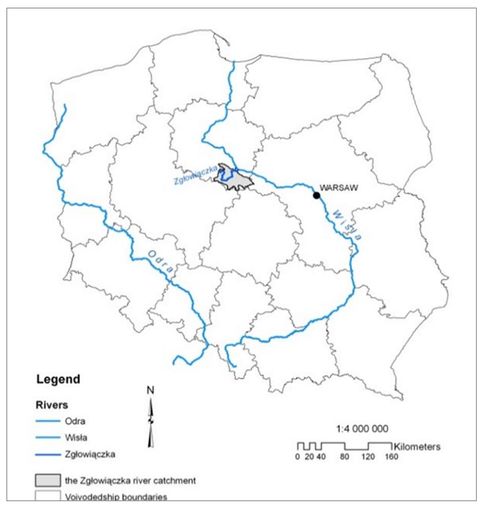
OPTAIN

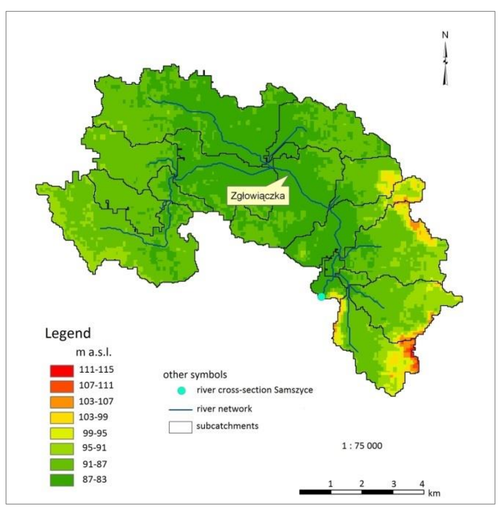
OPTimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe

ITP/WULS STUDY SITE: UPPER ZGŁOWIĄCZKA RIVER BASIN

Zygmunt Miatkowski, Wiesława Kasperska-Wołowicz

LOCATION & LANDUSE





Selected data of the Upper Zgłowiączka experimental basin

Parameter	Cross-section Samszyce
River basin, km^2	78 (60% total)
Length of main stream, km	11.2
Arable land, %	90
Forest, %	4,0
Urban, %	2,0
Subsurface tile drainage, ~%	65
Precipitation, mm/a	513
Growing season precipitation, ~mm/(April-Sept.)	300
Crop water deficits *p = 50%,* mm	
- winter oilseed rape	0-40
- winter wheat, maize	40-80
- sugar beet	80-120

Main problems

- Increasing water deficit in crop production
- Nitrate loads and concentration in water

EXISTING NATURAL/SMALL RETENTION MEASURES

Mid-field permanent grassland - a buffer zone along a drainage ditch - an exception in the landscape

Mid-field pond - a rare sight in the landscape

Cover crops in fall - a commonly used measure. Other soil conservation techniques are not common

Upper Zgłowiączka estuary to the Głuszyńskie Lake. Natural wetlands buffer zone

GENERAL INFORMATION & PROBLEMS

Upper Zgłowiączka river

Monotonous agricultural landscape -> wind erosion of light-textured soils and low biodiversity

Arable lands prevail in the watershed (90% of the area) due to high quality of soils. Dominant soil types are Phaeozems (about 85%) and Luvisols (15%) underlain by low permeable glacial till

The main crops are cereals, maize, oilseed rape and sugar beet as well as alfalfa, ground vegetables and herbal crops. The fertile soils allows for intensive crops. The increasing water deficit is the main factor limiting crop production

Arable land use is very high. Riparian buffers are rare

One of the most important environmental problems - water eutrophication and nitrates loads

Drainage system (open ditches and subsurface drainage) drains excess water in wet periods. It is a main nitrate outflow path

STAKEHOLDERS

Participation already confirmed:

1. Ministry of Agriculture and Rural Development, Department of Advisory and Science
2. Kuyavian-Pomeranian Agricultural Advisory Centre in Minikowo (KPODR)

