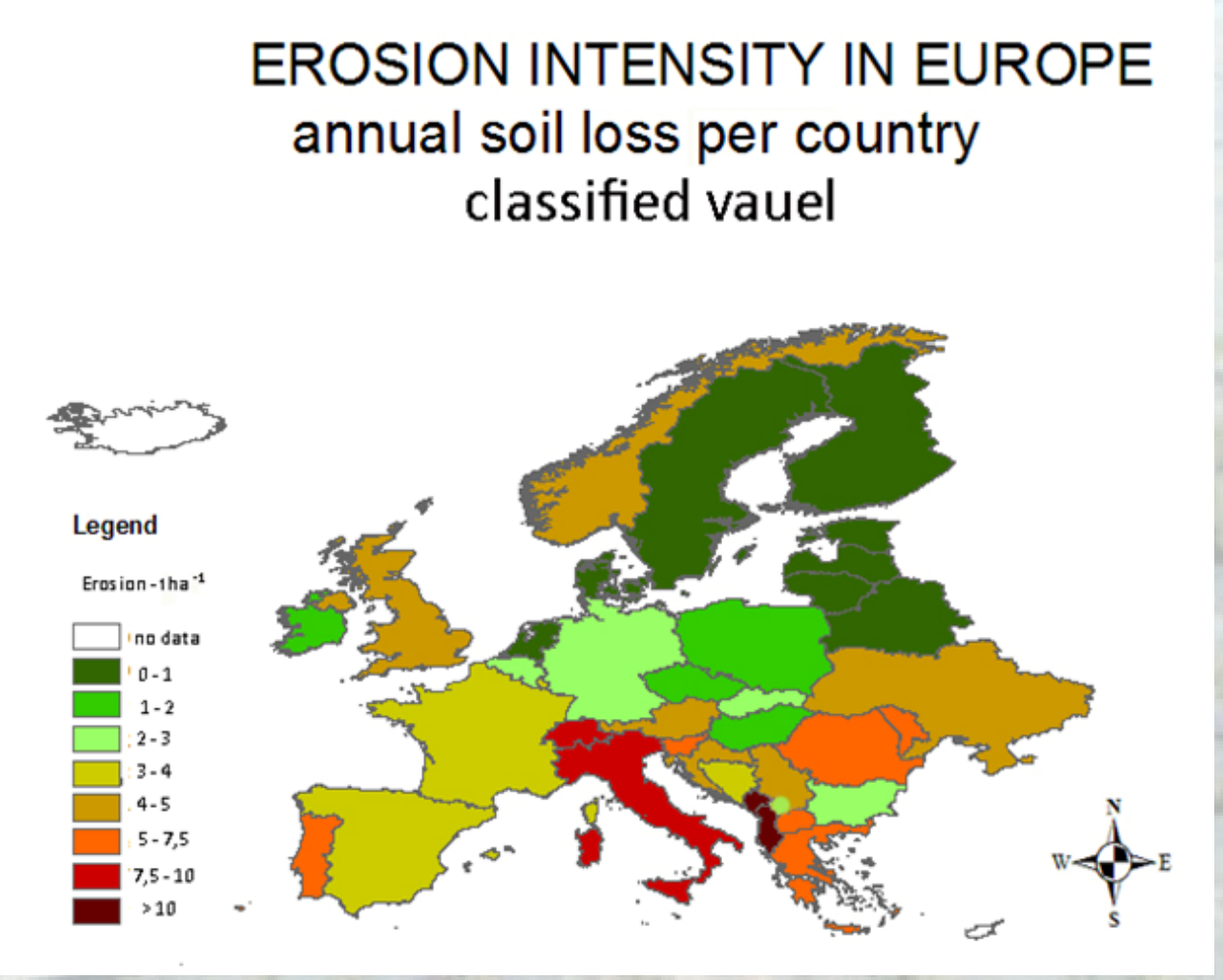




Erosion Intensity in WBC

Country	Area	Annual Erosion intensity		Map scale	Source
		t	m^3	t/ha	
	km^2	$*10^6$		m^3/km^2	
Albania	28748	53,0		1870	Pixel 1km	Grazhdani S.* (2007)
B i H	51129	16,5		323	1:25000	Lazić Z. (2012)
North Macedonia	25713	17,0		685	1:50000	Gorgević et al. (1993)
Montenegro	13812	17,3		1253	1:50000	Kostadinov S. (2007)
Serbia	77477	37,0		488	1:50000	Kostadinov S. (2007)
Kosovo (UN 1244)	10908	2,7		289	1:50000	Kostadinov S. (2007)
Total	***207787***	***143,5***	***7,03***	***703,4***		

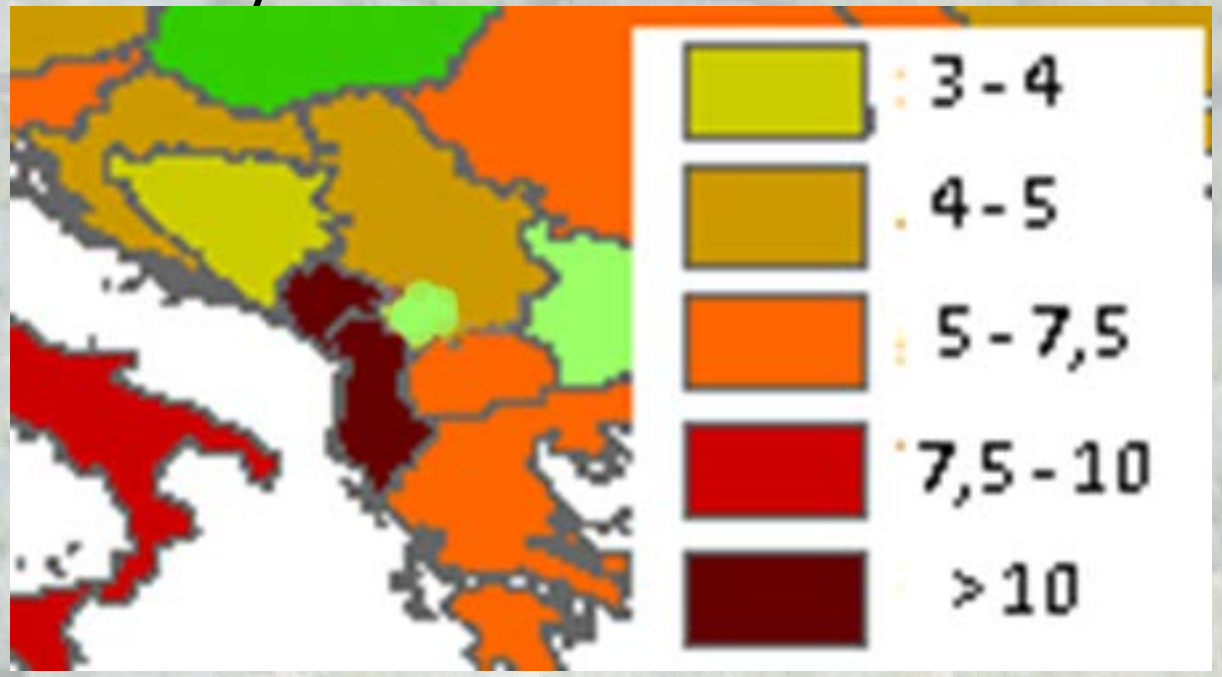
Grazhdani (2006) stated that the maximum erosion intensity in Albania reaches 510 t/ha y in Gjirokaster



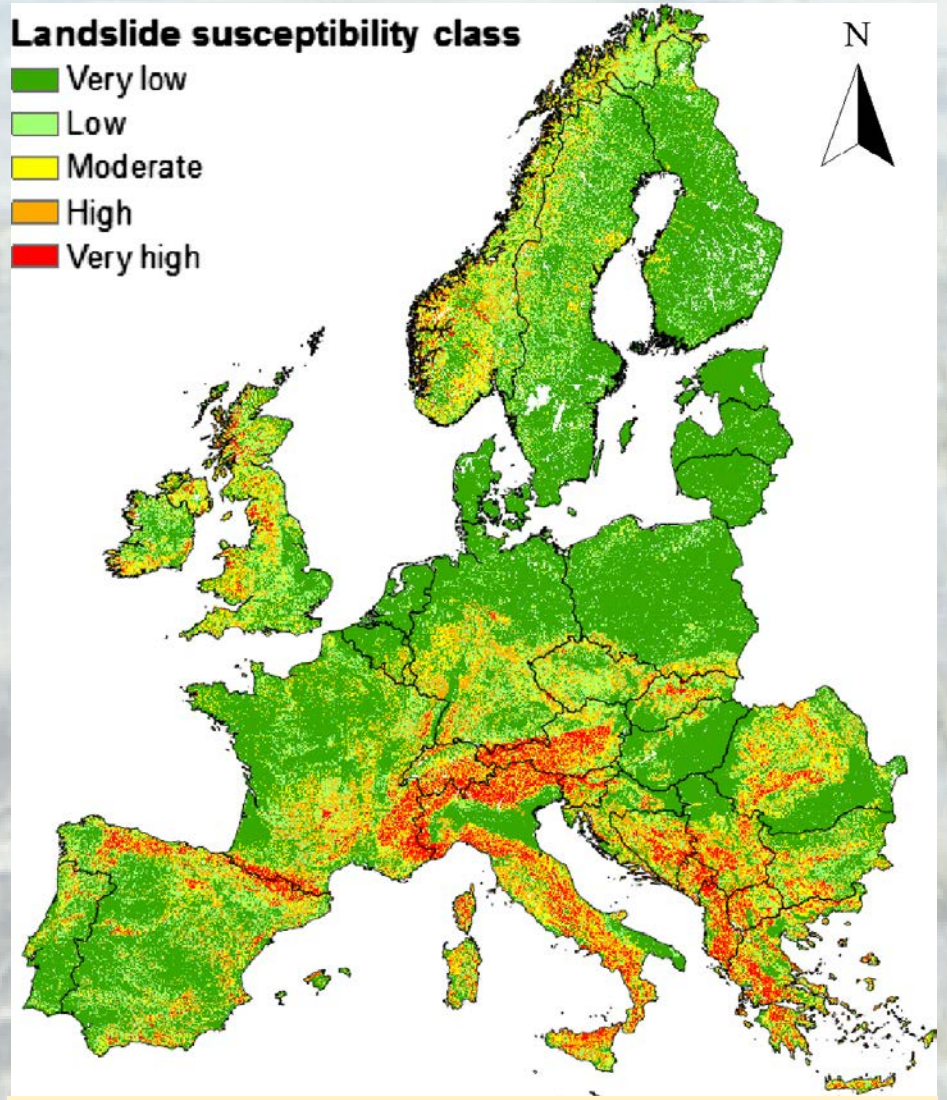
Albania (18,7 t/ha) and
Montenegro (12,5 t/ha)
are the most erosive countries in Europe

