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To store or to drain – to lose or to gain?

Economic evaluation of water storage role of floodplain wetlands as an element of stakeholder dialogue in adaptive management in protected areas

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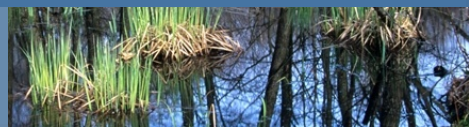
Hydrology and Society, Torino, 2012



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What is the problem?

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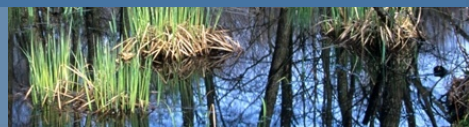
Haymaking – the only possible agricultural activity in the Biebrza Valley
EU – subsidies – environmental schemes ☺



What is the problem?

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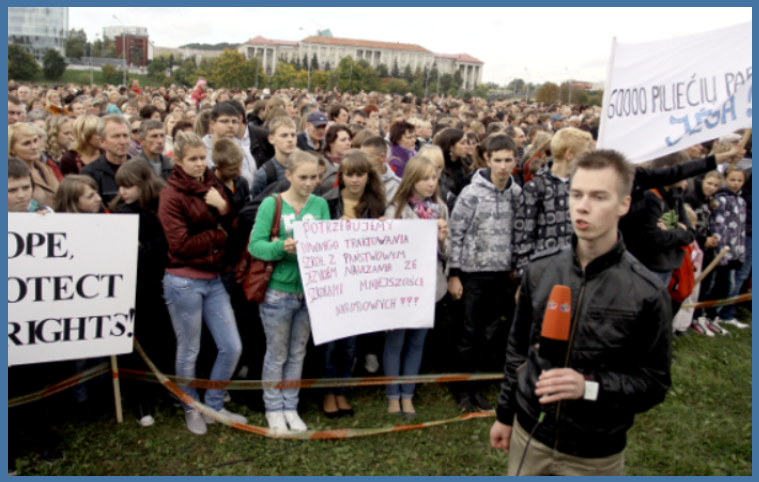
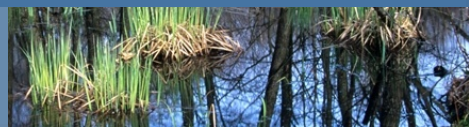
Efficient mowing requires mechanical equipment: ratracks and tractors
Approximately 15000 ha is being mown on regular basis.
But… if water level in summer is high…





Hypocrites

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EU environmental schemes for agriculture – Natura 2000 species & habitats.

Mowing to protect the nature (active protection to keep the landscape open)

To mow, water level has to be low…

Hence, mowing requires drainage…

Though they insist to drain wetland meadows.

They claim to destroy nature in order to protect it ☺

Crex crex: 200EUR/ha

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When has the problem started?

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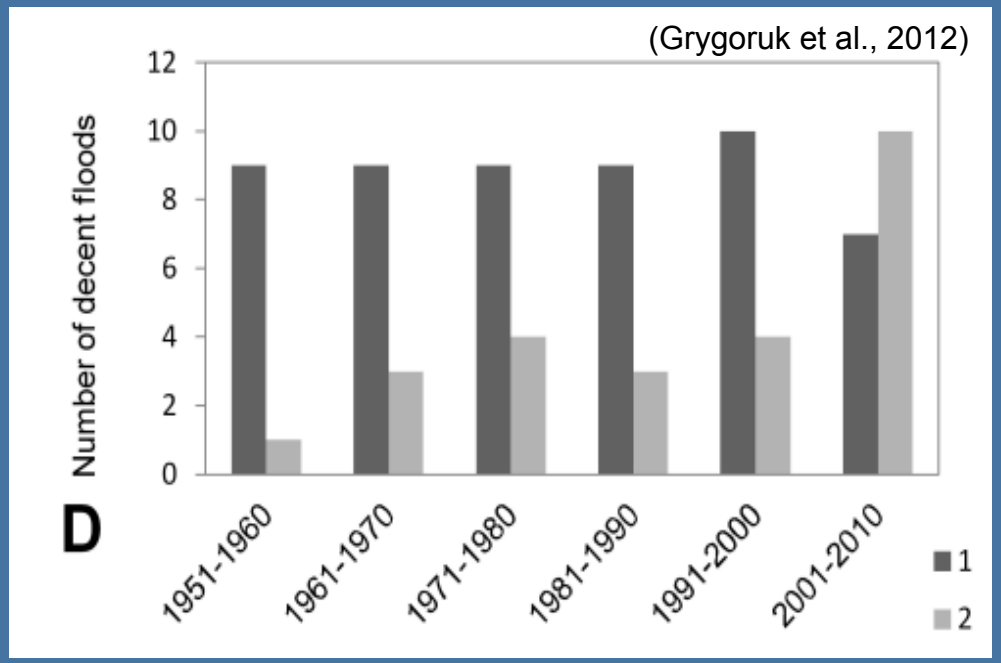
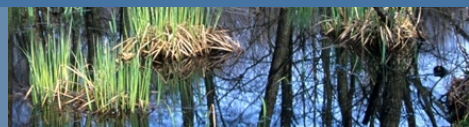


1 – winter floods; 2 – summer floods

In the decade 2001-2010 a vast increase of summer flooding frequency was observed in the Biebrza Valley.



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Why do the farmers complain?

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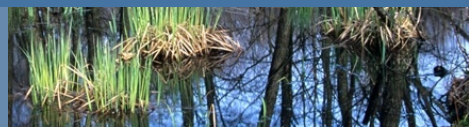

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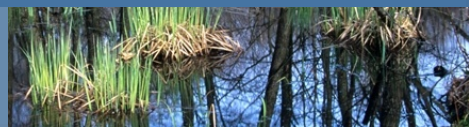
Storage cost calculation