We also plan to involve local farmers and agricultural organizations as well as representatives of units responsible for water resources and rural areas management and protection as well as representatives of units responsible for operation and maintenance of hydrotechnical infrastructure

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No *862756*

ITP

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OPTimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe

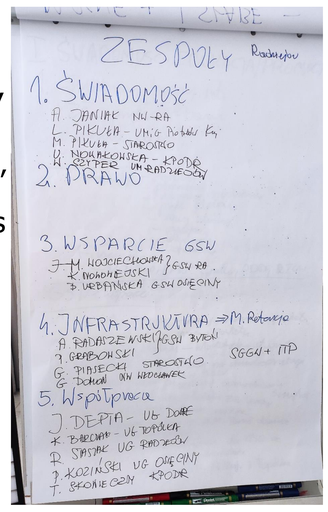
WULS/ITP STUDY SITE: Upper Zgłowiączka (Poland)

Ignacy Kardel, Marek Giełczewski, Mikołaj Piniewski, Wiktor Halecki, Wiesława Kasperska-Wołowicz, Tymoteusz Bolewski

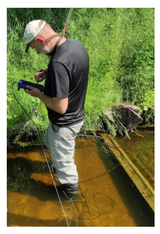
HIGHLIGHTS & ISSUES 2021

MARG: 1st MARG workshop (7/2021), regular, 24 participants, together with Local Water Partnership meeting.

Additionally, 3 pre-MARG meetings: Regional Agricultural Advisory Center (5/2021) and Local Water Partnership meetings (on-line 3/2021 and regular 5/21)



4 field visits (March to July 2021) – equipment installation (water quality probe [NO_3, pH, EC, Turbidity, Redox, O_2], water level loggers, soil moisture monitoring), discharge and water quality measurements