Source: Blinkov I. 2015

- The mean annual erosion intensity of European states is 3.18 th^{-1}, and the total soil losses are $1973*10^6$ t/a
- The WBC cover 207787 km2 or 3,486% of the European territory but total annual erosion production is estimated as 7,4% of total European erosion intensity.

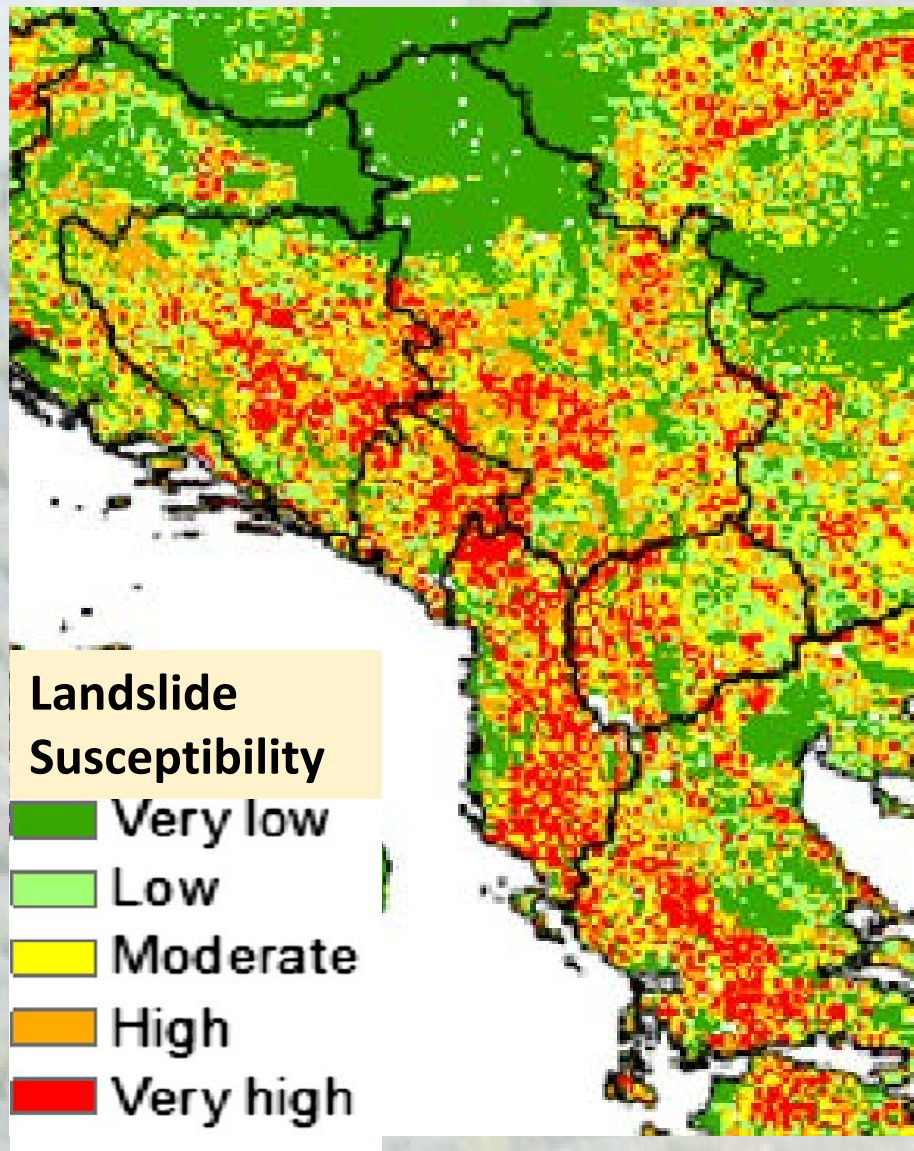


Landslide susceptibility



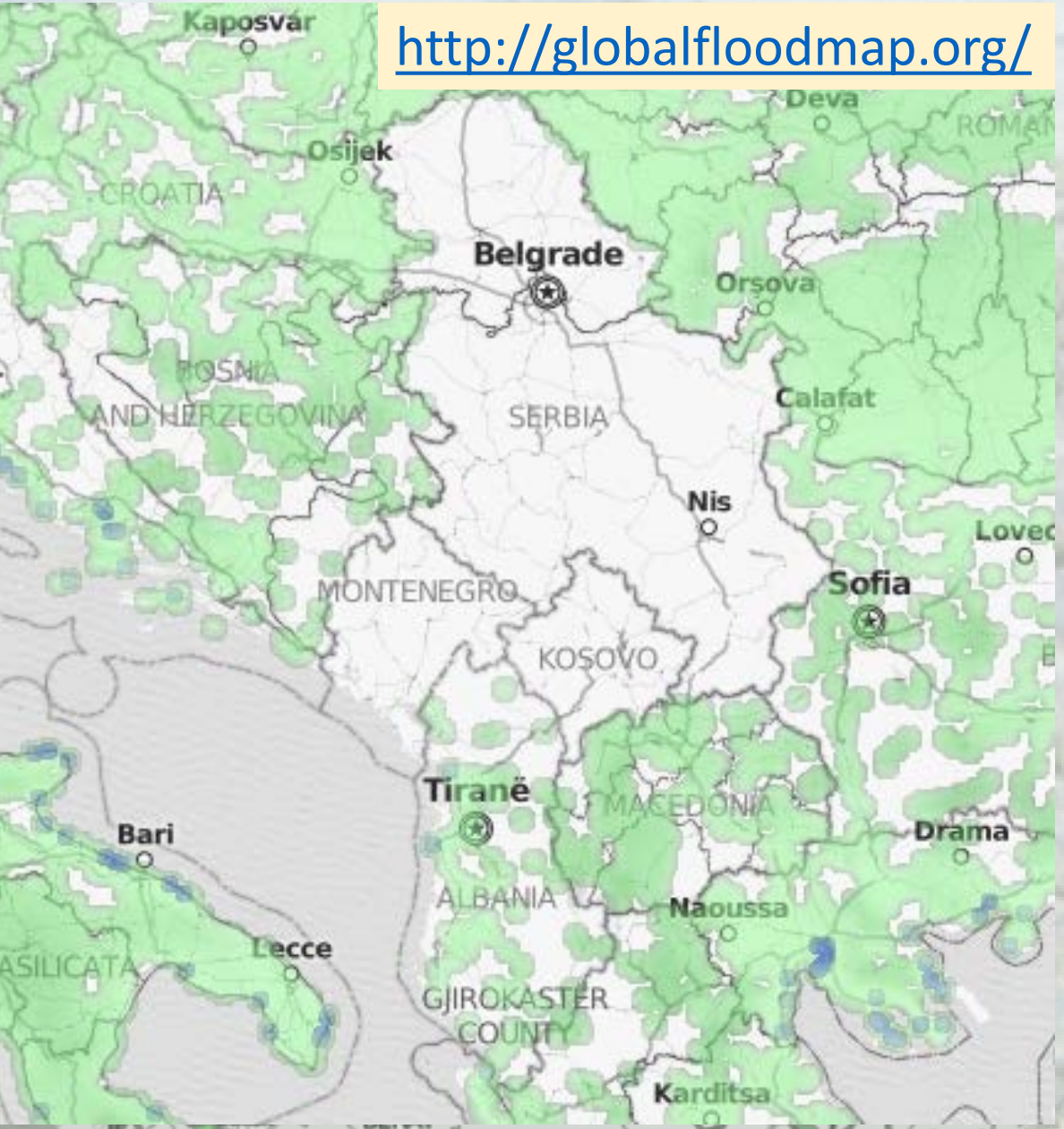
GUNTHER A. et al, 2014

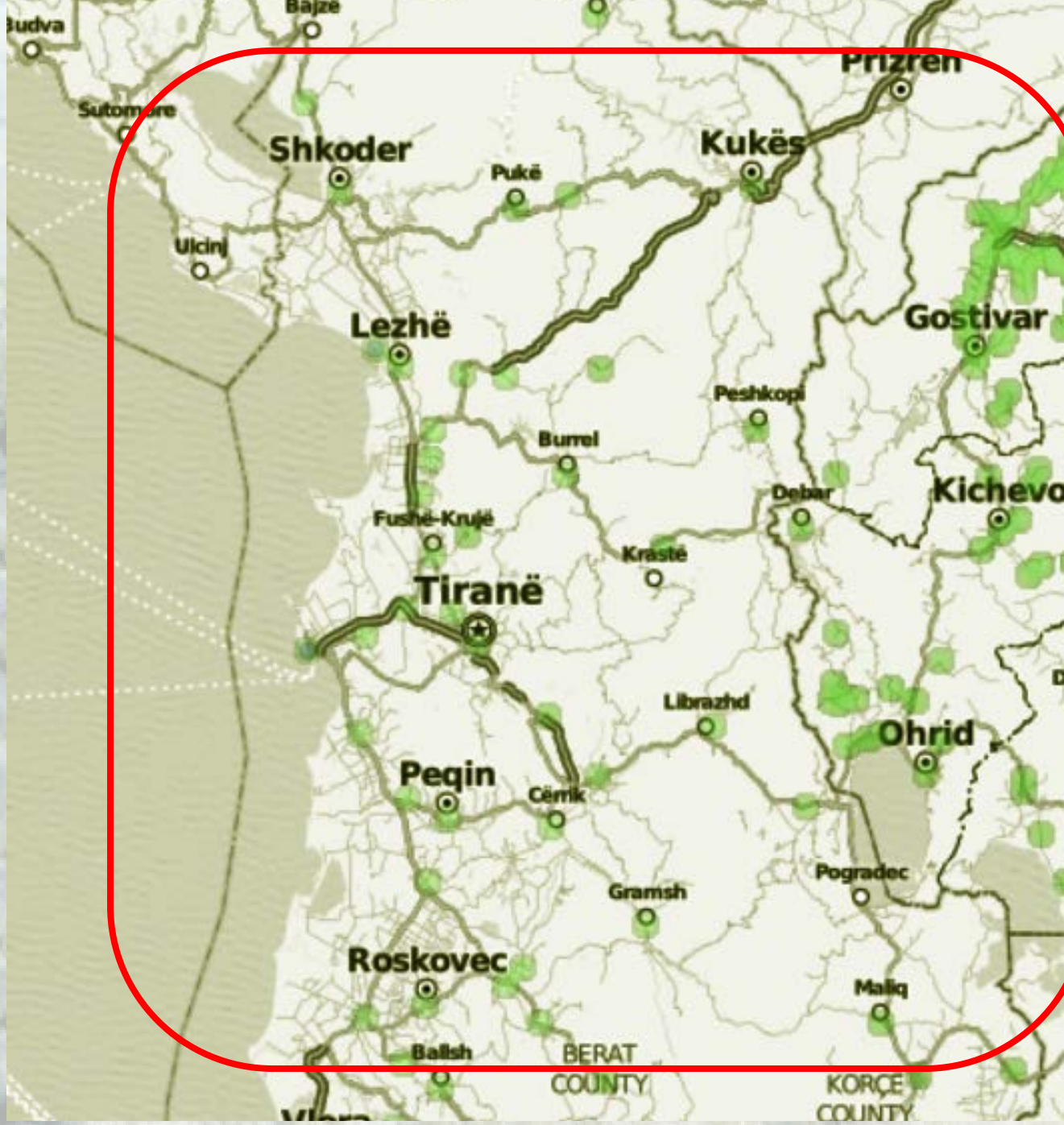
- Bosnia and Hercegovina
- In 2012 registered 1800 active landslide
- Serbia – 40 000 possible locations



Registered floods

http://globalfloodmap.org/





Recent Torrent flood disasters

- Bosna and Hepcegovina,

Serbija

- **North Macedonia 2015,2016 - 28 fatalities**

2.2. Erosion and torrent control in WBC and Drin/Drini Basin

- **Albania**