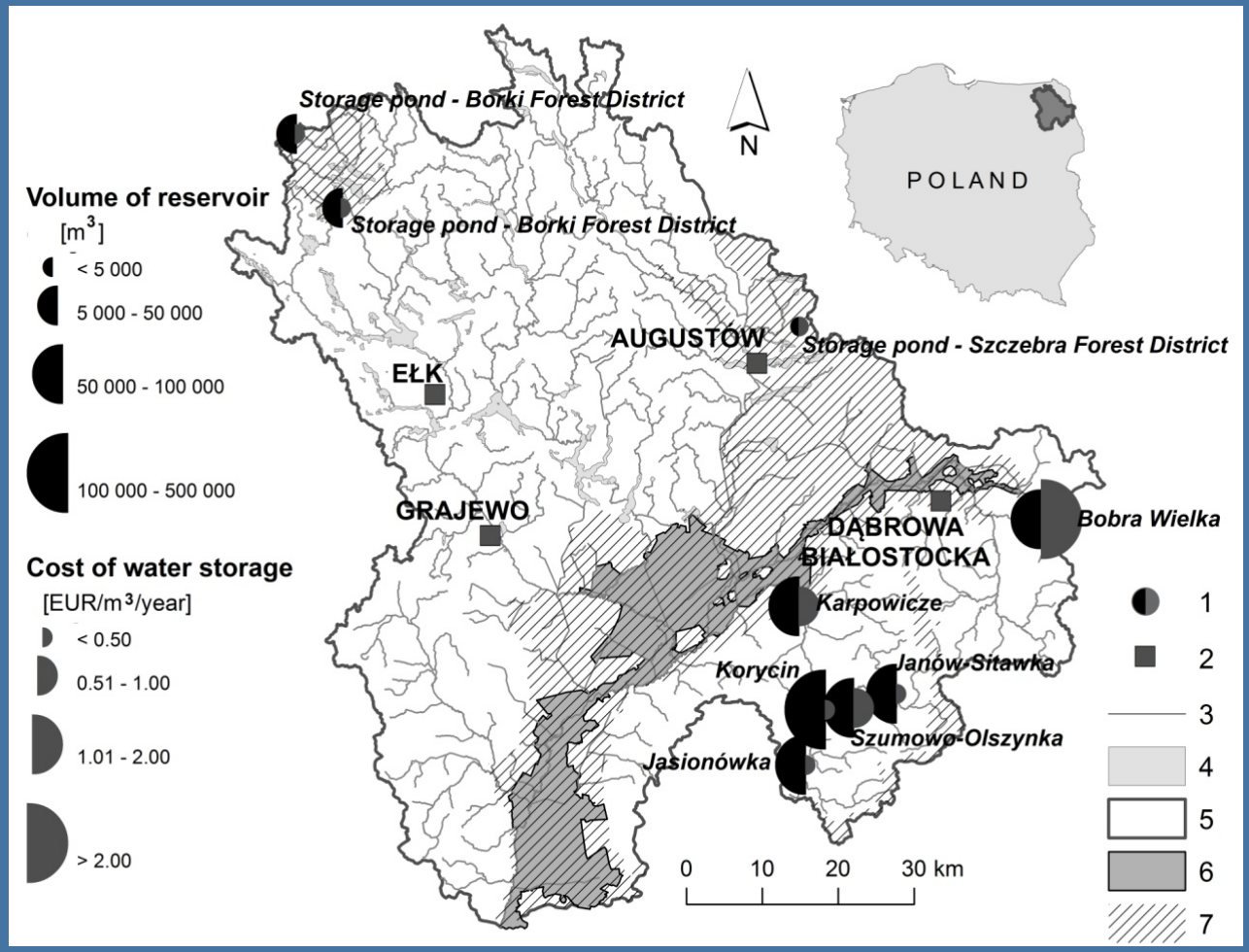
$$Scost = \frac{\sum_{i=1}^{n}(Rc+M)}{\sum_{i=1}^{n} Rv} * Dr^{-1}$$

Scost – unit cost of water storage in the catchment,
Rc – Total cost of reservoir design and construction,
M – total cost of reservoir's technical maintenance,
Rv – total volume of reservoir
Dr – depreciation rate per annum

<u>In our approach:</u>
M = 0, as the maintenance cost is unknown
Rc and *Rv* – data retreived from procurement procedures
Dr = 4.5% per annum, due to the national legislation