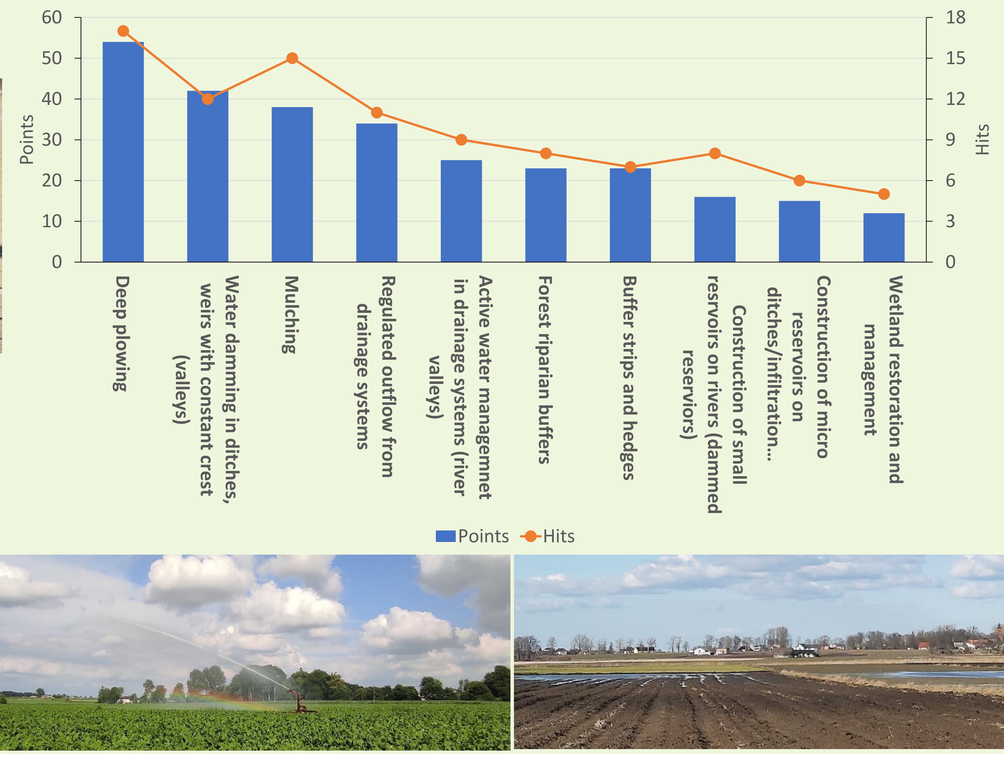


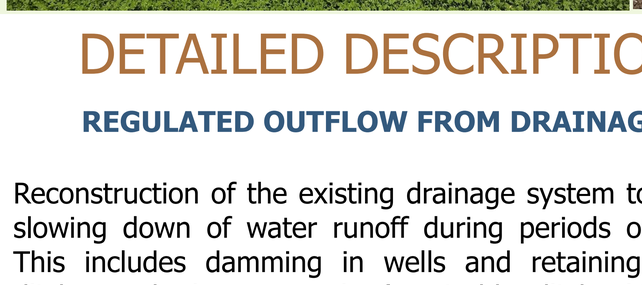
Problems to be addressed

- Extreme climate events (droughts vs intensive & prolonged rainfall)
- Yields reduction in wet year on clay soils (water standing on fields)
- Intensification of sprinkler irrigation leads to progressive lowering of deep groundwater levels
- Bad ecological status of watercourses and lake (extremely high NO_3 concentrations)
- High cost of land resulting in lack of set-a-side/wasteland areas and no space for NSWRMs (only crop rotation, conservational tillage, green cover, ponds are used)
- 43% of arable land is drained and no damming structures on ditches
- Hazard runoff process (35% of CS area has on the top clay soils)
- Legal prohibition to use drainage water for irrigation of vegetables, inhibits nutrient recycling initiative

ACTOR-BASED PRIORITISATION OF NSWRM

- Presentation of selected (by us) NSWRM during plenary session
- Discussion, in a smaller group particularly interested in NSWRM, on feasibility and efficiency of measures for the case study area:
  - Need to educate and raise awareness among actors (mainly farmers) on NSWRM benefits
  - Need for financial incentives to make actors apply NSWRM
  - Highly productive soils & high land prices in this region make difficult to apply measures that would require additional space (to be given up by farmers)
- Plenary presentation of the discussion results
- Ranking of NSWRM by all participants - each one could select up to 5 measures and assign points based on scale: 5 (the most preferred) to 1 (the least preferred) points
- Participants' preferences are driven by 'here and now' altitude

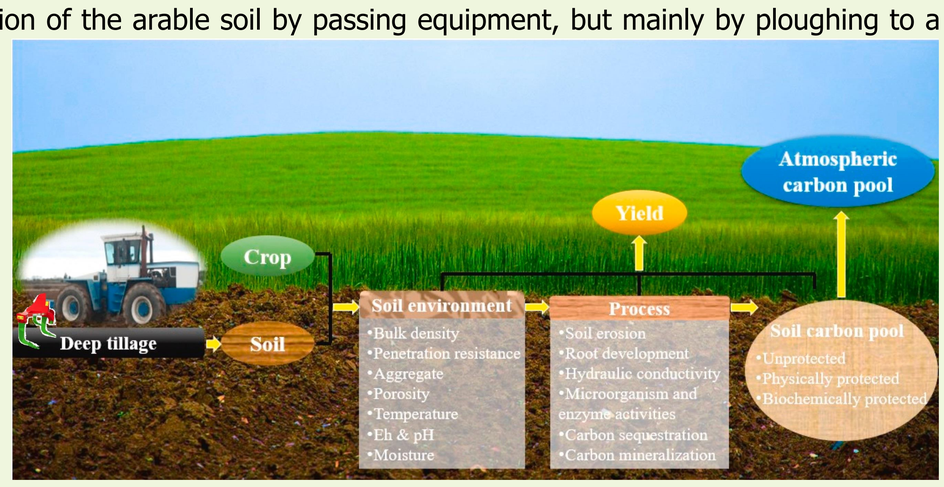




DETAILED DESCRIPTION OF 1st NSWRM

DEEP PLOWING on fine or medium textured soils (1st place actors' based)

This is a variation of ploughing without turning the soil. It involves dragging tines (also known as chisels or paws) working at a depth of 40-60 cm into the soil. The effect is to break up the impermeable layers known as the ploughshare, which is formed by the compaction of the arable soil by passing equipment, but mainly by ploughing to a constant depth.



