COST Action CA15206 Payments for Ecosystem Services (Forests for Water)
Scientific Meeting Opatija, Croatia 17-19 October 2017

Woodlands for water PES: state and regional opportunities in Croatia

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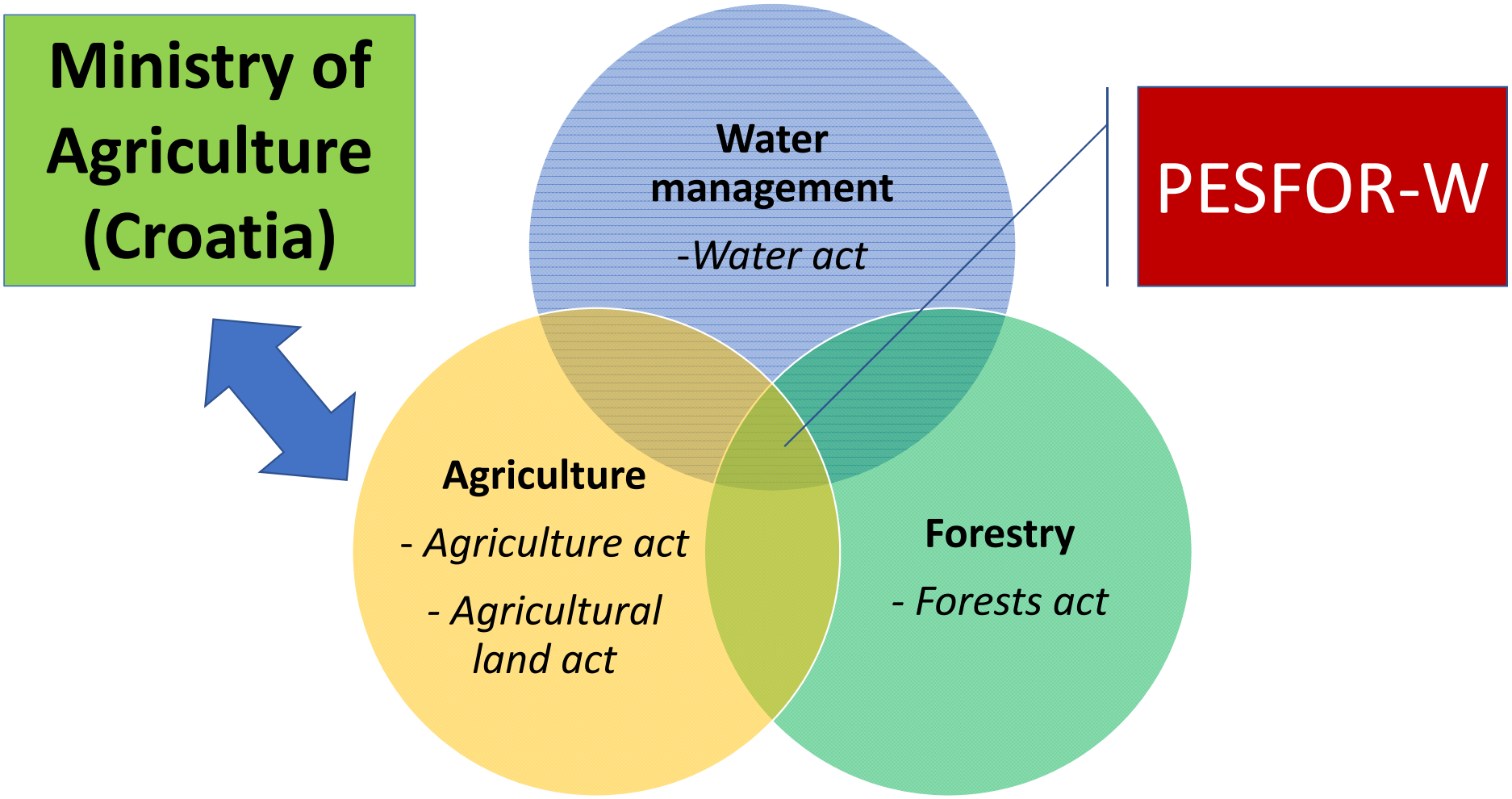
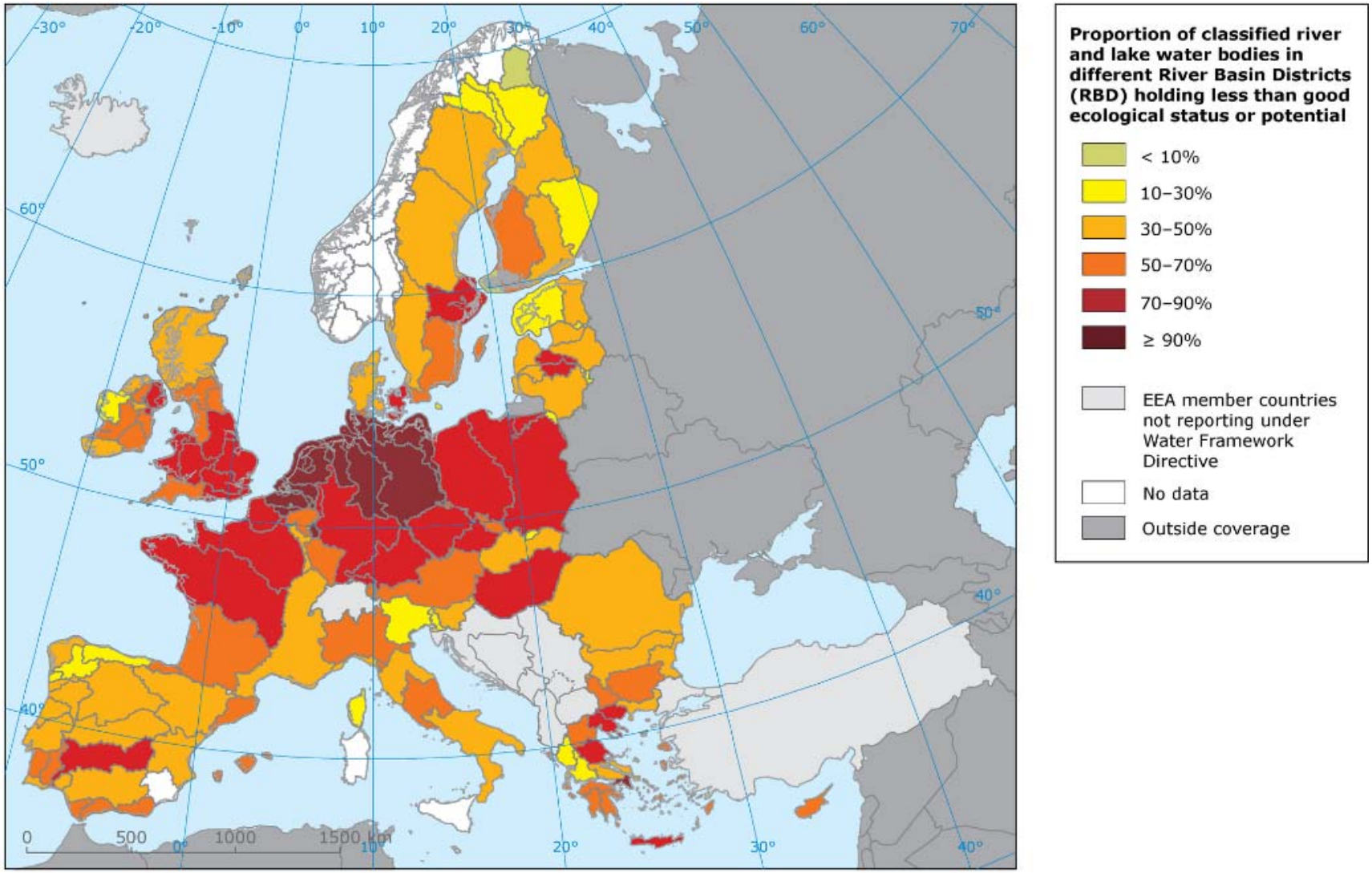