In the 30's, the King Zog recognized the damages produced for the torrents and provided government support for erosion control measures.
Grazdani states that gully control concept in Albania, consisting in - filling, shaping for smooth water flow, sown to grass and leaving undisturbed control measure for small gullies and to build series of check dams, for large i gullies was very successful

Montenegro

The first organized erosion and torrent control works started in 1880. After multiannual torrential floods in the region, the Austro-Hungarian Government started the works in the Bay of Kotor. Collection dams were constructed in the upper course of torrents, which prevented deep erosion, and in the lower course the stream regulation works were performed

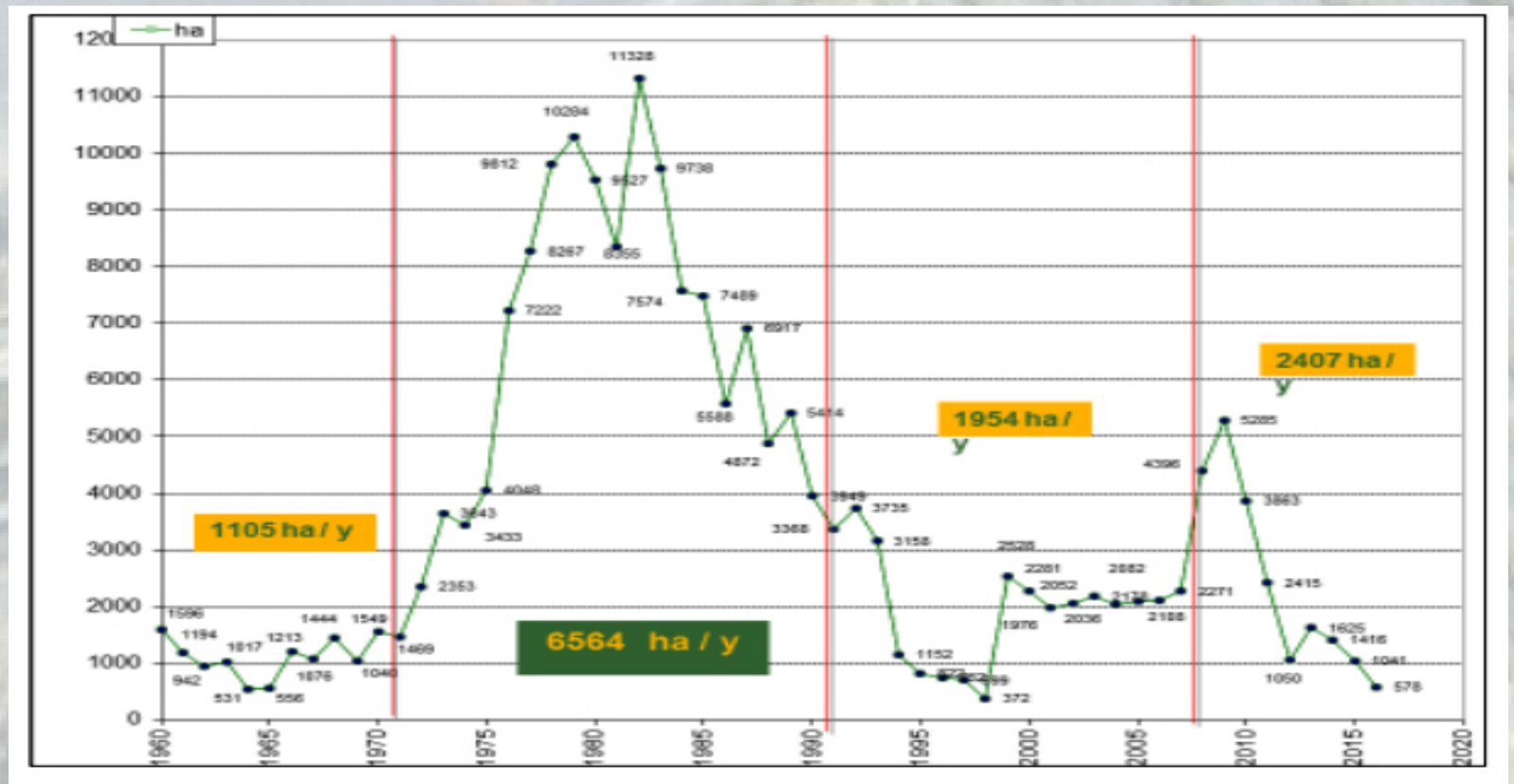
Mass works were performed up to 1963. Later the intensity of erison and torrent control decrease