- Reference: Feng, Q.; An, C.; Chen, Z.; Wang, Z. Can Deep Tillage Enhance Carbon Sequestration in Soils? doi:10.1016/j.rser.2020.110293.

Environmental effects:

- improving infiltration rainwater,
- facilitating access of air,
- ensuring better root growth,
- increasing yields in a wet year (no plant loss),
- reduces surface runoff and thus the transport of organic forms of nitrogen, phosphorus and carbon to surface water,
- enhance carbon sequestration in soils.

Hazards: when used on drained soils increases leaching of nitrates into groundwater

Cost: ~100 EUR/ha. **Policy aspects:** In the past, this measure was recommended in hydraulic engineering works connected with the improvement of drainage function. Currently, it does not belong to the group of good practices and is not co-financed due to the fact that under certain conditions it may adversely affect nitrogen leaching to groundwater. It is included only in the catalog of good practices for sugar beet cultivation.

DETAILED DESCRIPTION OF 2nd NSWRM

REGULATED OUTFLOW FROM DRAINAGE SYSTEMS (4th place actors' based)

Reconstruction of the existing drainage system to allow for slowing down of water runoff during periods of drought. This includes damming in wells and retaining water in ditches and micro-reservoirs (created by ditch widening and damming).

Environmental effects:

- retention of water in soil and in micro-reservoirs (also located on ditches),
- increased groundwater recharge,
- increase in biomass/crops,

Other effects:

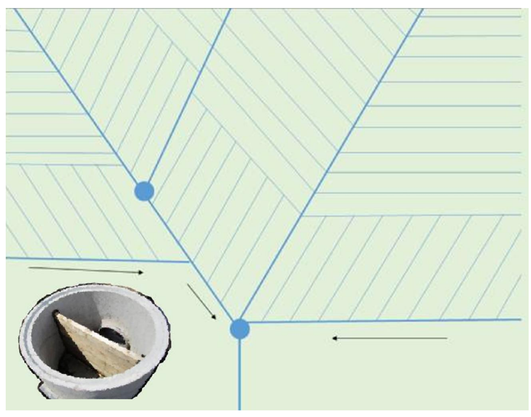
- potential for secondary use of water for irrigation,
- reduction in production costs

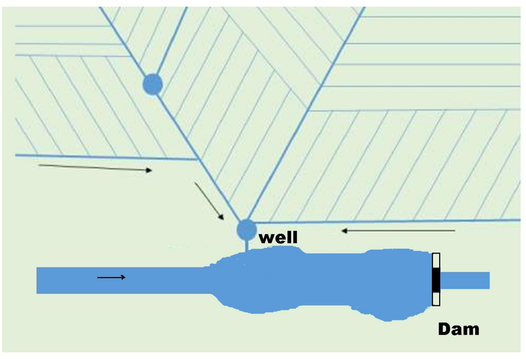
Hazards:

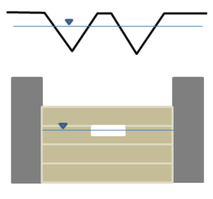
- contamination of shallow water and possibly deep groundwater with nitrates,
- blocked drainage pipes

Cost: depended on scope

Policy aspects: Replacement of drainage systems from drainage to mixed systems (irrigation and drainage) is a measure planned for implementation in Water Management Plans, and funding can be applied for.