Ministry of Agriculture (Croatia)
Water management
-Water act
PESFOR-W
Agriculture
- Agriculture act
- Agricultural land act
Forestry
- Forests act

The aim of this presentation

- To provide brief insight of regional characteristics related to 3 sectors (Water management, Agriculture, Forestry)
- To shortly present main 3 sectorial legislation and related funding schemas
- To asses compliance of PES FOR-W schema with official sectorial legislation
- To provide some regional PES FOR-W case study examples and possible oportunities



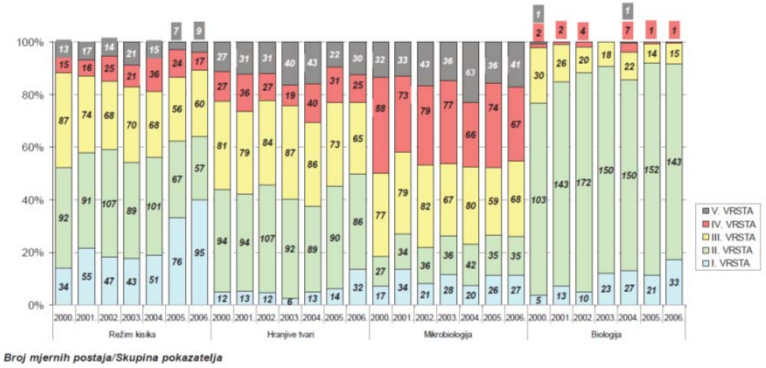
Proportion of classified river and lake water bodies in different River Basin Districts (RBD) holding less than good ecological status or potential

- < 10%
- 10–30%
- 30–50%
- 50–70%
- 70–90%
- ≥ 90%
- EEA member countries not reporting under Water Framework Directive
- No data
- Outside coverage


MER DE BARENTS
PECHORA
KALIXÄLV
TORNEÄLV
KEMIJOKI
PITEÄLV
LULEÄLV
SKELLEFTEÄLV
VINDELÄLV
ÅNGERMANÄLV
LAUNGAN
INDALSÄLV
LJUSNAN
GÄLÄVE
DVINA SEPTENTRIONALE
NEVA
MER CASPIENNE
MER BALTIQUE
NARVA
VOLGA
MER DU NORD
DVINA OCCIDENTALE
NIÉMEN
DON
DNIEPR
ELBE
ODER
VISTULE
MEUSE
RHIN
SEINE
DNIESTR
BUG
OCÉAN ATLANTIQUE
LOIRE
DANUBE
GARONNE
RHÔNE
PÔ
MER NOIRE
DOURO
ÉBRE
ADRIATIQUE
TAGE
MÉDITERRANÉE
GUADIANA
GUADALQUIVIR
Bassins hydrographiques et principales lignes de partage des eaux européennes
Fleuve
Bassin hydrographique
Principales lignes de partage des eaux européennes


AUSTRIA
HUNGARY
ITALY
SLOVENIA
Ljubljana
Zagreb
Trieste
Beograd
Sarajevo
Podgorica
CROATIA
BOSNIA AND HERZEGOVINA
SERBIA
MONTENEGRO
ALBANIA
ADRIATIC SEA
Sava
Kolpa
Kupa
Una
Vrbas
Ukrina
Bosna
Tinja
Drina
Lim
Ibar
Kolubara
Morava
Ljubljanica
Krka
Orljava
Danube
20°
45°
15°
Kilometres
0 25 50 75 100
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
UNEP/DEWA/GRID-Geneva 2011

River water quality *(oxygen regime, nutrients, biological indicators)*



Slika 2.8. Ukupni prikaz stanja kakvoće voda (2000. - 2006.)

Tablica 2.3. Ocjena kakvoće voda na graničnim mjernim postajama u godini 2006.

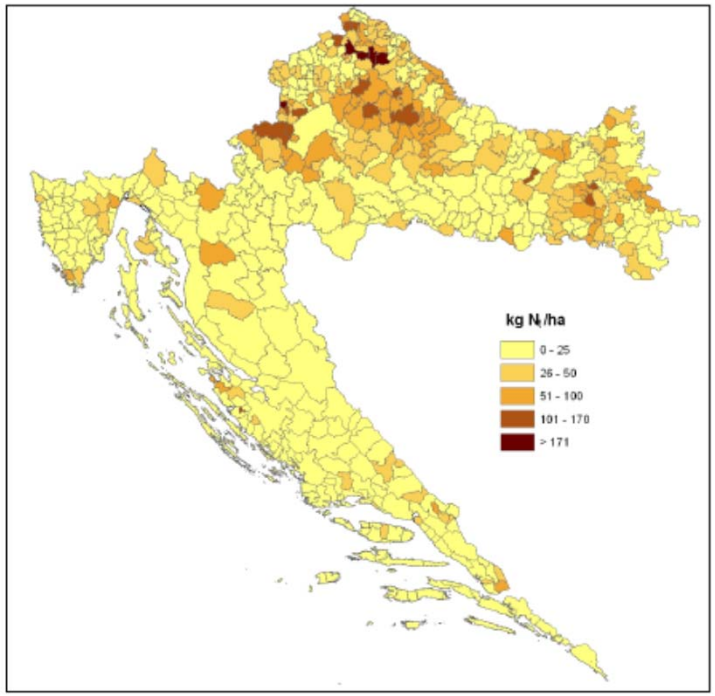
Sliv		Save				Drave i Dunava			dalmatinski	
Vodotok		Sava		Una		Drava	Dunav		Neretva	
		Ulaz	Izlaz	Izlaz	Ulaz	Ulaz	Ulaz	Izlaz	Ulaz	Izlaz
Mjerna postaja		Jesenice	Gunja	Donja Suvaja	Struga	Ormož	Batina	Ilok	Metković	Rogotin
Vrsta monitoringa		PGM	NM	NM	NM	PGM	PGM	NM	NM	LBA
Skupina pokazatelja	B Režim kisika	II	II	I	I	II	III	III	I	I
	C Hranjive tvari	III	III	I	II	III	III	III	II	II
	D Mikrobiološki	IV	IV	I	IV	III	IV	IV	IV	V
	E Biološki	II	II	I	II	II	II	II	II	II
Kategorija vode		II	II	II		II	II	II	II	II

Tablica 2.4. Ocjena kakvoće vode na ušćima rijeka u Jadransko more u godini 2006.