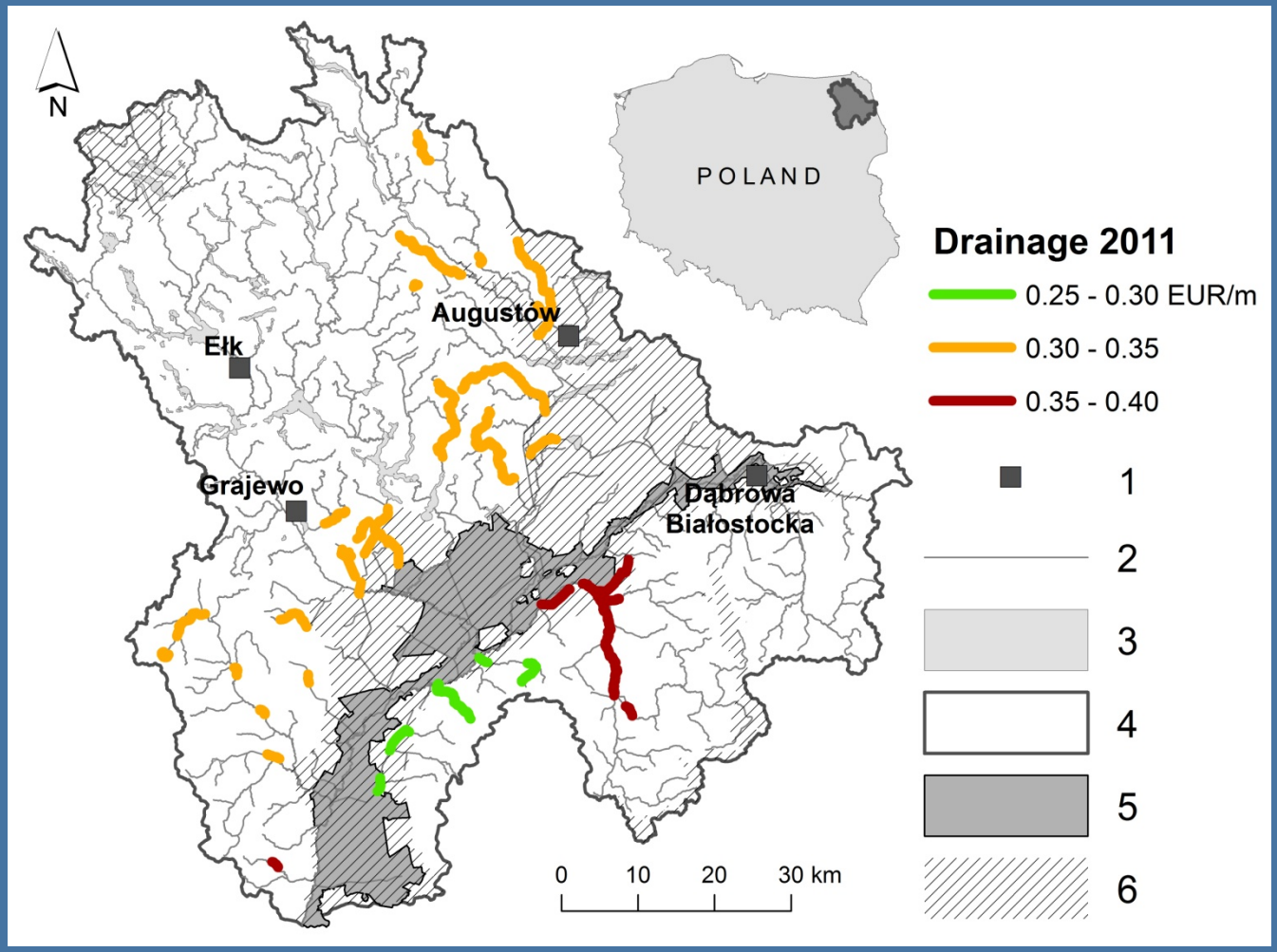


How much for 1 m^3 of water?



Average *Scost* = <u>0.36</u> EUR · m^{-3} · $year^{-1}$

Drainage investments in 2011



Average drainage cost = 0.33 EUR · m^{-1}

Ditch – the loss of water

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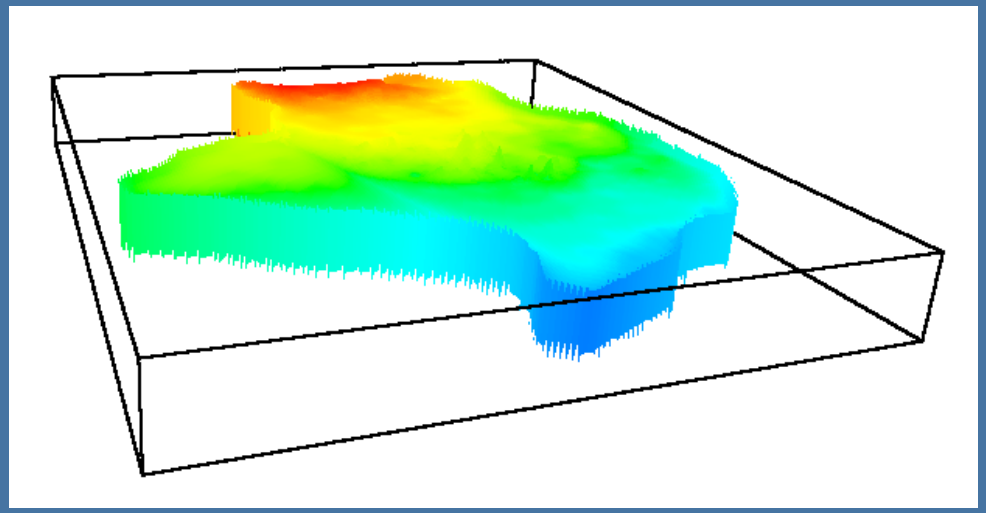
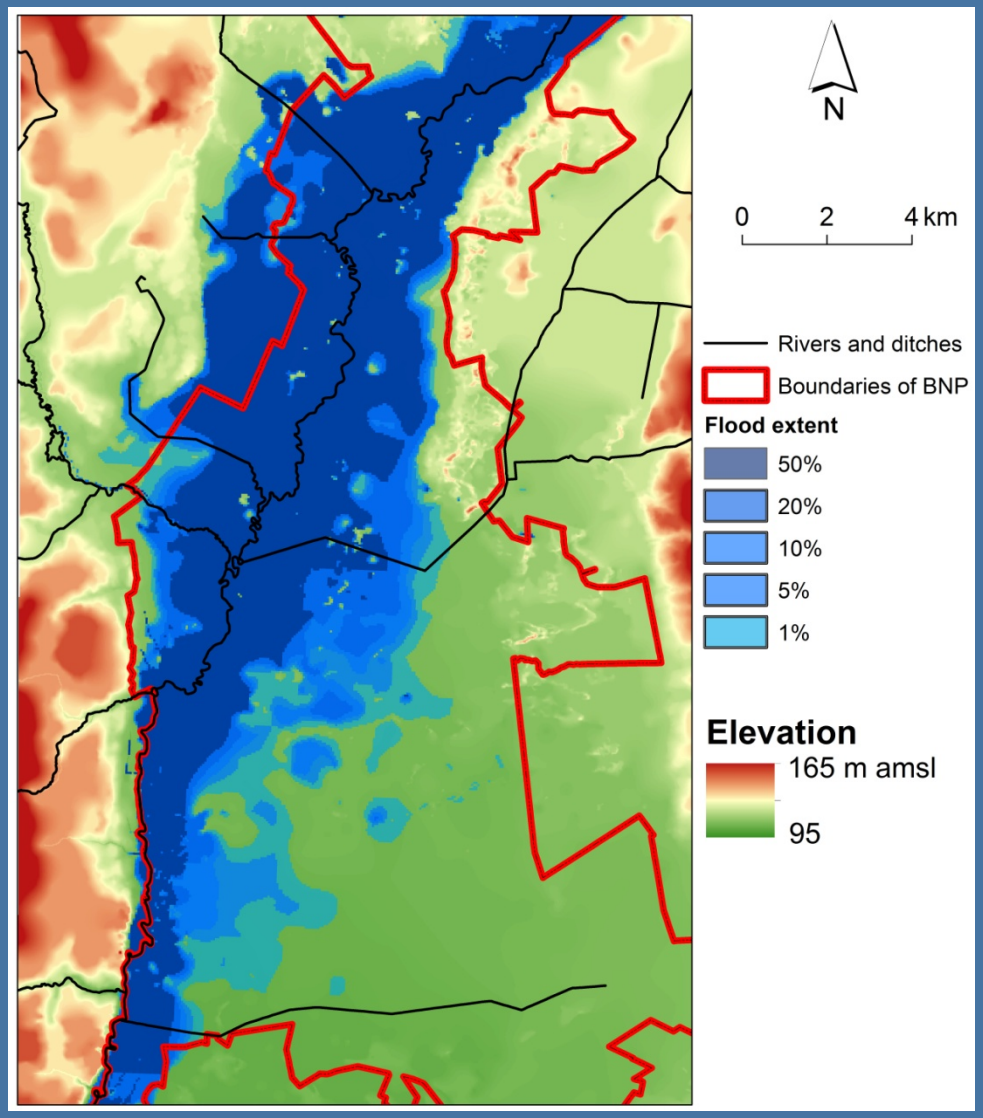
MODFLOW model based on the (Grygoruk et al., 2011) setup, was applied to quantify the amount of water removed from wetland by a newly constructed drain:



