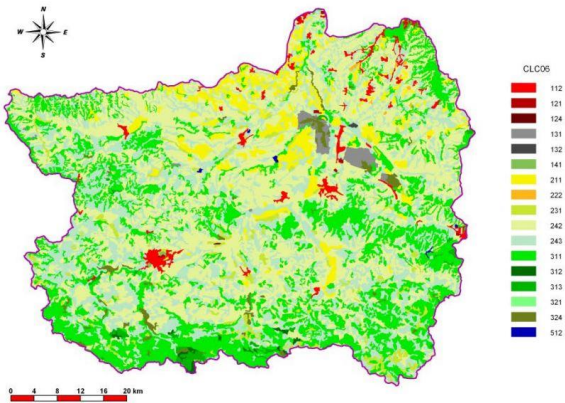
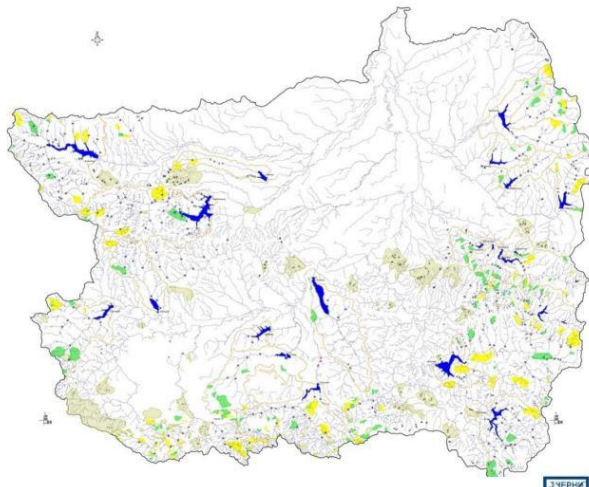


Case study name and location	Kolubara river basin (Serbia)
Authors	Aleksa Lipovac, Ružica Stričević
GENERAL INFORMATION	
area size (ha)	The Kolubara River Basin encompasses the western part of Serbia and covers 4.12% of Serbia's surface area. Total area of the Kolubara river basin is 363850 ha.
topography / describe the shape	Kolubara and its tributaries spring in hilly and mountainous areas, in the middle part they flow through slightly undulating, hilly areas, while the rest of the river basin mostly flat. The highest point of the drainage basin is at 1,346 m, and the lowest has altitude of 73 m. The Kolubara River is the last large right tributary of the Sava River, and according to the flow length (86.4 km) and the basin area (3,641 km²) it is classified as a middle-sized river on the territory of Serbia
climate – yearly? Period? Precipitation (amount and distribution, appearance of the storms)	The largest part of the territory of Serbia, including the Kolubara basin, belongs to the temperate continental climate, which is characterized by the existence of double maximum precipitation with frequent and heavy rains in the summer and secondary maximum in autumn with rather dry winter. The average annual amount of precipitation in the Kolubara river basin is about 770 mm. In the higher parts of the basin, the amount of precipitation is 700-800 mm, and in the lower 600-700 mm. According to the nearest meteorological station in Obrenovac, this area is characterized by continental climate, the average temperature was 11° C.

TECHNICAL CHALLENGES	
Source of flood water surface water (streams torrential stream), salt (sea water)	In the Kolubara basin, the high water regime is naturally unfavorable, which is directly related to the geomorphological and hydrographic characteristics of the area. Torrential floods occur on the watercourses in the upper parts of the basin, characterized of short duration, very high flow velocities and massive sediment movement. In the lower parts of the Kolubara and tributaries, large water waves are slower, and water levels depend on the levels of the River Sava. The hydrographic network is such that, due to large falls of tributaries and their small distances, allows fast and concentrated runoff on a relatively short section of a central valley of the Kolubara. The river bed in the valley does not have enough discharge capacity to accept such a large concentrated inflow and to conduct directly into the main recipient - the Sava River. The consequences are frequent floods in the valley.
Soil type (for attendees not familiar with soil science e.g. heavy soils, with low permeability, shallow/deep soils, moor – swamp area)	Soil type on the Kolubara watershed are: Semigley (Clay loam); Pseudogley (clay to clay loam soil with hard pen), District cambisol (clay loam soil). CATCHMENT KOLUBARA Textural map Legend - Clay - Clay loam - Loam - Sandy clay loam - Silty clay loam - Silty loam http://www.sepa.gov.rs/download/prezentacije/2013/3Osnovne_karakteristike_sliva_Kolubare.pdf
Proposed/existing NBS	Proposed NBS measures - fashion to delay the runoff (e.g. on rill, gully erosion or bank erosion) where needed; - biological measures of afforestation over 3624 ha; - rehabilitation of degraded forests over 14207 ha; - the formation, conservation or reclamation of degraded natural pasture to mitigate the effect of floods over 777 ha; - conservation soil tillage and contour plowing; - remeandering of rivers