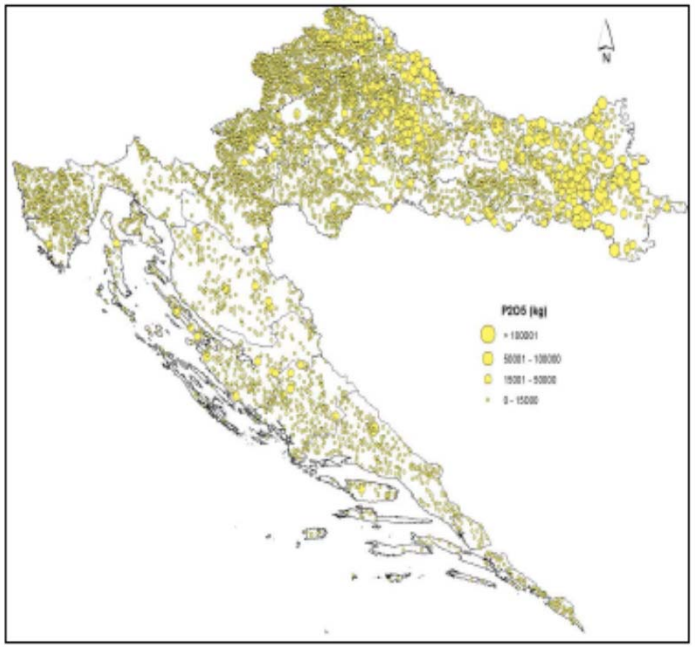
Slivovi		primorsko-istarski				dalmatinski			
Vodotok		Dragonja	Mirna	Raša	Rječina	Zrmanja	Krka	Cetina	Neretva
Mjerna postaja		ušće	Portonski most	most Mutvica ušće	ušće	Obrovac	Nizvodno od Skradinskog Buka	Nizvodno od HE Zakučac	Rogotin
Vrsta monitoringa		PGM-LBA	LBA	LBA	LBA	LBA	LBA	LBA	LBA
Skupina pokazatelja	B Režim kisika	I	I	I	I	III	I	I	I
	C Hranjive tvari	II	III	III	II	I	I	II	II
	D Mikrobiološki	III	III	IV	IV	IV	III	IV	V
	E Biološki	II	II	II		II	II	I	II
Kategorija vode		II	II	II	II	II	II	II	II

Slika 2.9. Stanje kakvoće voda prema biološkim pokazateljima

The use of nitrogen and phosporus in agricultural production (source Romić et al.)

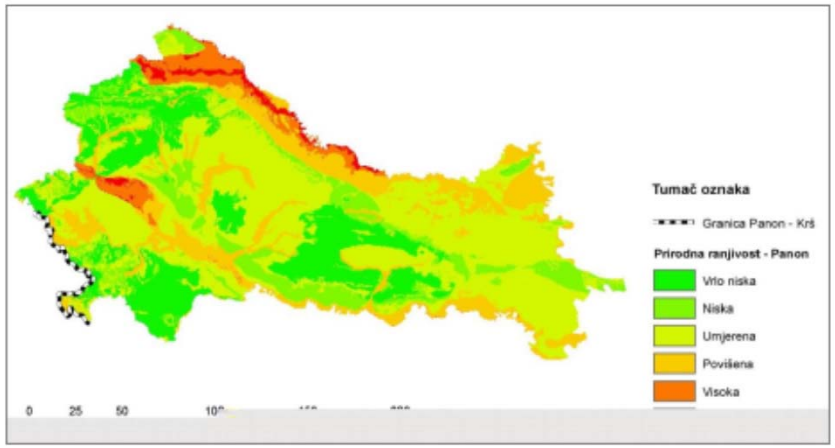


Slika 11. Količina N/ha korištenog poljoprivrednog zemljišta po općinama u RH

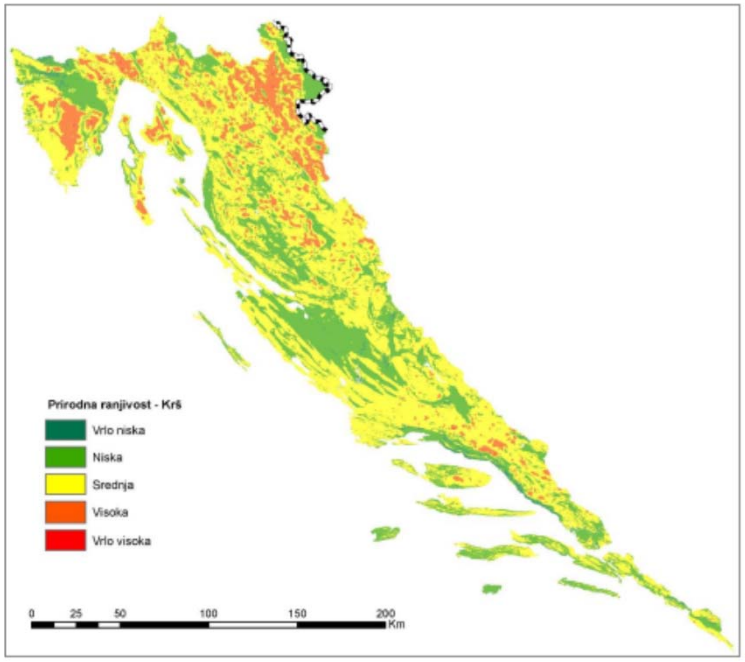


Slika 13. Raspodjela fosfora (izraženo u kg P_2O_5) iz stajskog gnoja u RH po naseljima

Vulnerability of natural groundwater aquifers to pollution



Slika 2. Karta prirodne ranjivosti na području panonskog dijela RH (Brkić i sur., 2009)



Slika 3. Karta prirodne ranjivosti u krškom dijelu RH (Biondić i dr., 2009)

Water act

Zakon o vodama (NN 153/09, 63/11, 130/11, 56/13, 14/14)

- Regulation of the legal status of water, water resources and water structures
- Regulation of the management of quality and quantity of water, protection against harmful effects of water, detailed melioration drainage and irrigation, public water supply and public drainage activities
- Institutional set up of these activities and other issues related to water and water resources.
- Transposition of the EU directives into the legal order of the Republic of Croatia
  - The EU Water Framework Directive 2000/60/EZ
  - Groundwater Directive 2006/118/EZ
  - The EU Floods Directive 2007/60/EC

Water protection (Water Act)

- Objectives of water protection (*better water status*)
- Definition of the water quality standards
- Monitoring of surface and groundwaters
- Classification of the water bodies
- Programe of measures
- Designated areas of special water protection

Water fees

- **Water contribution fee**
  - for newly constructed structures (buildings, roads, pipelines) (m2)
  - The revenue from the water contribution is used for construction works of water regulating and protecting structures, agricultural drainage systems
- **Water regulation fee**
  - calculated by square meter for any real estate with the exception of agricultural land
  - Fee on forest land (0.0015 kn/year)
    - *Croatian forests ltd governs 2,018.987ha (30 284 805 kn ≈ 4 mil EUR)*
  - Fee on national parks (0.0005 kn/year)
- ***Water protection fee***
  - **paid for the reason of water pollution by the persons that discharge wastewater, and persons that produce or import mineral fertilizers and plant protection products (***diffuse agriculture pollution is not directly included***)**

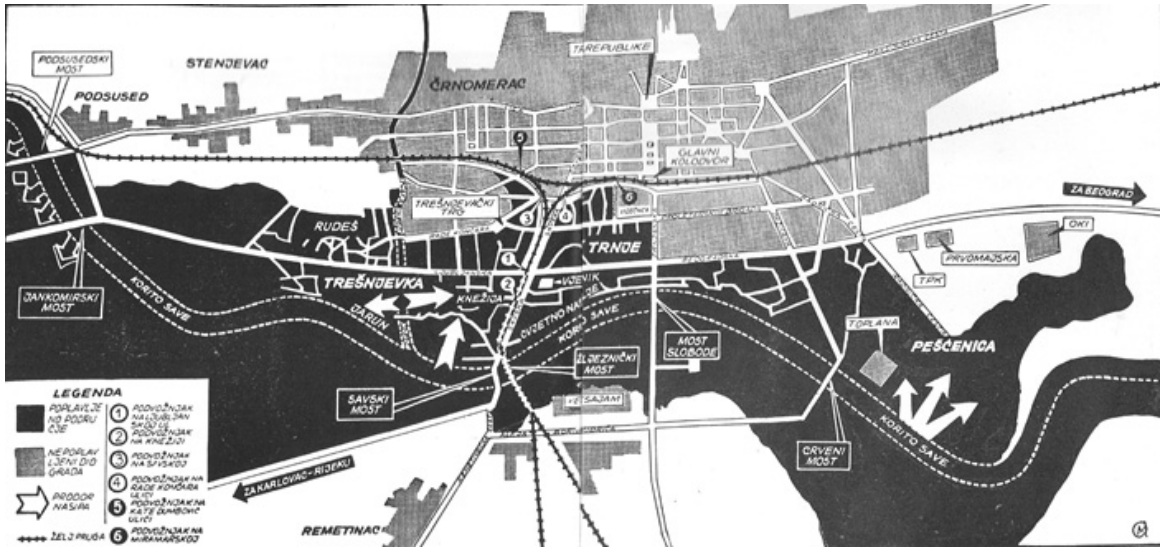
- **Water use fee**
  - Calculated by quantity of abstracted water or produced electrical energy
- **Amelioration drainage and irrigation fee** (regional)
- **Development fee and connection fee** (local)