Average annual discharge of the drain: 0.01 m^3*s^{-1}

Floodplain capacity: V = f(h)



- **Flood extent (water level)** (hydrodynamic model of flood wave propagation was designed for the Lower Biebrza Basin (Świątek et al., 2008)

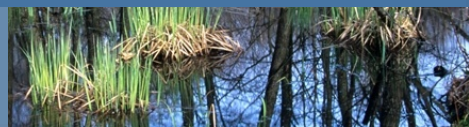
- **Flood volume:**
  GIS-based approach
  (*Flood elevation – DEM)*

Storage volume

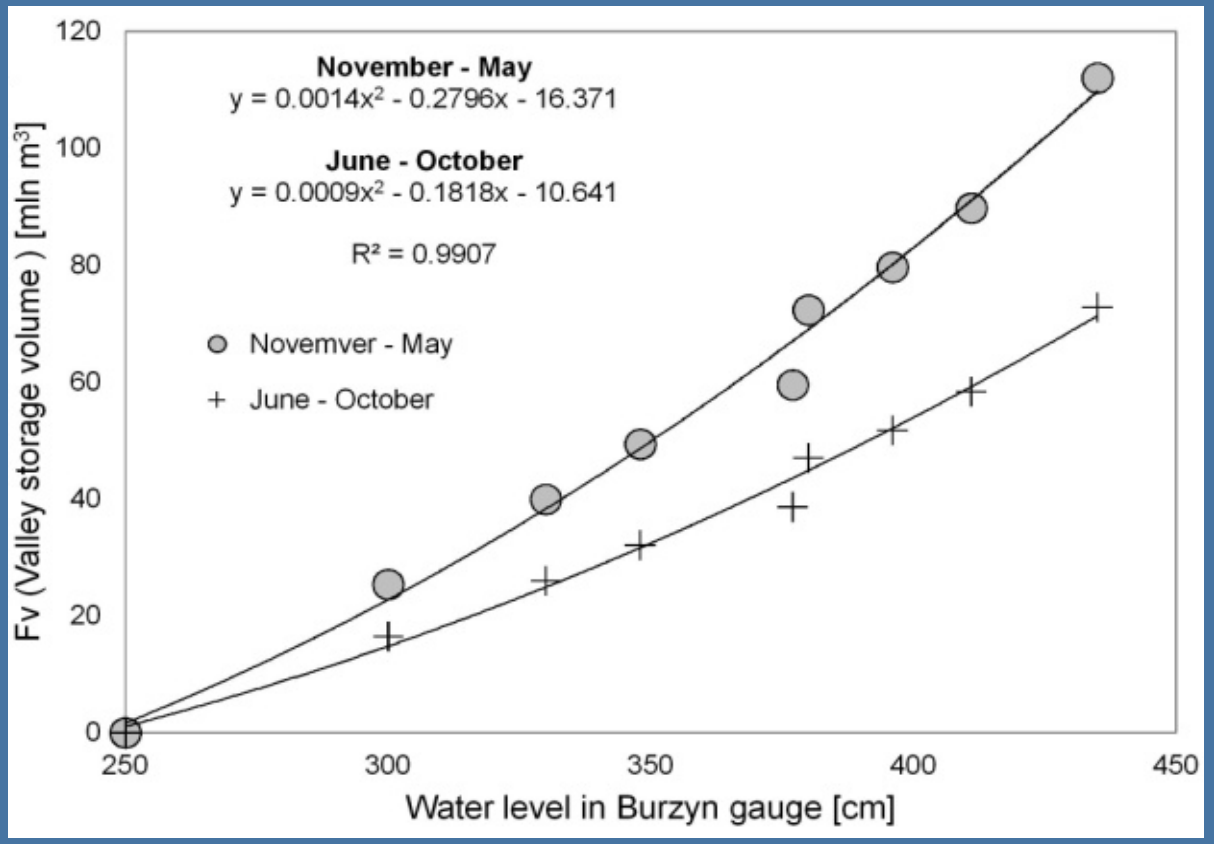
$$StWet = Fv + (\phi Fa * Cd)$$

StWet – floodplain storage volume [m^3]
Fv – flood volume (surface water) [m^3]
Φ – porosity of the superficial soil [-]
Fa – area of flood [m^2]
Cd – critical groundwater depth [m]

In our approach:
Fv – a GIS-based calculation
Φ = 0.9 (based on soil reseach and the literature)
Fa – a GIS-based calculation
Cd = 0.1 m (based on experience with farmers)
Water in deeper layers of peat is not considered!