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ITP

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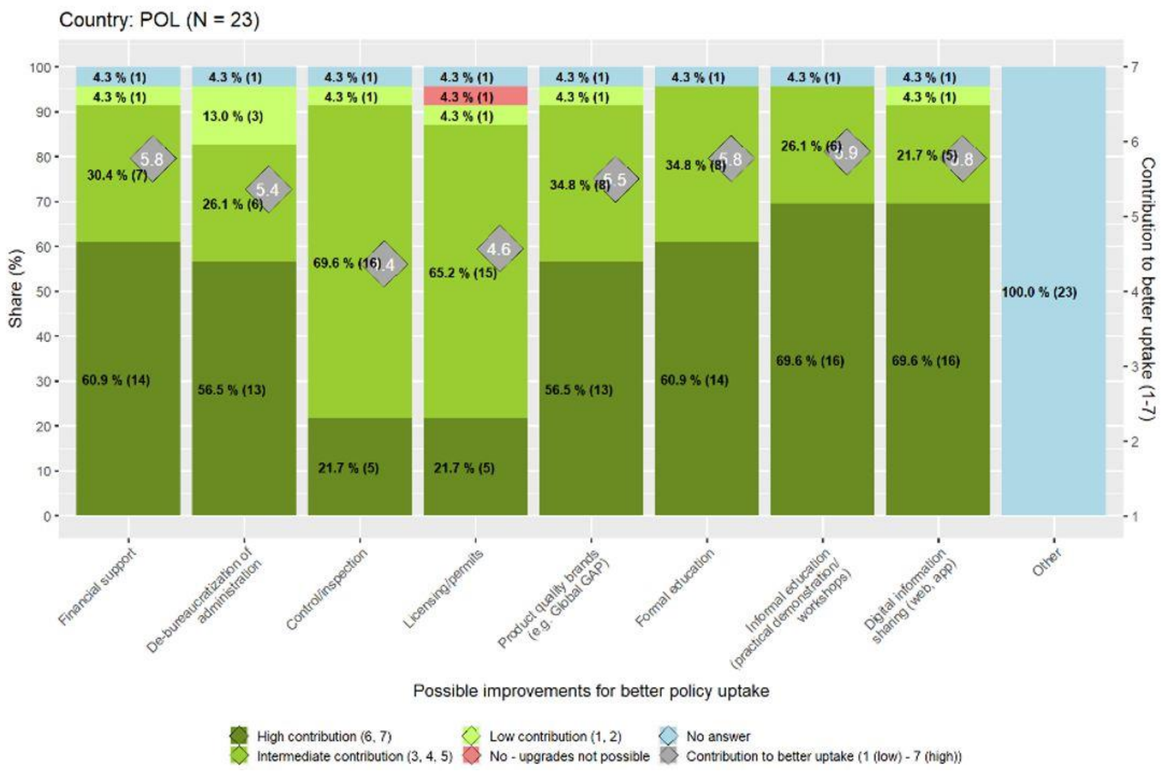
WULS/ITP-PIB STUDY SITE: Upper Zgłowiączka (Poland)

Marek Giełczewski, Ignacy Kardel, Mikołaj Piniewski (WULS)
Wiesława Kasperska-Wołowicz, Tymoteusz Bolewski, Ewa Kanecka-Geszke (ITP-PIB)

POLICY SURVEY – key findings

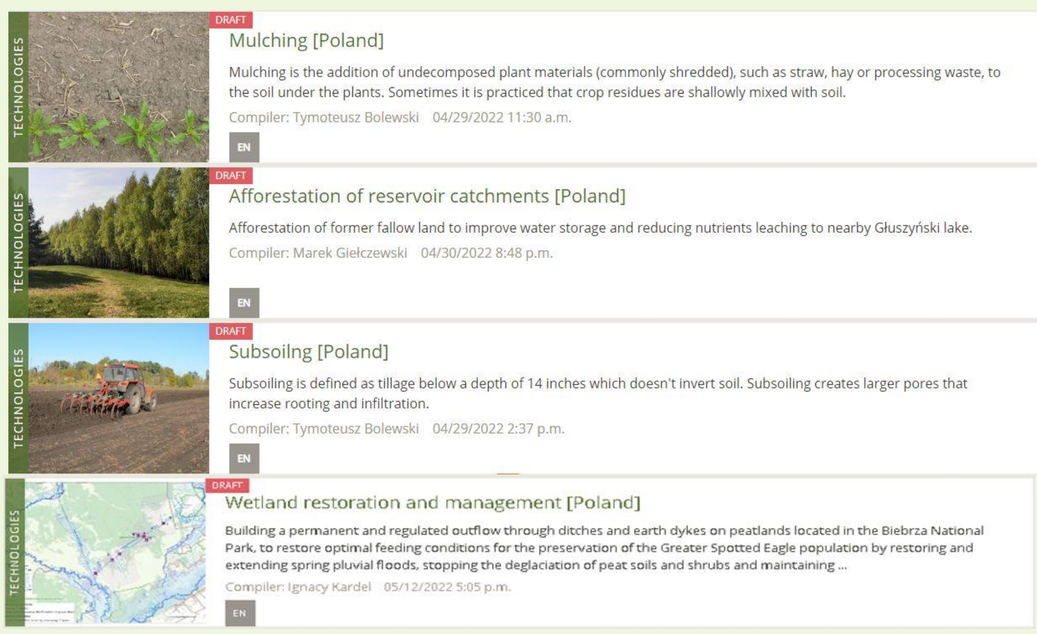
- 23 informants filled in the survey
- In general, **ALL informants** agreed that the policy mechanisms are **NOT adequate**, for most of the environmental concerns with some exception for water quantity
- Barriers for implementing NSWRM: administrative barriers (5.3;5.4), voluntary measures (5.3;4.9), low benefit-cost (4.8; 4.8), complicated implementation (4.1;4,9), control/inspection system (4.6;4.4), communication aspects (4.6;4.3), land-ownership (3.7;4.1)
- Needs to improve: education, information and money!!! But many fields of improvement were indicated as nearly equally important