Water protection measures

- Water quality standards
- Prohibition of the release of dangerous substances
- Monitoring
- Classification of water bodies
- Program of water protection measures
- Areas of special water protection *(areas subject to eutrophication and areas vulnerable to nitrates, areas designated for species and habitat protection (Natura)*


JCB

Zagreb flood – 26.10.1964



Consequences

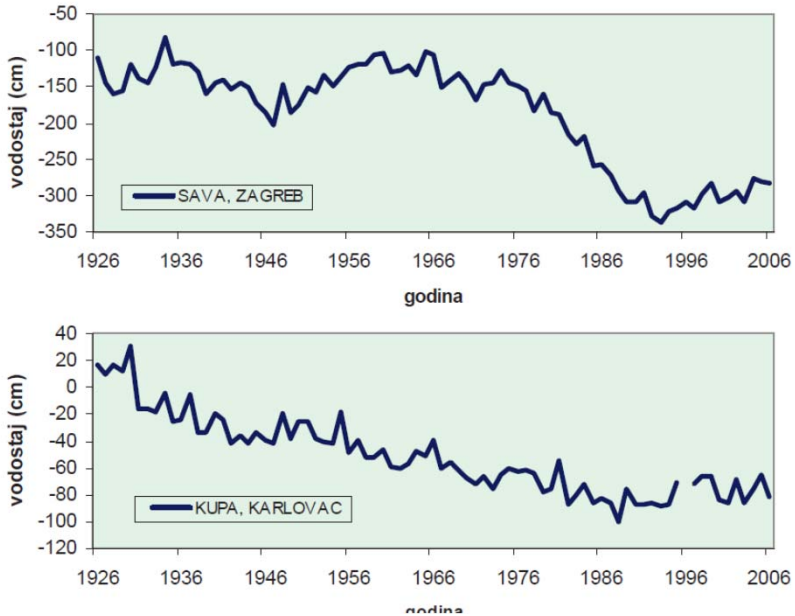
- Direct impact on 180 000 citizens, 17 people were died
- After the withdrawal of water, the construction of the flood defense system „Middle Posavina” initiated, within which cities threatened by flooding from Sava (Zagreb, Karlovac and Sisak) were defended by defensive floods and flood discharges.
- Initiated extencive construction works: the use of natural areas and lowland forests along river as a flood retention areas, construction of embankments along the settlements, canalization of rivers…

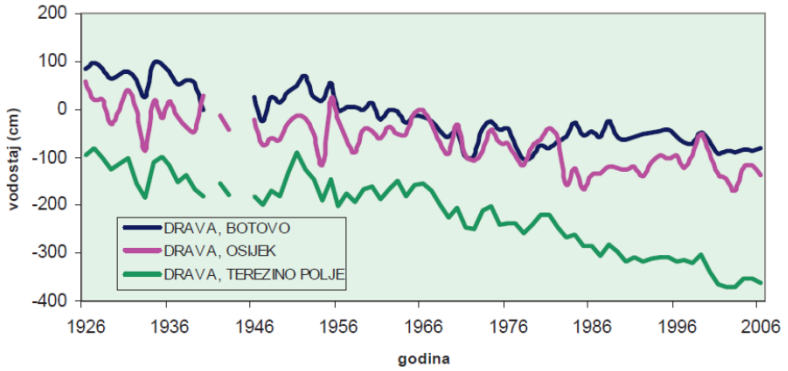
Constructed flood protection system

- Retention of high flood wave in Žutica forest

Negative trend of waterlevels of Sava and Drava watershed

Slika 2.2. Prosječni mjesečni protoci na slivu Save (1961. - 1990.)





Slika 2.5. Vremenski nizovi najnižih godišnjih vodostaja zabilježenih na karakterističnim stanicama na Dravi

Agriculture act

- Objectives and measures of agricultural policy, subsidies…
- Related to the forestry:

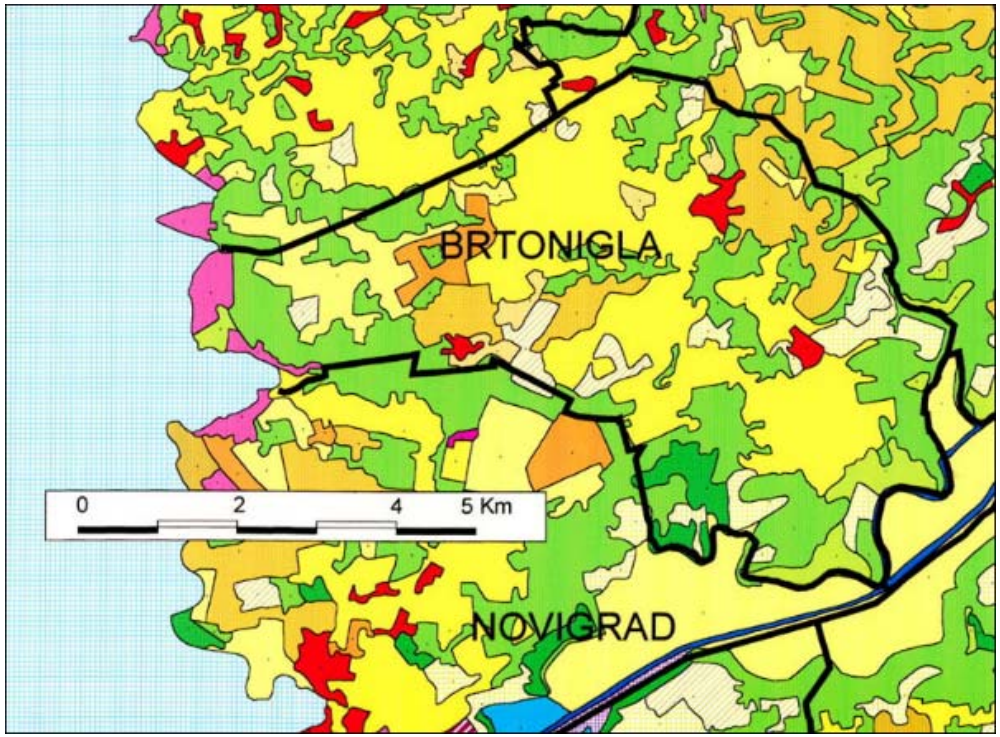
Ordinance of „Support for inve

Agricultural Land Act

- This Act regulates the protection, use and change of use of agricultural land, the management of agricultural land owned by the Republic of Croatia
- Agricultural land must be maintained in good condition for agricultural production. To maintain agricultural land in good condition for agricultural production means to keep it free from weeds and prevent it from being covered with perennial plants.
  - *A legal person shall be guilty of a misdemeanour and fined from HRK 10,000.00 to HRK 30,000.00 for failing to maintain agricultural land in good condition for agricultural production and for failing to cultivate it in accordance with agricultural engineering measures without diminishing its value (Article 5 paragraphs 1, 3 and 5).*
- Change of use of agricultural land for non-agricultural uses shall be made in accordance with the documents on spatial planning and with other regulations.