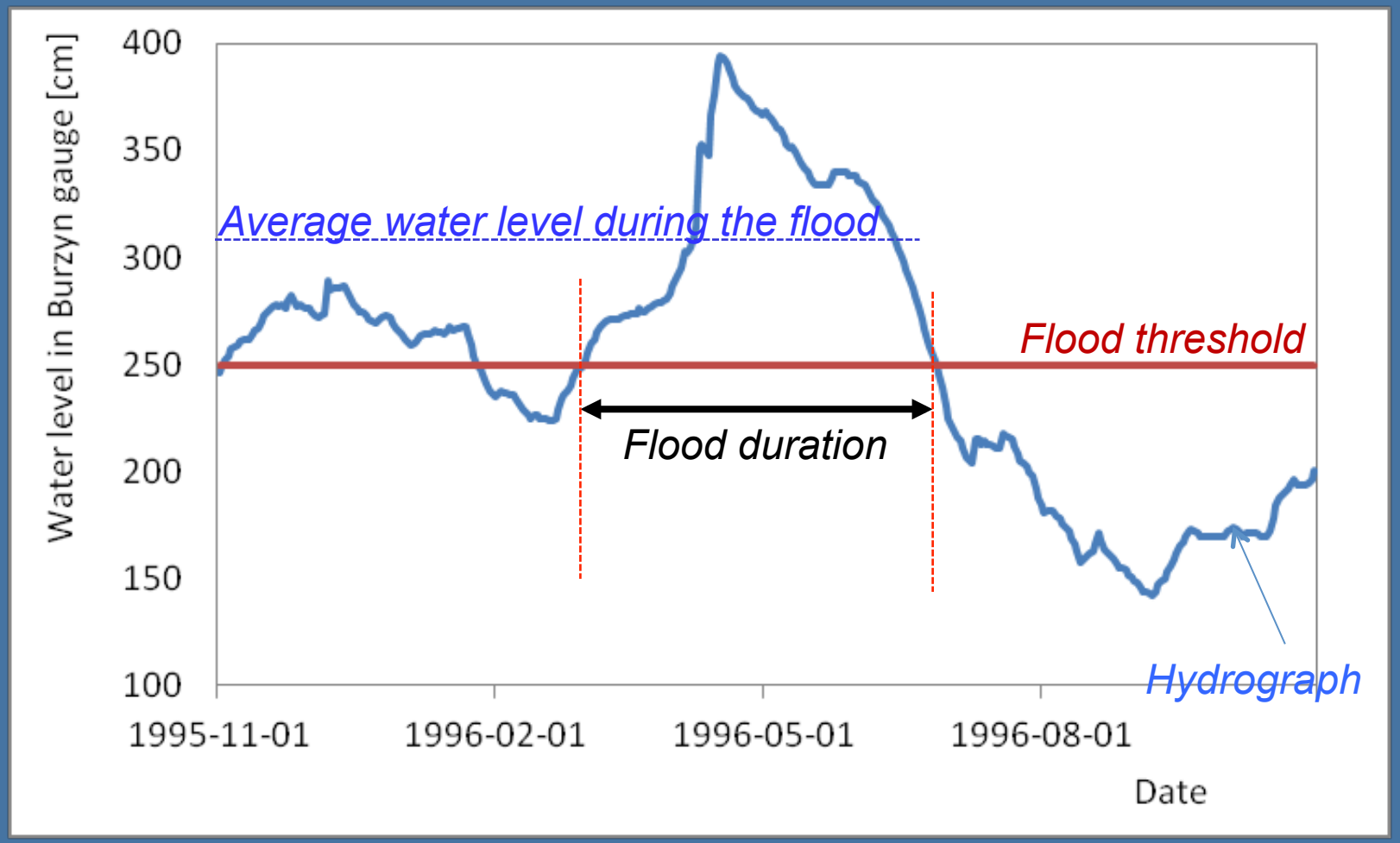


Flood volume – a GIS-based apprach

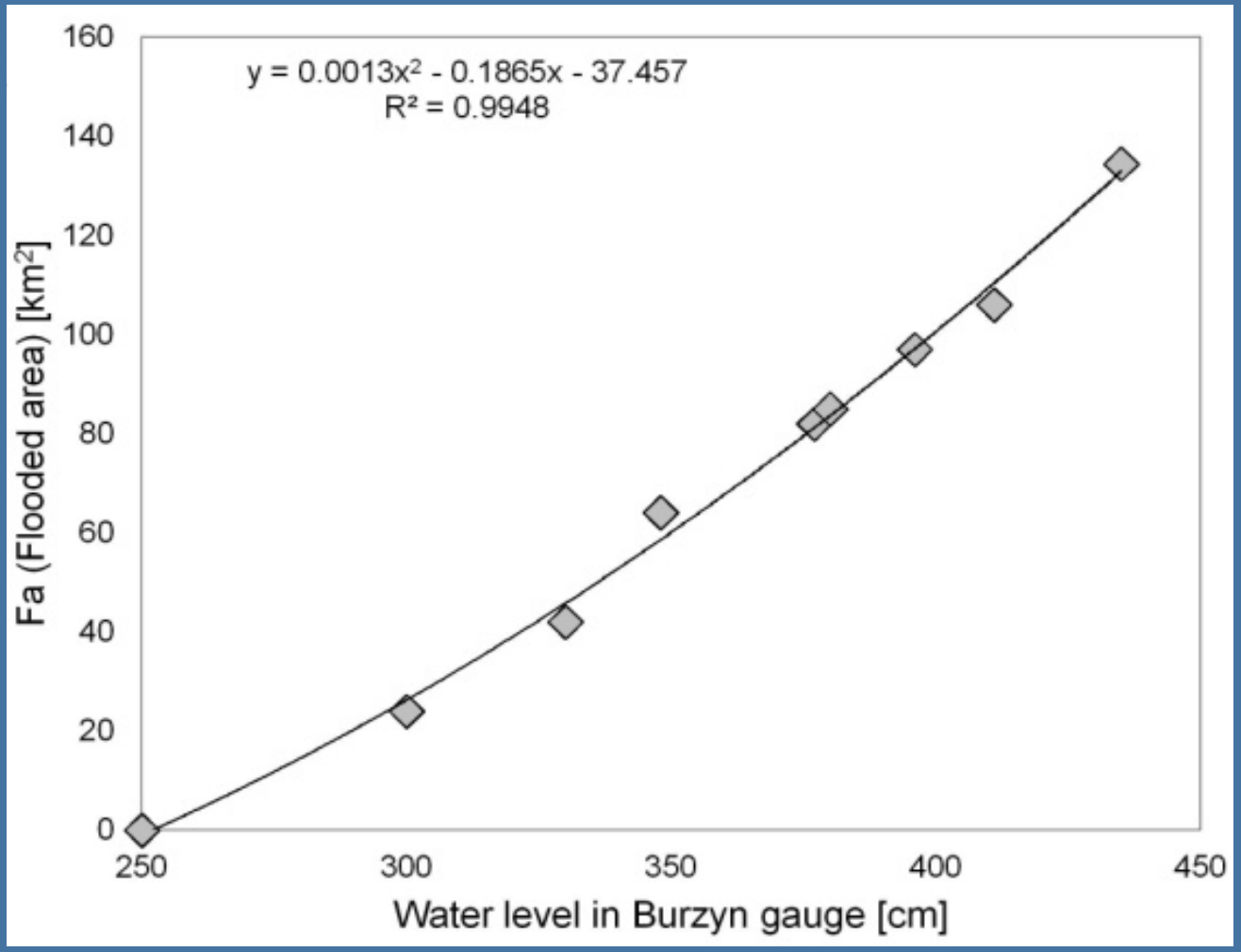


Two regression curves were derived in order to simulate winter conditions (no vegetation) and summer conditions (vegetated floodplain) (Świątek et al., 2004)

Water storage: *Fv = f(h)*



Flood area – a GIS-based apprach



Water storage in Lower Biebrza Basin
1995-2011 – a „gain”?