WOCAT – status of documentation

- Drafts for 4 measures created
- Most of technologies have been consulted with experts/owners/users
- Complementation of documentation with gained information is still pending

Completeness



80%

80%

67%

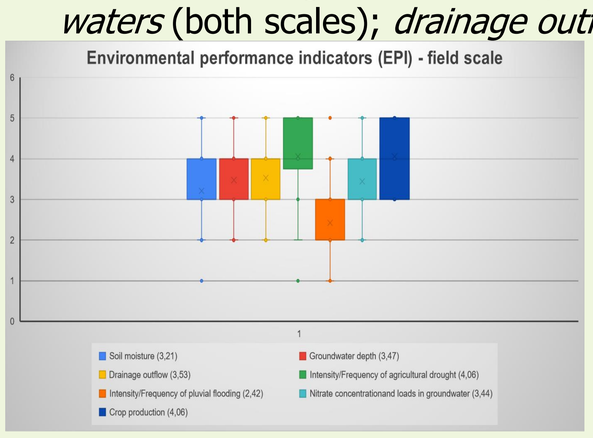
submitted

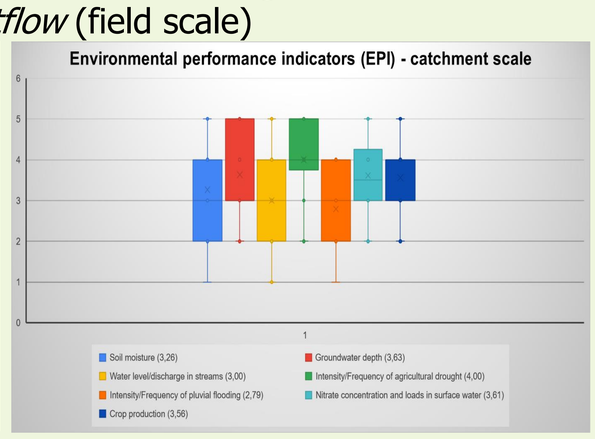
INDICATORS – workshop results

Questionnaire, scale 1 (least important) to 5 (most important), 19 stakeholders

Environmental performance indicators

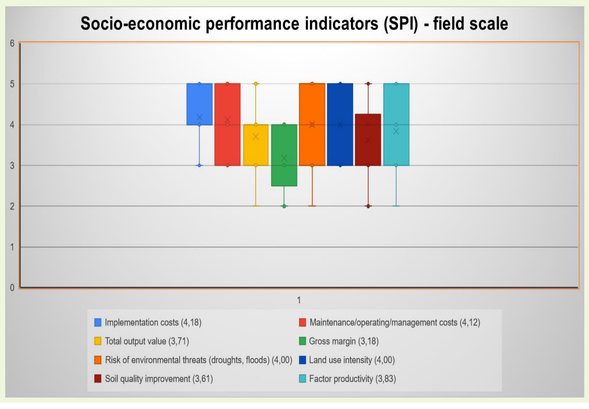
- The most important: *droughts* (both scales); *crop production* (especially field scale)
- Also important: *groundwater depth*, *nitrate level in ground and surface waters* (both scales); *drainage outflow* (field scale)