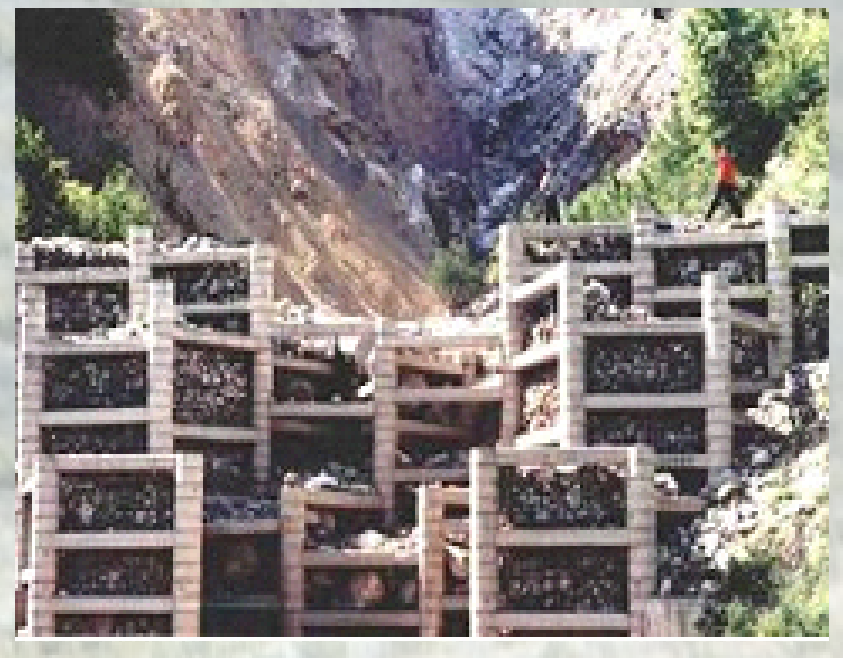
Serbia

- The erosion and torrent control works (ETCW) in the territory of Serbia started prior to 1900 but the organized work began in 1907. The first works were for torrent control and channel training at the zones of intersections with railways, aiming at railroad protection. There were works in the torrents of the Grdelička Klisura gorge in the South-East of Serbia, to protect the international railway line and road Belgrade-Skopje –Athens.
- During the period of almost 100 years in Serbia the technology for torrent control was mostly applied following the Classical European, French and Prof. Rosić's System of torrent control.
- In the period 1907- 2006, were realized technical works (check dams and correction of lower parts of torrents) totalizing 1,501,656.00 m^3, and biological works (afforestation of barren land) in a total of 120,987.00 ha.

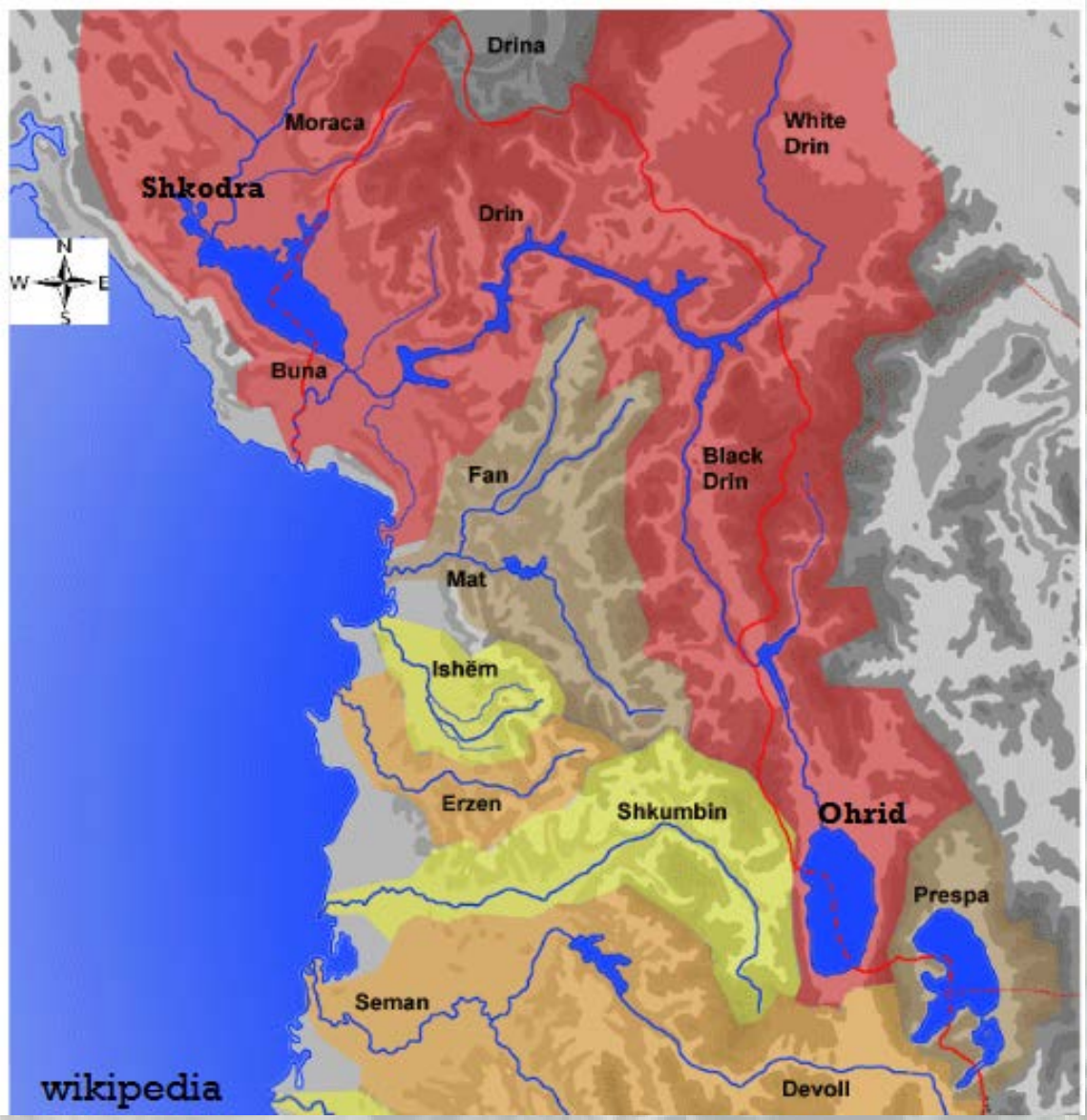
North Macedonia

The first reforestation started already in 1914. Significant erosion control activities were carried out up to 1935.
After the II WW, up to the 1990, almost 300 torrents were regulated.
From 1945 up to 2017, more then 200 000 ha barelands and degraded grasslands were afforested mostly in the period 1971-1990, during the existence of Fund for Afforestation of barelands.



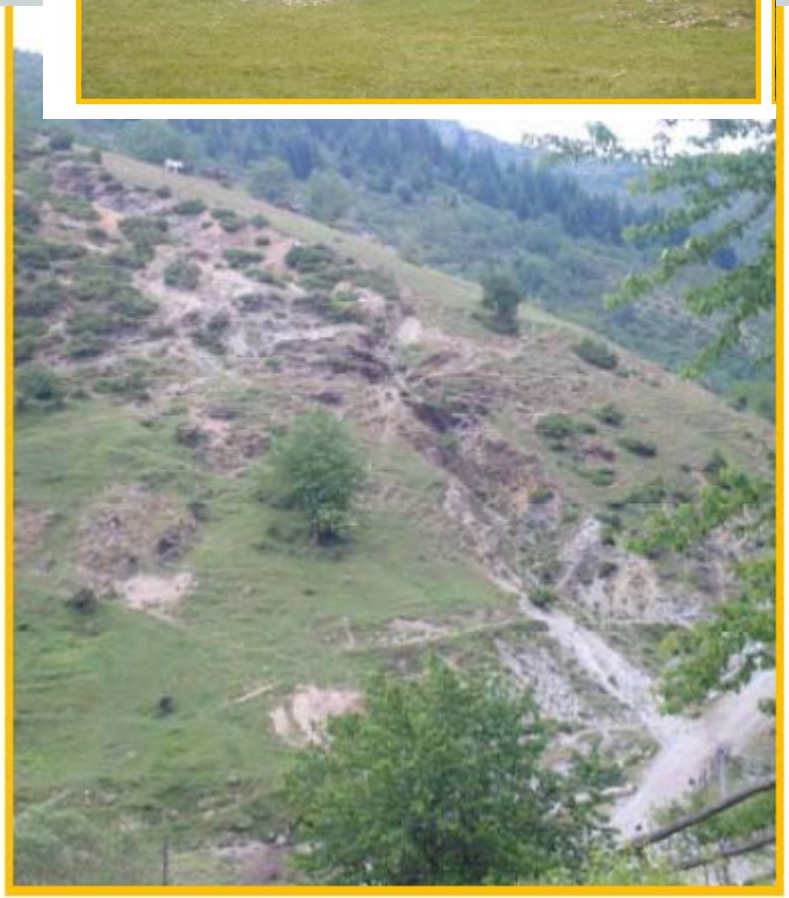


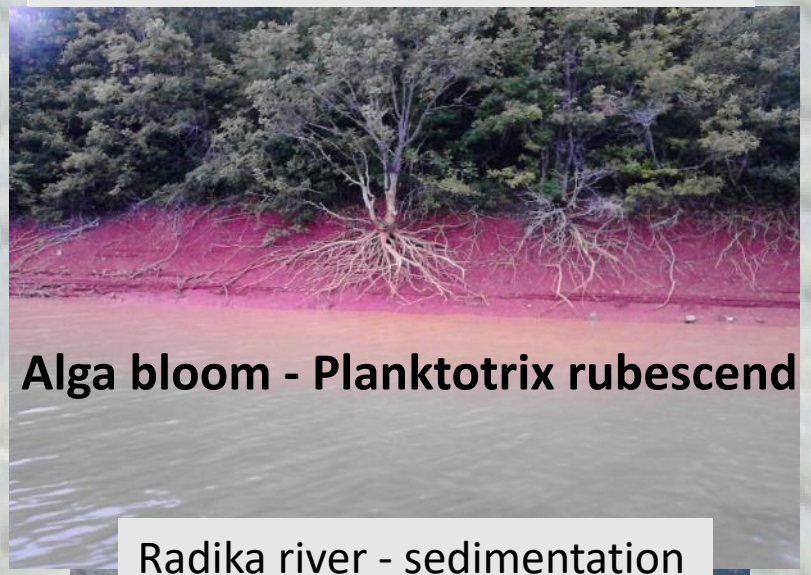
Erosion and Erosion control in Drim/DRINI Basin