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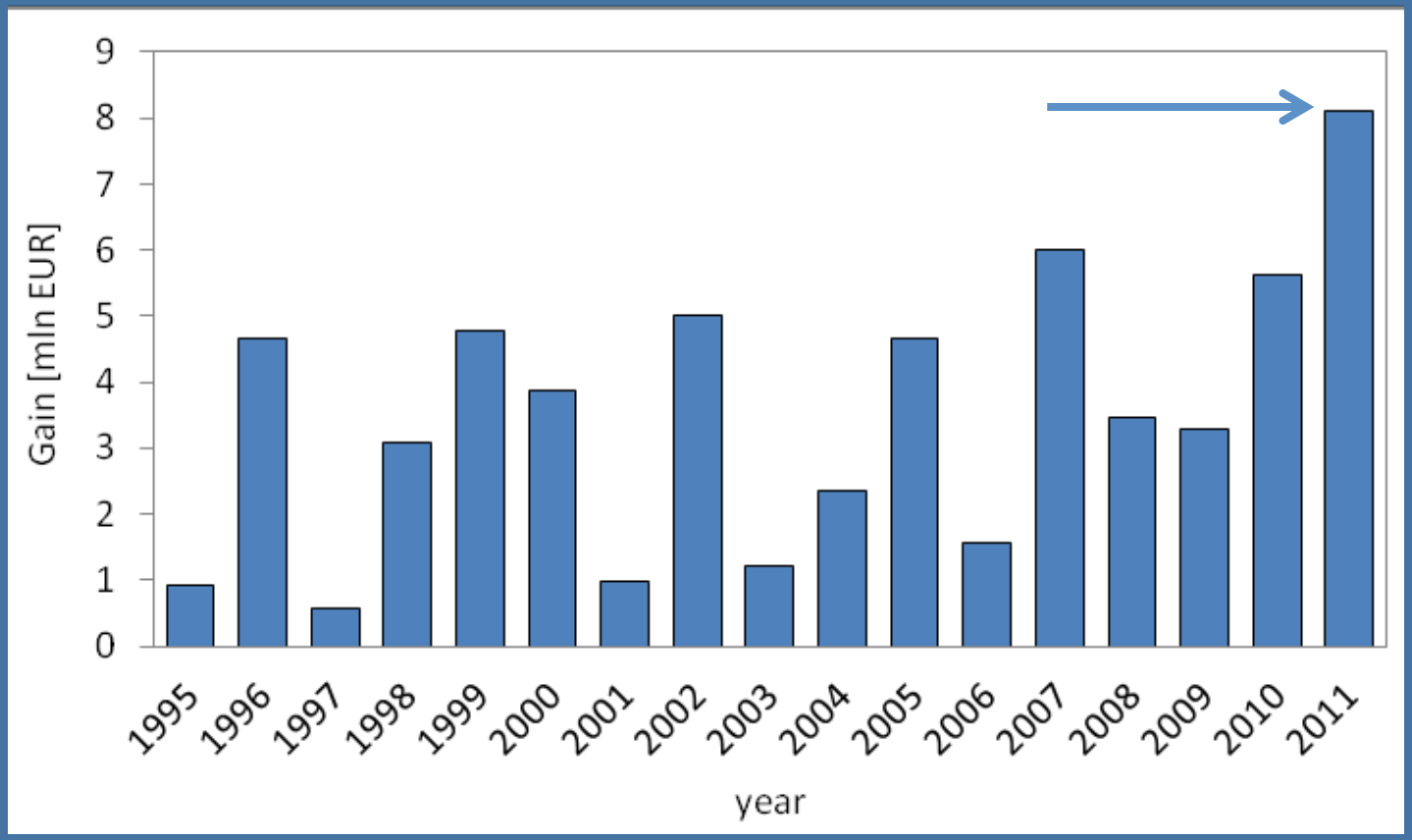

Average annual gain = 3.54 mln EUR · year^{-1}

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Farmer's loss – how much?

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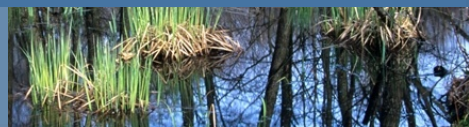
$$Fl = (Afm * Hprod * Hprice) - Pc$$

+ moral aspect?

Fl– Farmer's loss [EUR],
Afm – Area of flooded maintained meadows [ha]
Hprod – hay productivity [tons*year^{-1}*ha^{-1}]
Hprice – market price of hay [EUR/ton]
Pc – processing cost (fuel, work, machines) [EUR]

<u>In our approach:</u>
Afm = spatial data from reports,
Hprod and Hprice – annual data from Agricultural Agency
Pc – fixed value 120 EUR/ha



Water storage – a profitable ecosystem service of wetlands

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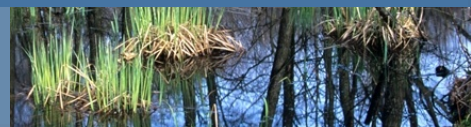
Economic calculation – year 2011

	Variable	EUR/year
Money spent	Storage in reservoirs	323892
	Drainage	160542
	Total	**484434**
Money earned	Floodplain storage	8110000
Opportunity cost	Damages in crops (hay)	533000
	Balance	**7577000**

- Drainage is financed by the regional authorities
- Storage reservoirs are mostly financed from the budget of local authorities (comunes)

- Hence, we propose, that…



A „storage subsidy”?