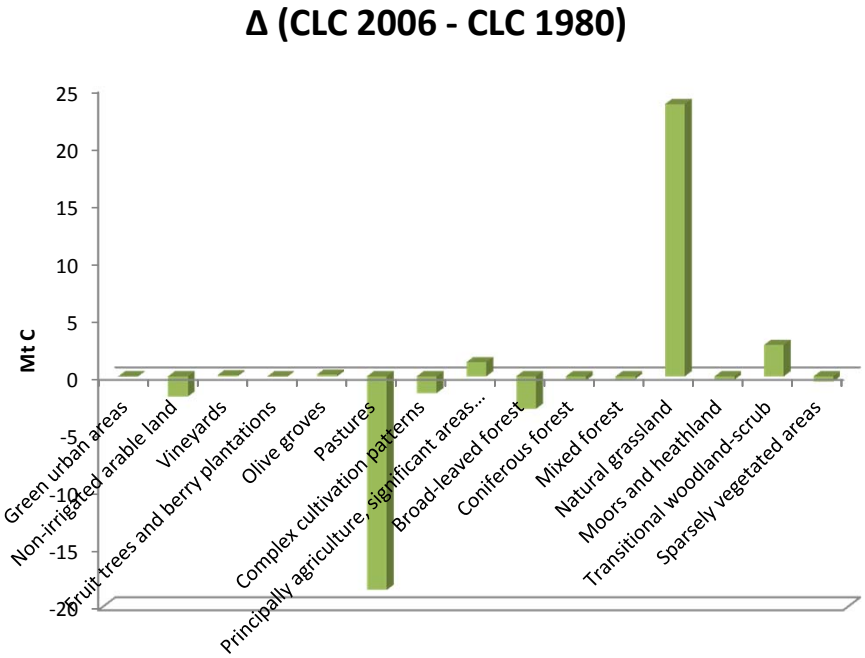
The use of land is defined by spatial plans, land-use change is not so simply accomplished *(especially planting trees in P1 or P2 categories)*

- P1-especially valuable agricultural land
- P2- valuable agricultural land
- P3- other arable land
- PŠ – woodlands and forest land



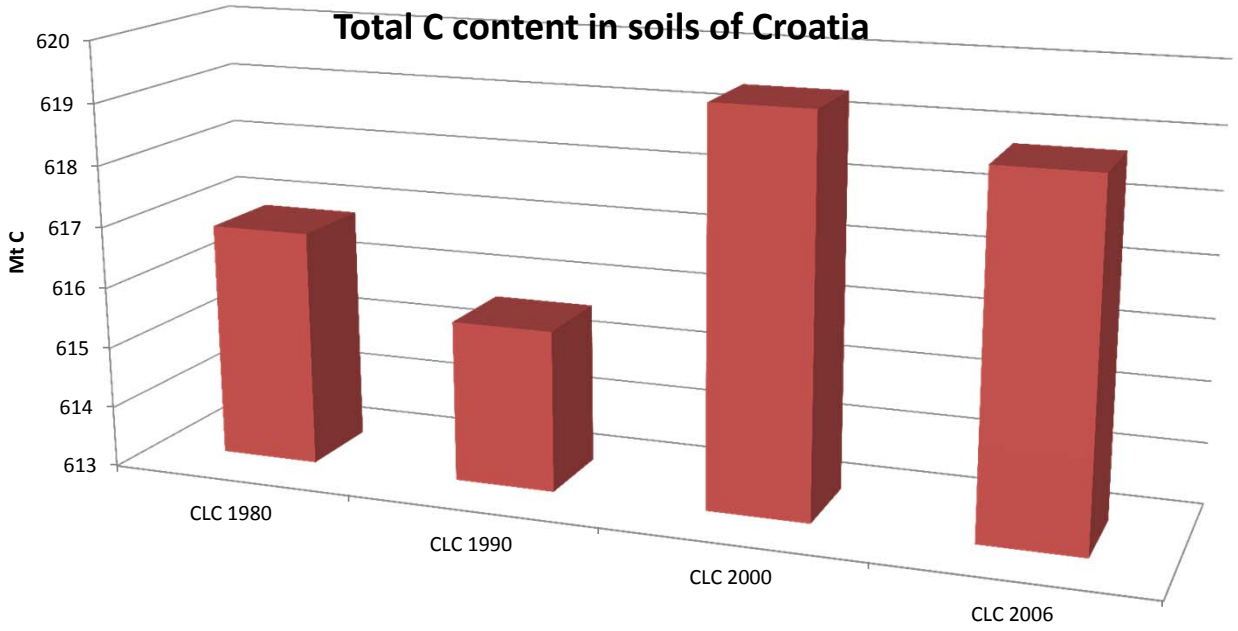
Changes in land use from 1980-2006

CLC level 3	N	Mean	CLC 1980	CLC 1990	CLC 2000	CLC 2006	CLC 1980	CLC 1990	CLC 2000	CLC 2006	Δ (CLC 2006 - CLC 1980)
		(T C/ha)	(ha)				(Mt C)				(Mt C)
Green urban areas	29	**115,18**	1812	1812	1782	1724	0,21	0,21	0,21	0,20	-0,01
Non-irrigated arable land	629	**114,29**	385633	378430	368974	370262	44,07	43,25	42,17	42,32	-1,76
Vineyards	137	**135,3**	28200	28193	28925	29055	3,82	3,81	3,91	3,93	0,12
Fruit trees and berry plantations	40	**163,92**	9760	9410	9548	9574	1,60	1,54	1,57	1,57	-0,03
Olive groves	15	**121,62**	18759	18705	20223	20197	2,28	2,27	2,46	2,46	0,17
Pastures	97	**104,96**	475815	477566	307296	298950	49,94	50,13	32,25	31,38	-18,56
Complex cultivation patterns	21	**114,2**	1034844	1026779	1017238	1022051	118,18	117,26	116,17	116,72	-1,46
Principally agriculture, significant areas of natural vegetation	10	**137,52**	515282	510822	523509	524202	70,86	70,25	71,99	72,09	1,23
Broad-leaved forest	723	**117,08**	1706194	1695356	1695495	1682078	199,76	198,49	198,51	196,94	-2,82
Coniferous forest	103	**126,53**	105473	102496	105702	102528	13,35	12,97	13,37	12,97	-0,37
Mixed forest	142	**117,88**	273533	275465	272522	271624	32,24	32,47	32,12	32,02	-0,23
Natural grassland	259	**134,74**	77147	77103	252102	252781	10,39	10,39	33,97	34,06	23,66
Moors and heathland	8	**121,95**	6892	6916	4114	4421	0,84	0,84	0,50	0,54	-0,30
Transitional woodland-scrub	94	**110,47**	567840	591160	579824	592532	62,73	65,31	64,05	65,46	2,73
Sparsely vegetated areas	7	**100,69**	65329	63989	61061	60807	6,58	6,44	6,15	6,12	-0,46
Total of above CLC categories			**5272513**	**5264202**	**5248315**	**5242786**	**616,86**	**615,64**	**619,41**	**618,77**	**1,91**
Total country land area acording to CLC			5657456	5657984	5658451	5658465					
Percentage of Country			93	93	93	93					