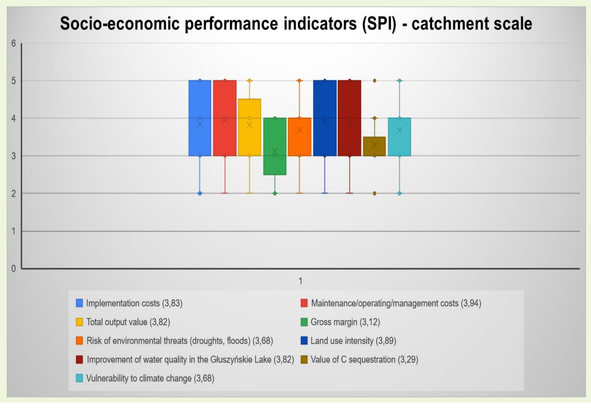




Socio-economic performance indicators

- The most important: *implementation and maintenance cost*, *land use intensity* (both scales); *risk of environmental threats* (especially field scale)
- Also important: *total output value* (both scales); *factor productivity* (field scale); *quality of Głuszyńskie lake* (catchment scale)





ALLOCATING MEASURES – workshop results

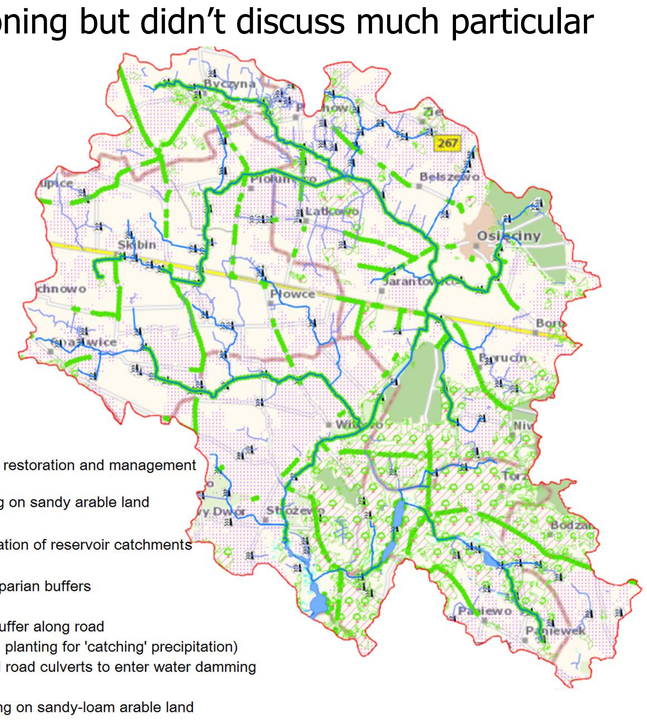
We presented our reasoning for allocation of measures and a map with proposed allocation. However, the discussion was rather limited, the stakeholders agreed with our reasoning but didn't discuss much particular measures.

Mulching

- Soils susceptible to drying and others exposed to wind and water erosion; *applied after corn regardless soil type, not applied on poor sandy soils*

Subsoiling

- Easily compacted soils (e.g. loamy-sandy); *common measure applied every 4 years on heavy soils*



Afforestation of reservoir catchments

- Watercourse and reservoir banks, wastelands and poor sandy soils, strongly sloping slopes, outcrops of aquifers, protection zones of intakes

Wetland restoration and management

- Primarily degraded wetlands within drainage range of deep ditches; *high pressure from agriculture and recreation in dry years*

Construction of micro reservoirs on ditches

- Detailed drainage network and deep ditches above culverts; *numerous problems*

Infiltration reservoirs and ditches

- Near roads & built-up areas, existing ditches with nutrient rich water

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