ECONOMICAL AND LEGAL ASPECT	
Compensation mechanisms Has there been a cost benefit analysis of using this piece of land for flood retention? If yes, what is the approximate level of costs and benefits? Do land owners / farmers receive a compensation for their service? What kind (one-time up-front payment, annual payment, flood damage-based compensation etc.)? Does it cover their loss? Which players finance this compensation?	http://studijakolubara.srbijavode.rs/wp-content/uploads/2016/06/Knjiga-1.pdf The results of the conducted Cost Benefit analysis(CBA) in the base case unequivocally indicate that all the relevant parameters of the CBA analysis have satisfactory values in accordance with project effectiveness evaluation criteria ($FRR > DR$; $NPV (B - C) > 0$; $B / C > 1$). Net Present Value (NPV); Financial Rate of Return (FRR); Discount Rate (DR); Benefit (B); Cost (C) Compensation for: accumulation lake, embankment reinforcement, Watercourse regulation, anti-erosion works Fair and efficient expropriation procedures, minimizing the negative effects of dissatisfaction of the local. Citizens are provided with information on the necessary relocation and use of their property at another location. The possibility of using the land for floods was not considered. According to the questionnaire provided by stakeholders, slightly less than half respondents agreed that uninhabited parts of the territory as future retention areas could be flooded (probably they were not farmers).

STAKEHOLDERS PERSPECTIVE	
GIS analysis of land use within the designated (or existing area) of dry reservoir if available or just a rough description of land use	GIS analysis of land use are represented in the Kolubara river basin study (link below) http://studijakolubara.srbijavode.rs/wp-content/uploads/2016/06/Knjiga-3.pdf  Agricultural land use: 70.6% Arable land: 10.5% (Cereals, Maize, Alfalfa, Clover, Vegetables) Perannual trees: 0.1% (Plums, Apples, Appricots, Berries etc.) Pastures and Meadows: 60% Forests Land: 26% Water Land: 0.1%
Social aspect, as in are these changes threats to the livelihoods of the private land owners or private land users, for agricultural or other land use: information of land-owners perspective on the NBS.	Flooding threats: Settlements, roud and infrastructure, agricultural and forest land land-owners perspective on the NBS was not considered in to detail.

POTENTIAL LAND DEGRADATION	
Expected challenges e.g. change in land use if nature base solutions are planned to be implemented (for example Savinja valley, Slovenia), etc or challenges with existing NBS (for example the Lake Kerkini, Greece) Hydrotechnical infrastructure (e.g. drainage or irrigation systems, dykes, dams, channels)	- NBS implementation would not significantly change existing land use in this case study. <u>Construction of facilities</u> for reception and reduction of flood waves. - For that purpose the possibilities of building frontal retentions in the upper catchment area of Kolubara tributaries were investigated as well as lowland - lateral retentions on the Kolubara and Ljig rivers (20 in total till the year 2035): - Application of anti-erosion measures and measures for natural retention of water in the basin; - Reconstruction of the embankment in order to raise the level of protection of the most important areas (near cities, towns, bigger settlements or industrial zones).  Water retention and NBS on the watershed (M. Babić Mladenović, J. Černi, 2018) http://studijakolubara.srbijavode.rs/wp-content/uploads/2018/03/Sastanak-mart-2018-Obrenovac-i-Ub-1.pdf