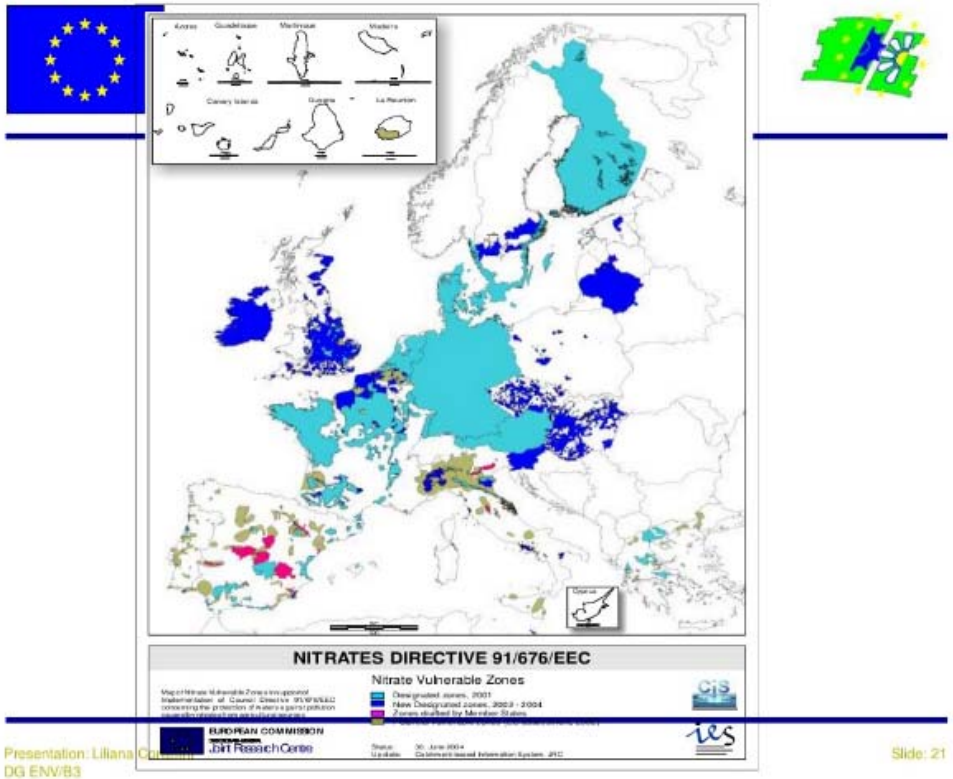


Pilaš et al. 2013 Estimation of soil organic carbon stocks and stock changes in Croatia (1980–2006) – use of national soil database and the Corine Land Cover PERIODICUM BIOLOGORUM VOL. 115, No 3, 339–347, 2013

Changes in C soil content due to the socioeconomic drivers and landuse 1980 - 2006



Areas vulnerable to nitrates (Water act – Agriculture act – Good agriculture practice – Aforestation)



Forest Act

- regulates the cultivation, protection, use and management of forests and forest land as a natural resource with the aim of maintaining biodiversity and ensuring the principles of economic viability, social responsibility and ecological acceptance.
- Defines „General beneficial functions of forests” – GBF ≈ Forest ecosystem services
  - protection of soil from water and wind erosion
  - balancing water relations in the landscape, preventing floods and high water waves
  - water purification by seepage through forest land, supply of underground flows and drinking water springs

- Classifies forests with economic function (Continental forests) and degraded forests with pronounced general beneficial functions (Forests on karst)
- GBF - the basis for the calculation of GBF is the total revenue of legal entities received on domestic and foreign markets.
- The fee is 0.0265% of the calculation base (was 0.07, then 0.05)
- Shortcomings – lack of effectivenes of provided measures, visibility of utilization of funds, very general approach…

Forestry and afforestation

- Republic of Croatia has forest land cover area of 2,468,830 ha or 43.7%
- From the 14 total categories of European forests, 11 prevail in Croatia which makes it one of the countries with the largest biodiversity in Europe. The predominant forest types are:
  - Beech forest, and mountainous beech forest - Central European submountainous and mountainous beech forest, Illyrian submountainous and mountainous beech forest).
  - Floodplain forest – Riparian and fluvial
  - Mesophytic deciduous forest – Pedunculate oak – hornbeam forest, Sessile oak – hornbeam forest, Ashwood and oak-ash forest
  - Thermophilous deciduous forest – Downy oak forest, Chestnut forest

- In continental area (high carst), afforestation activity on 150 000 ha of heathlands from 1960-1980
- 1964 was founded Yugoslavian Institute for Conifers, Jastrebarsko (present Croatian Forest Research Institute)
- Establishment of research and afforestation of continental high carst area with native and introduced conifer species such as: white spruce, Scotch pine, black pine, european larch, Weymouth pine and Douglas fir