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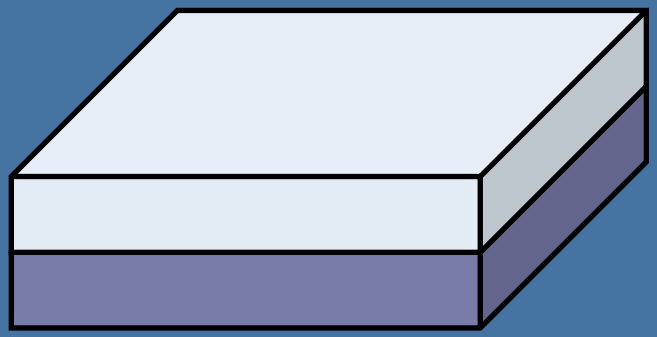
… if the drainage was not done, and if the storage ponds were not constructed, saved money could be transfered directly to farmers, if they report any flood damages:



Flooded meadow:
Area of the meadow: 1 ha
Flood depth: 0.1 m
Porosity of the peat: 0.9
Annual unit cost of water stored on the meadow: 0.36 EUR/m^3

If the flood lasts through the whole summer (3 months), then the storage subsidy could be calculated as follows:

(100m*100m*0.1)*0.089EUR+(100m*100m*0.1*0.9)*0.089 EUR =

168.65 EUR/ha

Can the „Biebrza" authorities afford?

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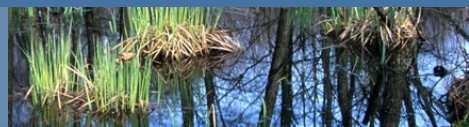
In case of the 1% flood:

168.65 EUR/ha * 1300 ha = 219255 EUR

	Variable	EUR/year
Money spent	Storage in reservoirs	323892
	Drainage	160542
	Total	**484434**
Money earned	Floodplain storage	8110000
Opportunity cost	Damages in crops (hay)	533000
	Balance	**7577000**

If appropriate political decisions were done, it is possible to compensate losses caused by flooding by transferring funds from storage and drainage investmens.

The money transfer can be even more effective, if some authority would pay for the whole amount of water stored on wetlands…



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Conclusion

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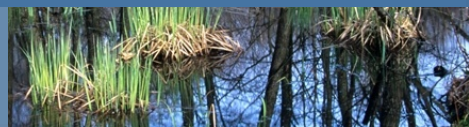
TO STORE = TO GAIN

- Avoiding drainage within valuable wetlands one fulfills the requirements of Habitat Directive and Water Framework Directive, and to save money!
- Storage role of wetlands entails other ecosystem services (habitats for plants and birds, nutrient removal, carbon sequestration). They bring money!
- why to spend money and build small reservoirs, if wetlands can provide much more for much less?

- 0.36 EUR/m^3 in the catchment of Biebrza. How much is it elswhere?



Boundary spanners[1] vs. gate keepers Hydrology in a stakeholder dialague

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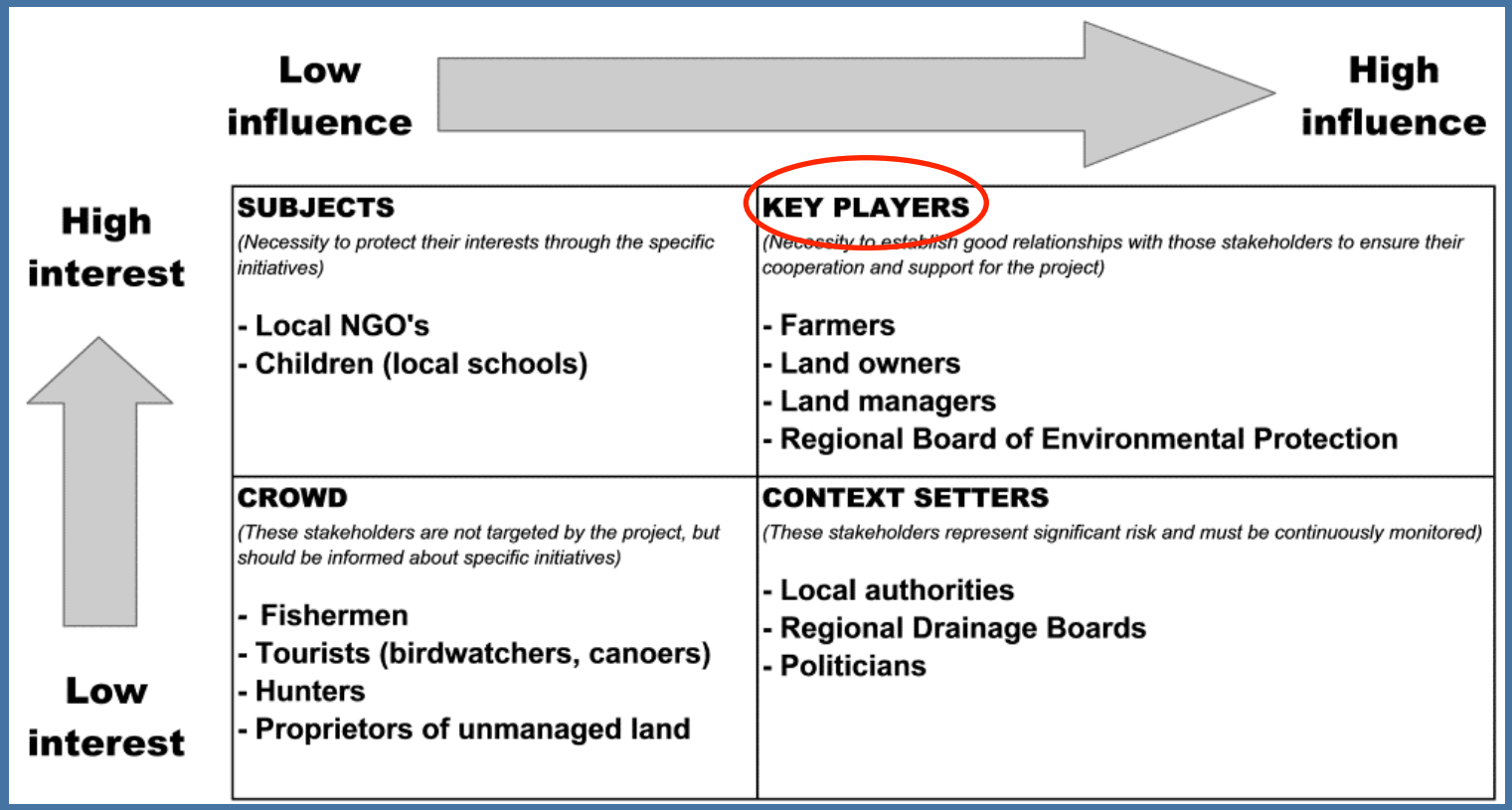

Stakeholder classification matrix – case study of the stakeholder dialogue in valuable and protected wetlands management in the Biebrza Valley (Grygoruk et al., 2012); after Boumrane (2007), modified).