- Mountain – Alpine character (young mountain, steep slopes, strongly developed drainage network
- Soil and geology prone to erosion
- Precipitations - > 1000 mm (NM, over 2000 MN)
- Sheet erosion, gully erosion, weathering and talus conus, Landslides, debris flows, avalanches debris, stream bank erosion, coastal erosion, sedimentation

Erosion processes – Drim Basin – North Macedonia

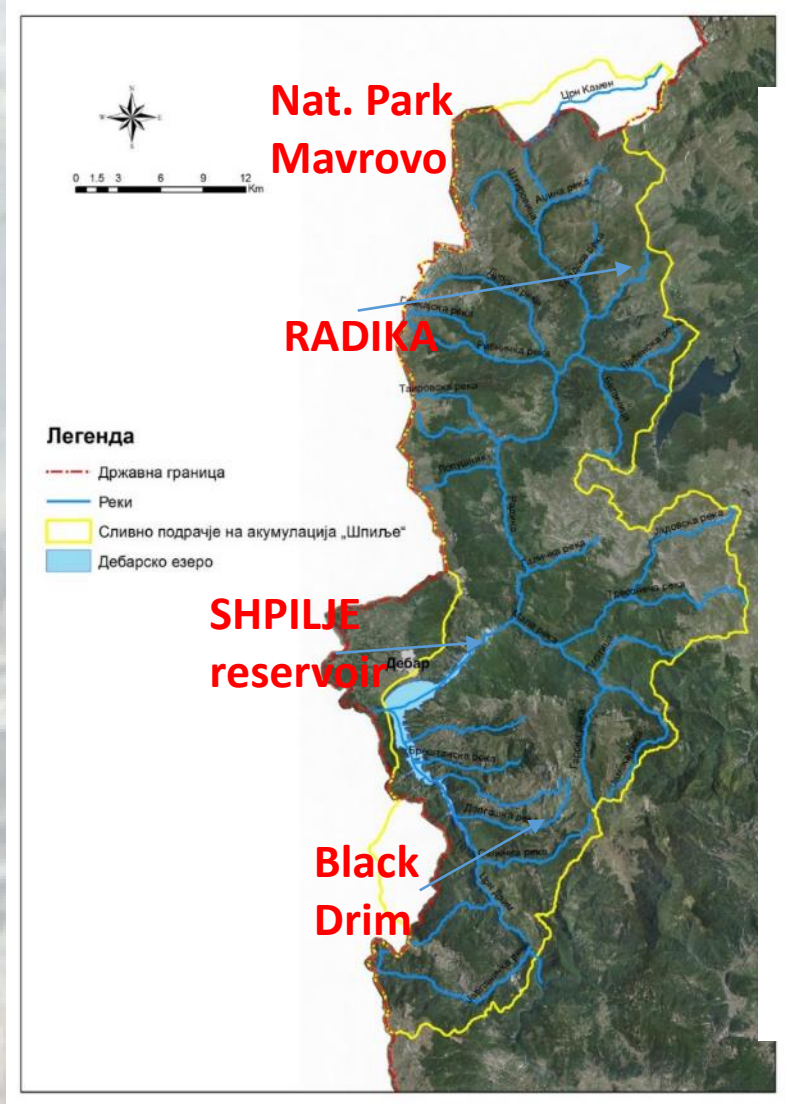


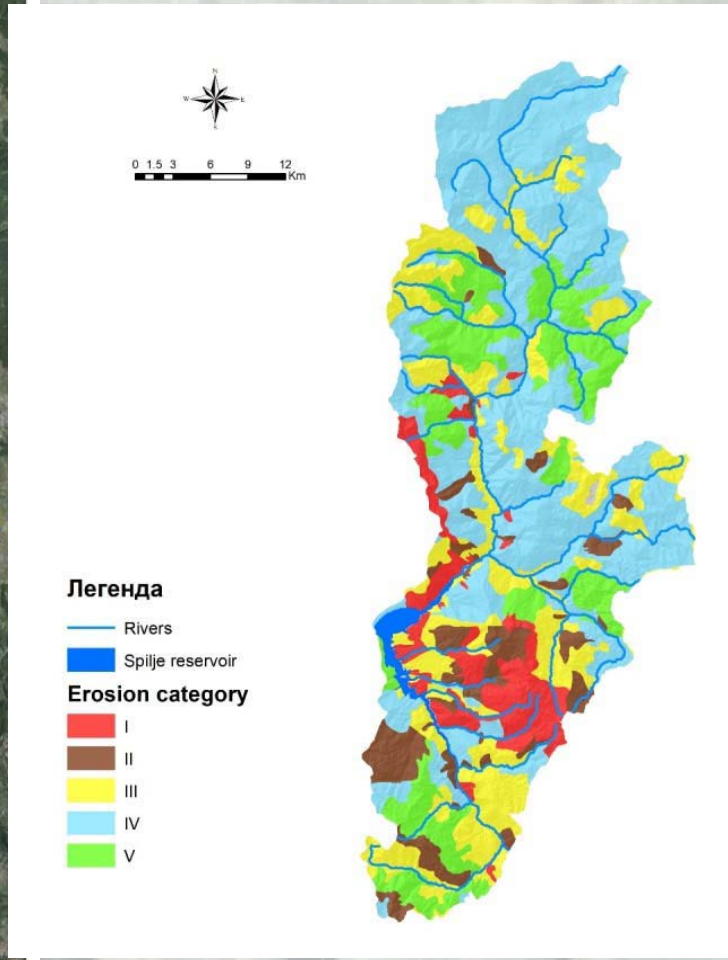


Alga bloom - Planktotrix rubescend

Radika river - sedimentation

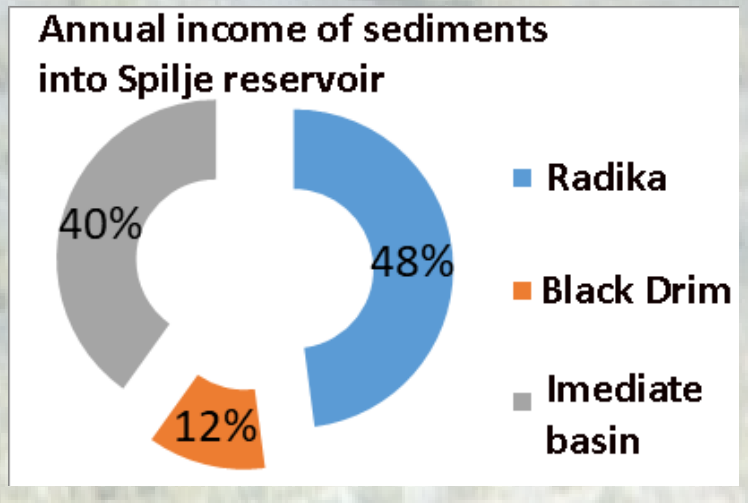
Drim/Drini basin – North Macedonia
2 reservoirs – Globocica and Spilje





- Sedimentation everywhere

- Spilje reservoir
- Total storage Vnn=506,3x10^6 m^3
- Operational storage for HEP Vmrn = 311x106 m^3
- From 1969-2014 deposed
- Vsed = 36.7 x 10^6 m^3
- Vsa = 815 500 m^3/ann



Erosion and torrent control works

DRIM BASIN –Albania

Mountain Vodno is located south of the city of Skopje on the right side of Vardar river. This mountain is very important for Skopje.

Area - cca 4500 ha

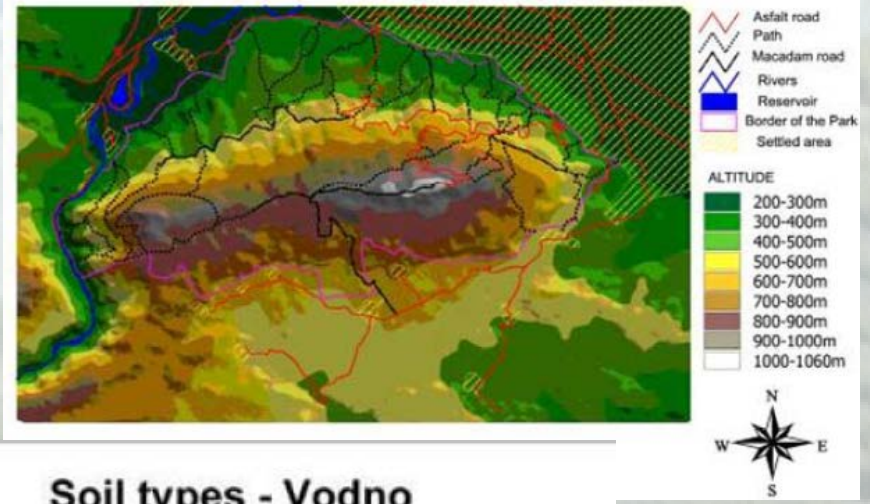
Altitude from 266 to 1066 masl

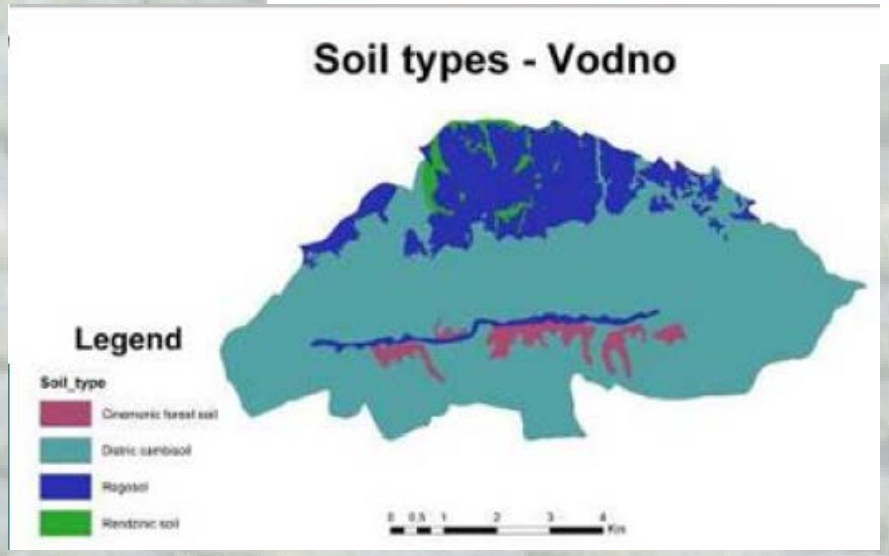
Inclination The greatest part of terrain is so steep (slope >45%).