Carstic area

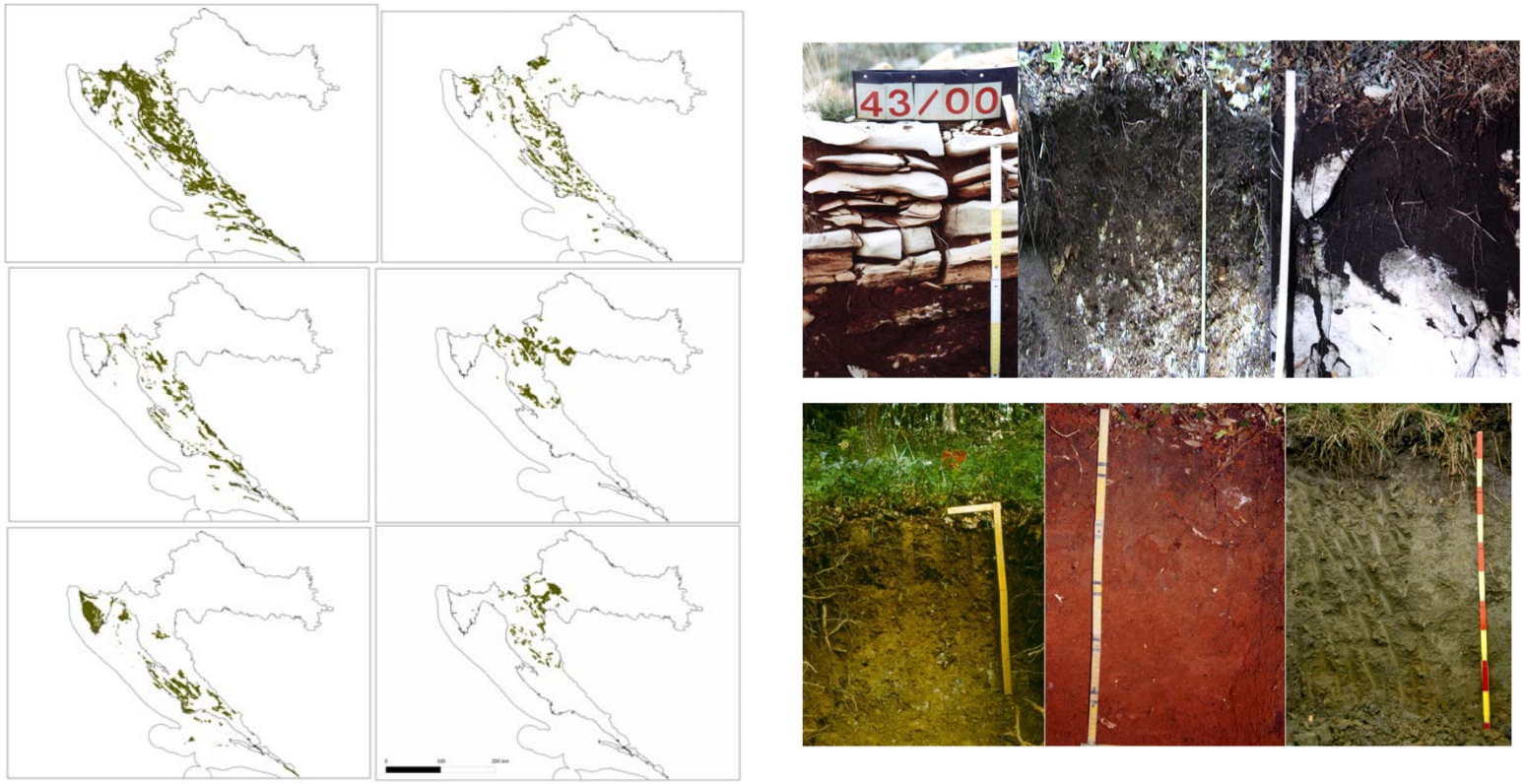


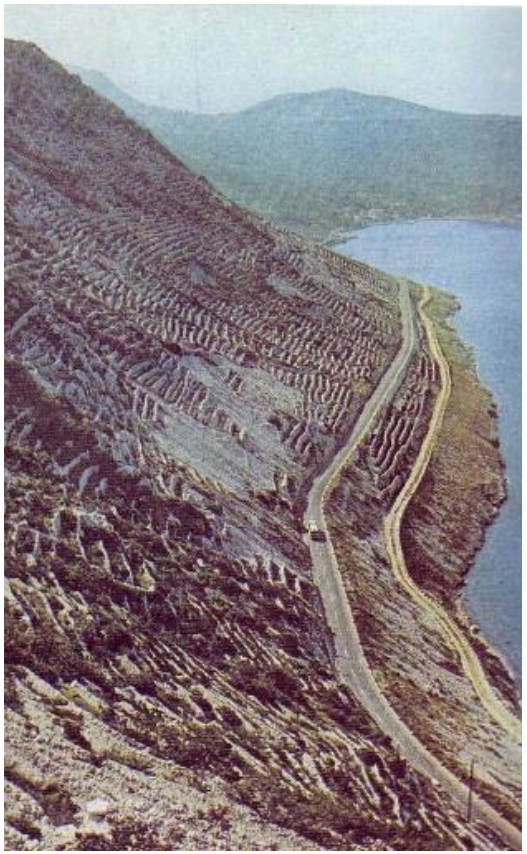
Figure 4. Maps showing distribution of dominant soil type, from top left row wise: a) Calcocambisol; b) Rendzina; c) Calcomelanosol; d) Dystric cambisol; e) Terra rossa; f) Luvisol

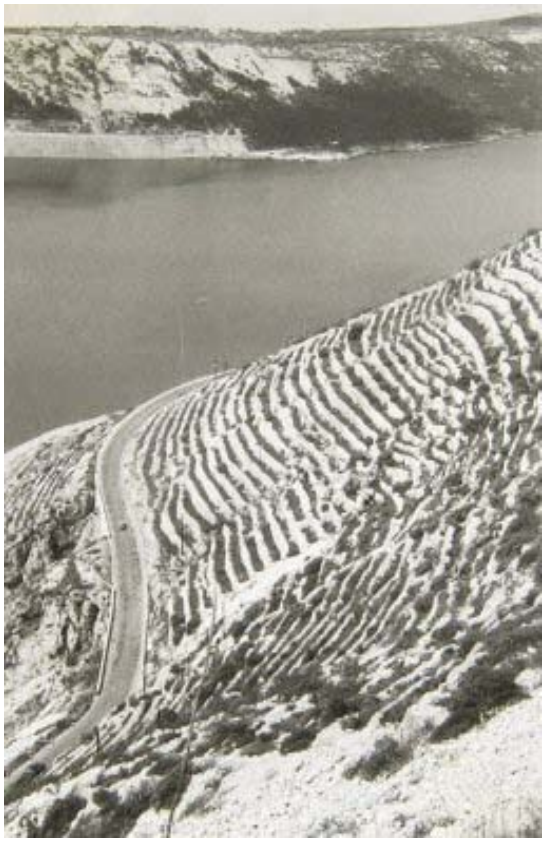
Marjan forest afforestation - Split

• Istočna strana još nepošumljenog Marjana s križem na najvišem vrhu. Snimljeno oko 1870. godine.

Forest fire in suburbs of Split, 2017

Bakarski prezidi (terraces)





PES Option

Example of usage of Water regulation fee (Croatian waters) to support sustainable forest productivity and biological function of lowland (floodplain) oak forests (and water)

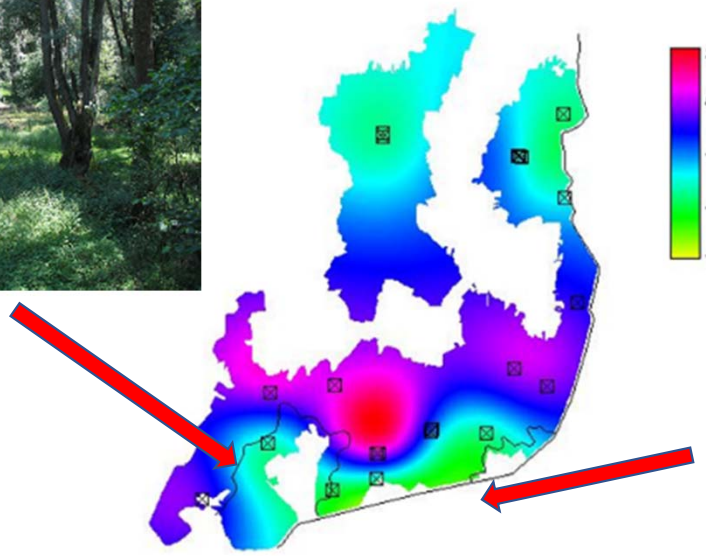
MOTIVATION:

- Lowland oak forests are the most valuable economic resource in Croatia (750 000 m3)
- They belong to the „Groundwater depended ecosystems “,usually under the influence of floods with strong biological function (Natura 2000)
- In recent decades there were episodes of oak decline due to the droughts and decline of groundwater tables
- The aim is to stabilise groundwater regime, retain forest productivity and resilience during episodes of drought, create habitat for hydrophytic plants, fish and water mamals (otter, beaver…)

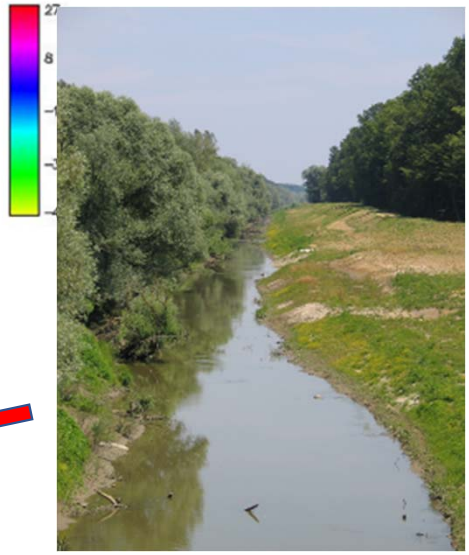
The case study of Česma forest

(COST ACTION FP0601 „FORMAN“ Second Science Workshop in Zagreb, Croatia, 9-11 April 2008)

Dry natural riverbed



linear structure (Canalized watercourse)