[1](Richter et al., 2006)

Boundary spanners vs. gate keepers
Hydrology in a stakeholder dialague

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$$\frac{\partial Q}{\partial x} + \frac{\partial (A_C + A_O)}{\partial t} = q$$

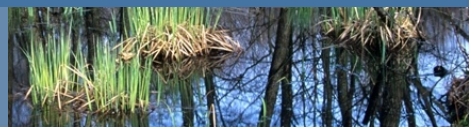
$$\frac{\partial Q}{\partial t} + \frac{\partial (\beta Q^2 / A_C)}{\partial x} + gA_C\left(\frac{\partial h}{\partial x} + S_f + S_{ec}\right) + W = 0$$

$$u = -\frac{K}{\mu}\frac{dP}{dx}$$

$$\frac{\partial}{\partial x}\left(kH\frac{\partial H}{\partial x}\right) + \frac{\partial}{\partial y}\left(kH\frac{\partial H}{\partial y}\right) = N + \phi\frac{\partial H}{\partial t}$$

EUR

In adaptive management of valuable wetlands, „spanning the boundaries", means to transfer the knowledge from scientific world of hydrology towards the stakeholders. They do not get neither „Darcies" nor „St. Venant's", but EUR.



Boundary spanners vs. gate keepers
Hydrology in a stakeholder dialague

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Hydrological analysis can strongly support decision making, by transfering the result of discharge into local economy, putting nature in political and social context.

ATTITUDE = KNOWLEDGE + EMOTIONS

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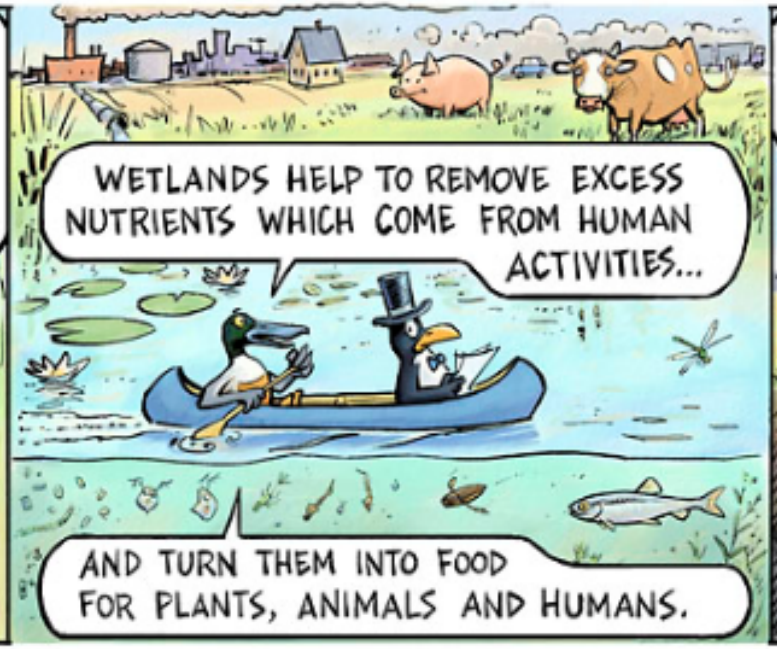
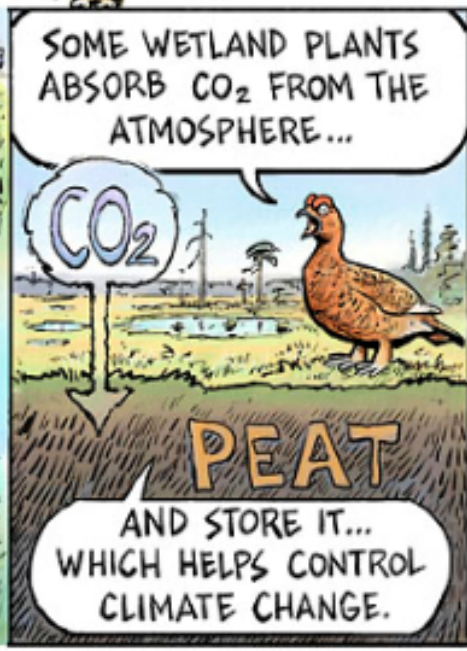
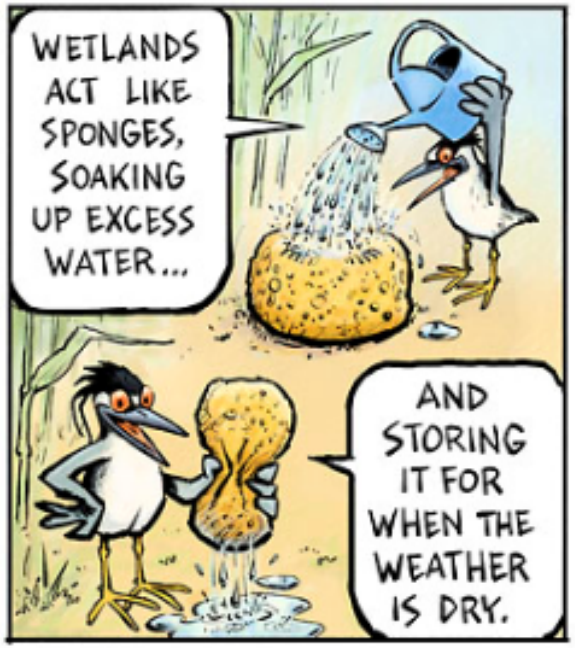
SOME WET FACTS ABOUT WETLANDS

www.ramsar.org







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Thank you for your attention

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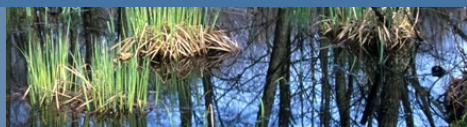

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