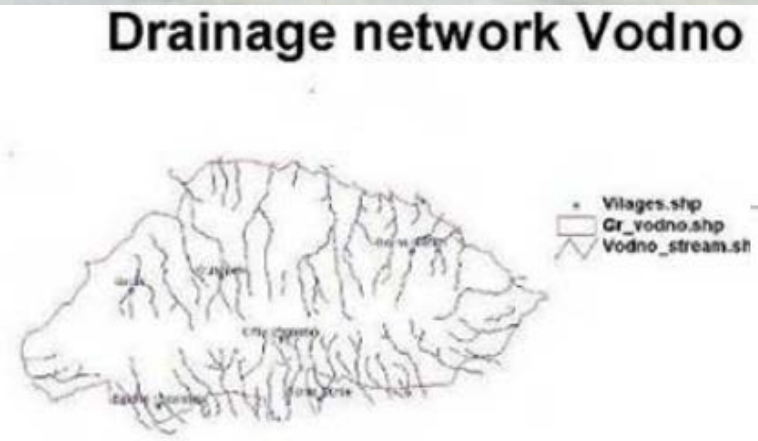
A lot of smaller and bigger torrents .

Soils and geology prone to erosion

Climate conditions are various in the valley and on the mountain. The climate in Skopje – valley is continental submediteranian with long , hot and dry summer and cold winter . for all III zones.







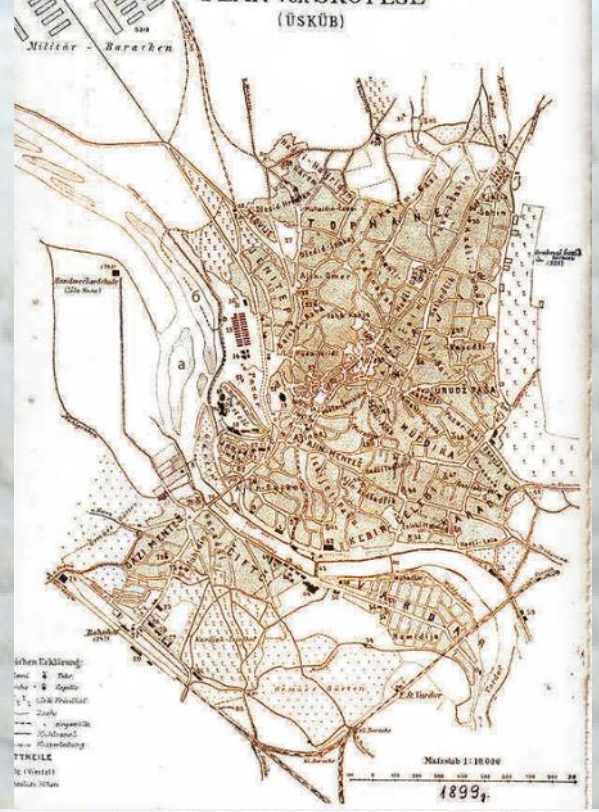
History

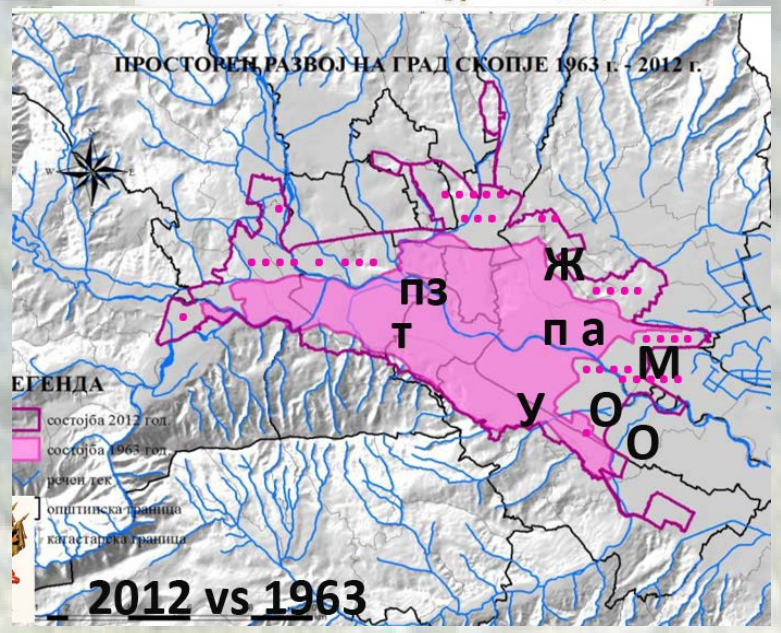
Skopje valley was settled continuously from the ancient period Cca 4000 BC, Paeonian tribe Agrianes established the first settlements and up the end of the 19 century on the left side of the Vardar river (opposite of Vodno mountain).

During the history, people who lived in Skopje and previous settlements cut forest from the mountain Vodno to fulfill all their needs for wood (fuel wood, construction wood etc.). It was extremely on the north slopes of the mountain.

As a result of over cutting , mountain Vodno become bareland.

Results of these were increasing of erosion processes and frequent torrential flows,





1920s

1940s

1950s

- The last big torrent flood happened in **1951**, when there was 1 dead, a lot of injured, but material cost was considerable. On the part near the foot of the mountain, as a result of intensive erosion processes and transport power of the water from the Gornovodnjanski Poroj, there were about few thousand m^3 sediment in the city.
-
- *The extract from the note contained in the daily newspaper "Nova Makedonija" No. 1998, issued on 3-06- 1951, in the week. Consequences of clouds over the water above Vodno, 01-06-1951, 5 pm:*
- *" The rusty roses were reddish over the yellow silt. In the morning, the streets were still covered with stones and water, and from all over there was heard the noise of the pumps that exhausted the water from the basements. At the same time, trucks and chariots were stoned along the streets. In the final balance, one victim was included".*
- *The general conclusion of this was:*
- *"Measures should be taken not to repeat the same, and the measures would be: afforestation, repairing the old and building new collecting channels in Vodno, in order to regulate any possible torrents that could be threatened".*

- After that in 1952 was adopted “A Law for erosion control”.
- Later based on this law, Vodno was proclaimed as erosive area.
- A full set of measures and activities were taken to minimize erosion and torrent hazard as follow:
- administrative (displacement of two villages, prohibition of agricultural activities, prohibition of live stocking activities, goat elimination,)
- bio-ameliorative (afforestation following erosion control rules in a sense of preparation cordons, selection of pioneer species adaptable to extreme soil conditions, high density of planting even 6-8000 seedlings, planting of trees but also bushes etc.),
- hydraulic measures (construction of cross structures as small and higher check dams for retention of sediment, decrease of fluvial erosion, decrease of velocity and kinetic energy; construction of channels with cascades for receiving and transport of flood water and decrease of velocity and energy, construction of evacuated channels that receive flood water from unit channels and evacuate to the recipient – river Vardar).