Croatian state forests

Water regulation fee

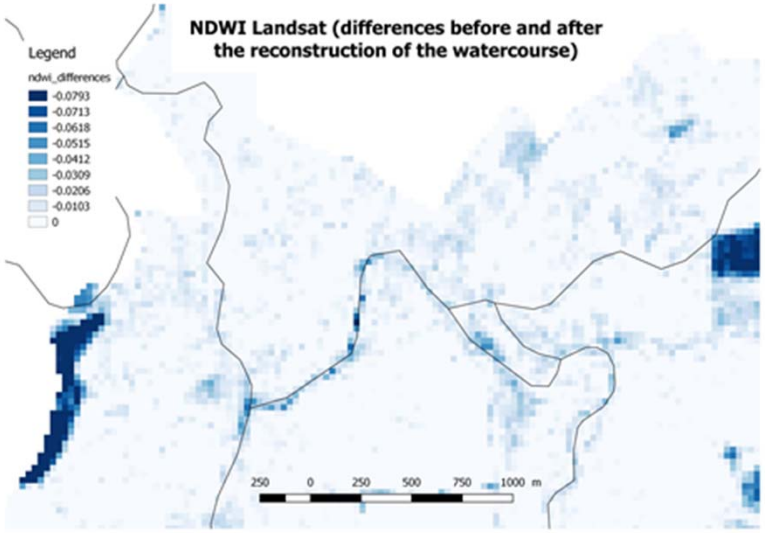
Croatian waters

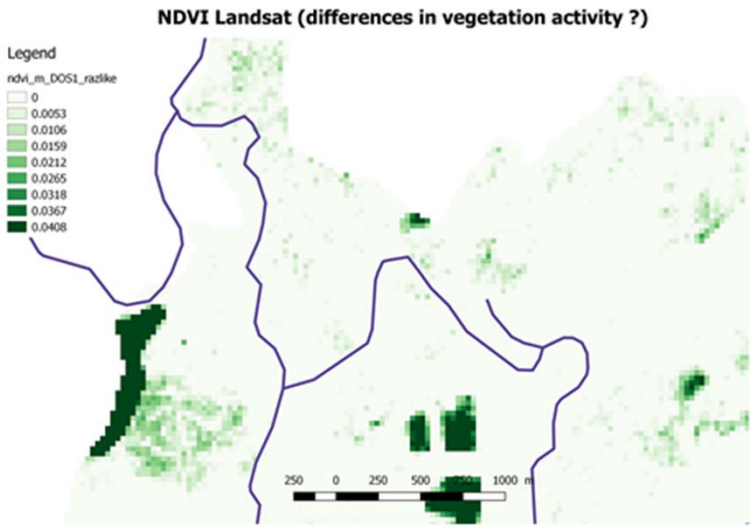
Return of 30% Water regulation fee through construction works

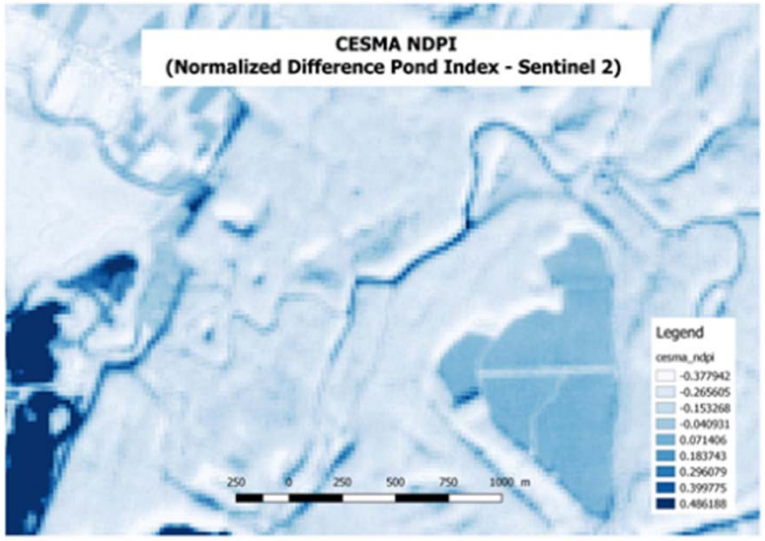
2007 - Construction of the first dam (accumulation)

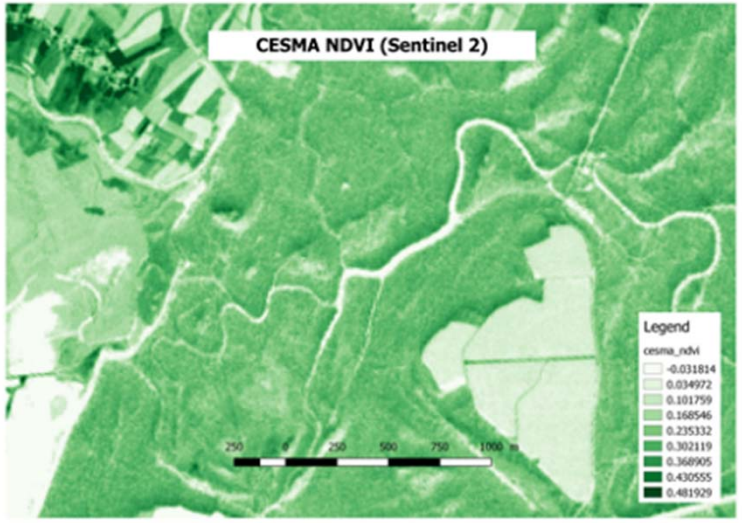
2010 - Construction of the second dam (accumulation)

	Dam1	Dam2	Canal	
amonnia	0,23	0,51	0,36	*mg/l*
nitrites	0,02	0,04	0,05	*mg/l*
nitrates	0,03	0,17	0,3	*mg/l*
mineral oils	0,13	0,12	0,24	*mg/l*
orthophosphates	0,05	0,05	0,04	*mg/l*
anionic detergents	0,19	0,23	0,26	*mg/l*
fats and oils	0,94	0,88	0,71	*mg/l*
sulphates	5,07	8,43	7,48	*mg/l*
dissolved oxygen	8,52	9,02	8,22	*mg/l*
chemical oxygen demand	51	37	31	*mg/l*
biochemic oxigen demand	20	14	12	*mg/l*
pH	7,71	7,67	7,57	
conductivity	121	250	300,7	*µS/cm*


NDWI Landsat (differences before and after the reconstruction of the watercourse)
Legend
ndwi_differences
-0.0793
-0.0713
-0.0618
-0.0515
-0.0412
-0.0309
-0.0206
-0.0103
0
250 0 250 500 750 1000 m


NDVI Landsat (differences in vegetation activity ?)
Legend
ndvi_m_DOS1_razlike
0
0.0053
0.0106
0.0159
0.0212
0.0265
0.0318
0.0367
0.0408
250 0 250 500 1000 m


CESMA NDPI
(Normalized Difference Pond Index - Sentinel 2)
Legend
cesma_ndpi
-0.377942
-0.265605
-0.153268
-0.040931
0.071406
0.183743
0.296079
0.399775
0.486188
250 0 250 500 750 1000 m


CESMA NDVI (Sentinel 2)
Legend
cesma_ndvi
-0.031814
0.034972
0.101759
0.168546
0.235332
0.302119
0.368905
0.430555
0.481929
250 0 250 500 750 1000 m

New INTERREG CROATIA-HUNGARY PROJECT (Oak protection)

Adaptive forest and water management practices in the lowland areas of NE Croatia (20 000 ha) to improve ecosystem functions

- Establishment of a transboundary **automatic groundwater monitoring system** (piezometers, loggers)
- Establishment of **automatic meteorological early warning system** (meteo stations, web-gis)
- Detail **microtopographic asessment** – LIDAR
- **Groundwater management** – measures to retain water in the landscape and recharge groundwater tables (DRAINMOD, 1D, 3D models)
- **Flood management** – estabilishement of sustainable flooding regime (reducing of flood duration and prolonged accumulation of surface water)


Zečevac
Zečevac
Zečevac
Kanal Močilna

Thank you for your attention and enyoy the field trip in Istria!