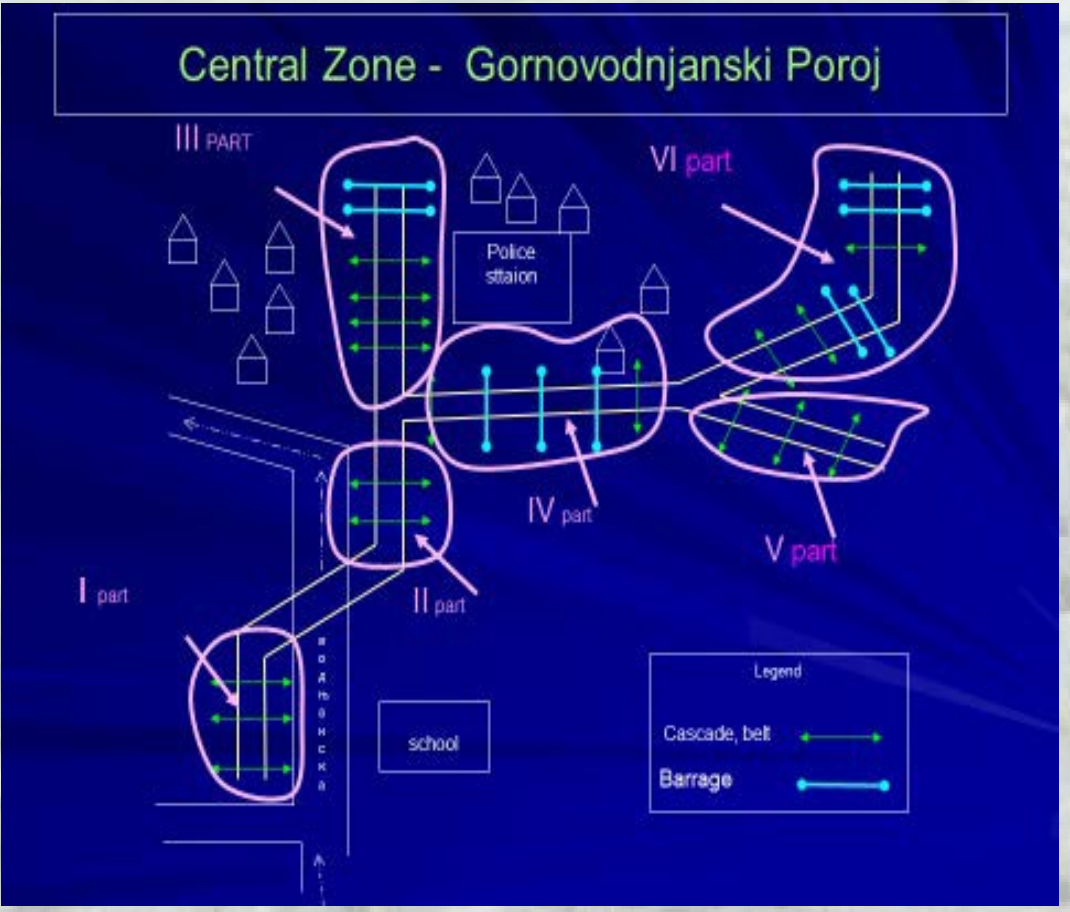
Territory on the northern hill-side tat attacked City of Skopje, was divided in 3 zones: west (WZ), central (CZ) and east zone (EZ).

All torrents in WZ (west zone) and CZ (central zone) were regulated with longitudinal and cross constructions. There are main drainage drains, collecting channels, barrages, cascades, concrete belts and mass biotechnical measures on the catchments. The same system of channels (1 main drain and 1 collecting channel) was built in the west and central zone too.

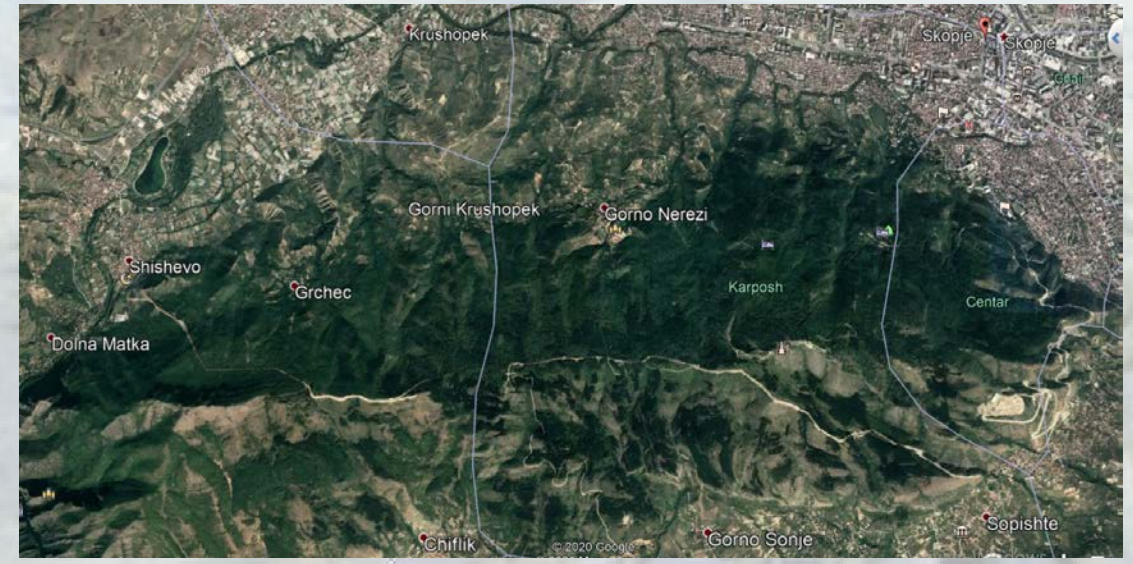
Unfortunately, as a result of lack of finance these channels were not finished in the east zone (EZ)

Due to urbanization there aren't condition for building this type of torrent management in the east zone and water flows on the streets after the end of the channel.

Hydraulic structures



218 species used for planting



FOREST COVER on VODNO

1951 - 450 ha

5,77 times more

2019 – 2 596 ha

1920 vs 2015

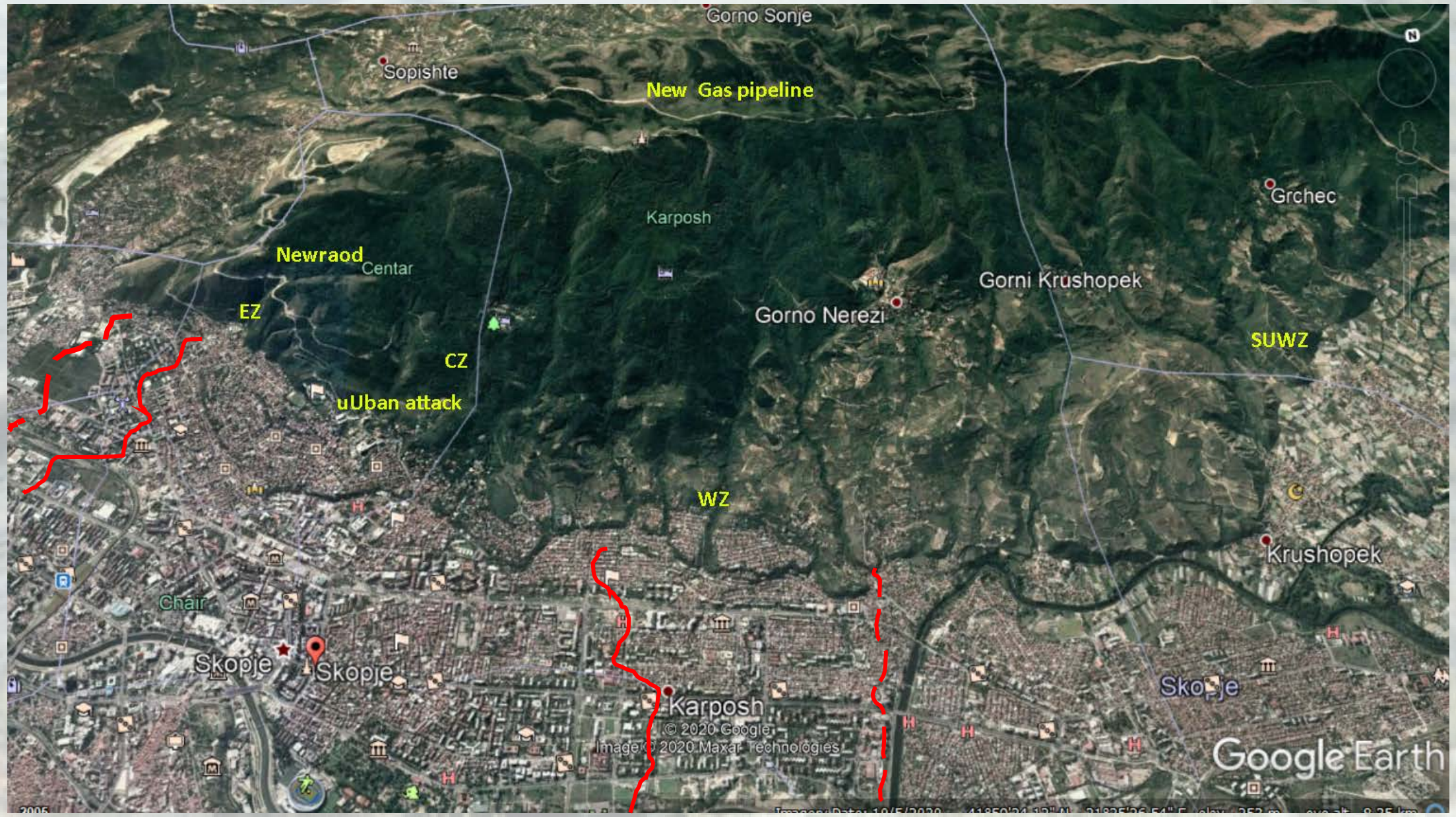
Effects

- Decreased risk of erosion and torrent flooding in central part of Skopje
- Lungs of Skopje
- Significant biodiversity (> 1000 floristic taxons, significant number of wild fauna)
- Several cultural- historical items contribute to the importance
- The most popular recreational area in the vicinity of Skopje
- In 1976 Proclaimed as Park Forest

- In a procedure for proclaiming as IUCN 5 – protected landscape
- In a procedure of proclaimed as actual and potential erosive area

- Aim: Long term protection of Vodno mountain

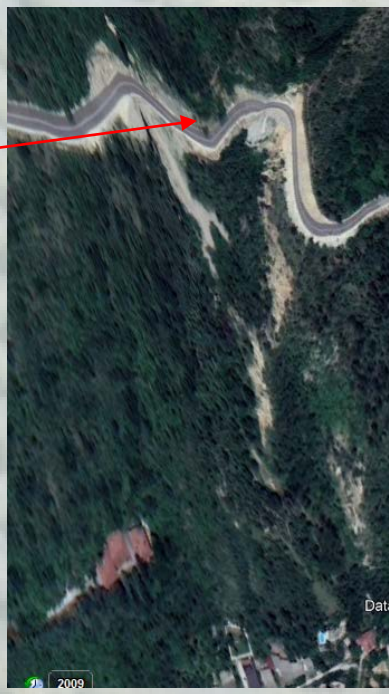
Attack on Vodno

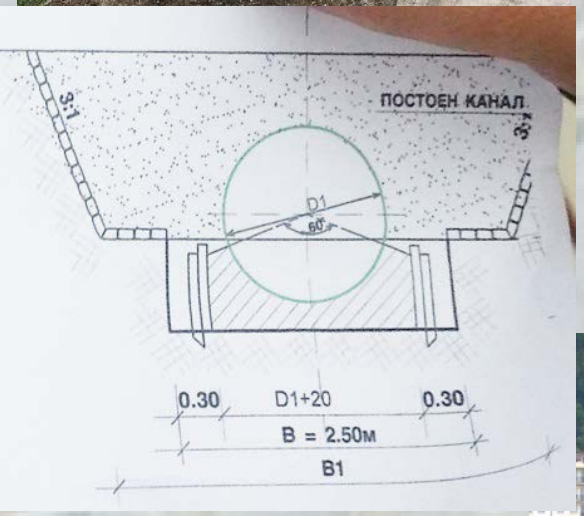


HUMAN IDIOTISMS

New Road construction

Closing of c**hannels**
Absence of knowledge

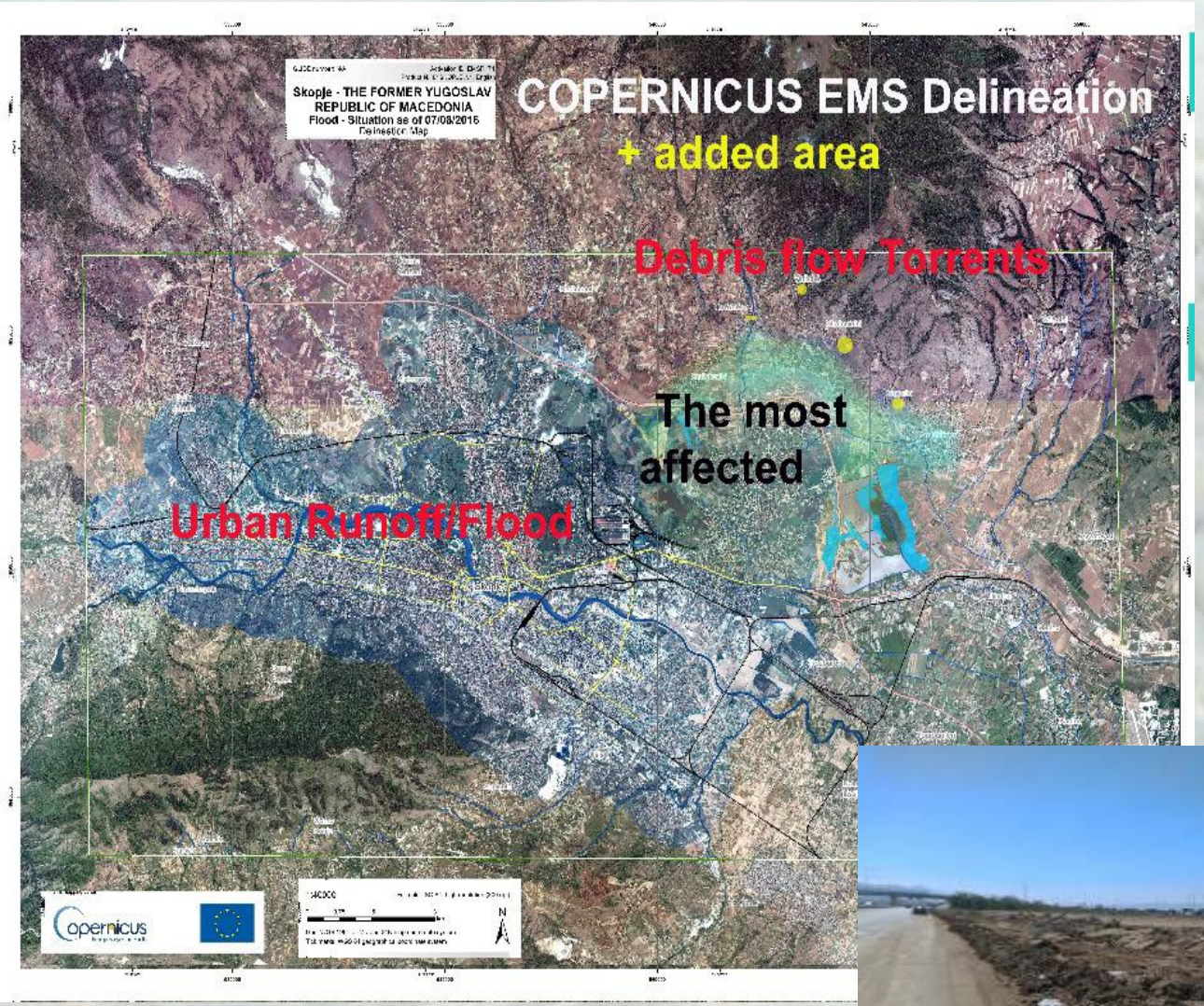




Legal urbanization

Illegal ban

Skopje torrent flood catastrophe – 2016 (22 fatalities)



EROSION STUDY AND ACTION PLAN
FOR THE CITY OF SKOPJE

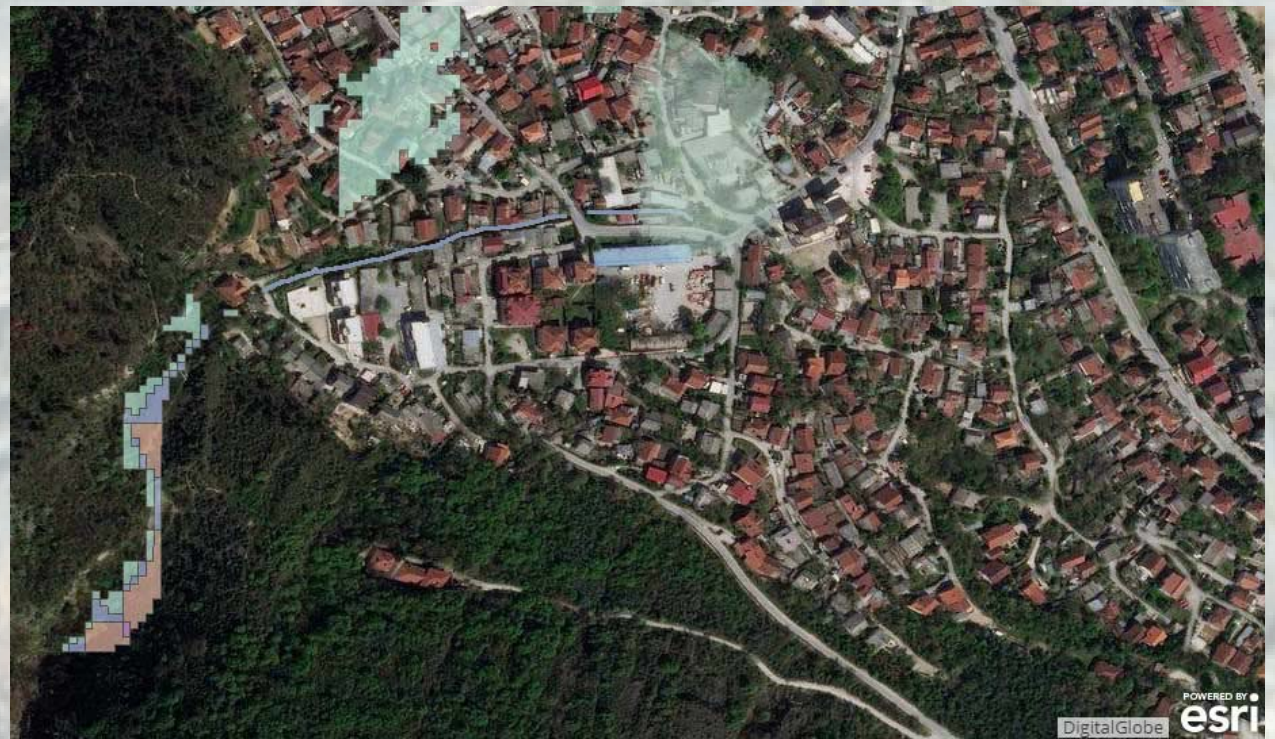
ГРАД СКОПЈЕ

REVIEW OF THE VODNO EROSION AND FLASH FLOODS PROTECTION SYSTEM

Empowered lives.
Resilient nations.

Flood **h**azard , flood risk map for Skopje , 2017

- Extension of the city and improper activities in eastern part contribute to increase of risk of torrent flooding



> Fight < for Vodno Mountain

- Proclaiming as actual and potential erosive area (with significant restrictions)
- Lobbing to be included hazardous areas within urban planning and to be avoided these areas for construction etc.
- Prepared Plan for Afforestation of bareland on Vodno
- Media promotion
- NGOs

Last Slide

It's not over...

Thank you for your attention