MEASURES AND RECOMMENDATIONS TO REDUCE ENTRIES OF NITROGEN, PHOSPHAT AND PESTICIDES INTO WATER IN THE DANUBE RIVER BASIN ORIGINATING FROM AGRICULTURE

ICPDR workshop on Agriculture
and water management in the
Danube River Basin
5/6th November 2012
Bucharest, Romania
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Outline

- **Danube countries: water protection needs will increase**
- **Key pollutants from Agriculture**
  N, P, Pesticides (PPP)
- **Main entry routes of pollutants to surface water**
- **Mitigation concept**
- **Runoff risk diagnosis**
- **Mitigation measures**
- **Outlook and motivation**

Opportunities and challenges

More demand for food, feed, fibres, fuel will increase pressures to increase agricultural production

- Danube countries offer potential to increase agricultural outputs by more investments (people, structures, inputs)
- Environmental challenges may increase in future if lessons to be learned from WE-countries are not considered
- Finding solutions is easier when problems are still small

Key pollutants from Agriculture

Nitrogen is special

- Nitrogen determines largely the yield of a crop
- Without Nitrogen no proteins
- Plants mainly uptake Nitrogen in the form of Nitrate in the soil solution
- Nitrate is water soluble and can easily be transfered with water
- Nitrogen needs are highest compared to other plant nutrients
- Nitrogen is subject to biological and chemical modifications in the soil (minearalization – microrganisms)
- Nitrogen is not supplied by the soil substrate (bedrock) as other nutrients
- 78% of our atmosphere consists out of Nitrogen

Key pollutants from Agriculture

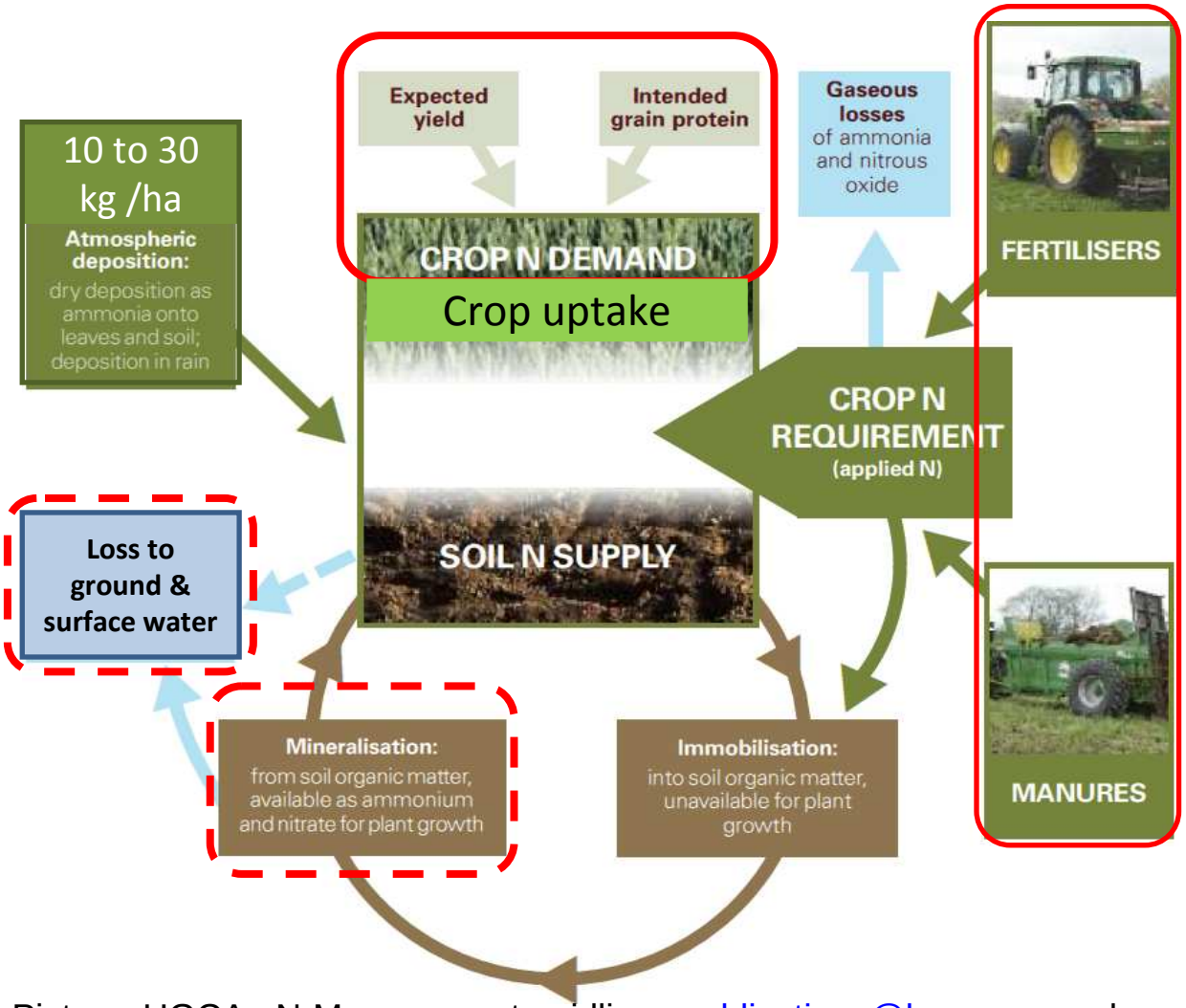
Nitrogen also has negative impacts

- **Nitrate in drinking water can effect human health Threshold 50mg/l**
- **Nitrate influence the eutrophication of waterbodies with negative impacts on aquatic organisms**
- **Emissions of Nitrogen gases are considered „clima gases“**

EU – regulations (Nitrate Directive)
Member states implement mesures to reduce Nitrate in the environment

- Best Management Practices for fertilizing (use restrictions: timing and volume)
- Nitrogen Balance (some countries – what goes in and what goes out)
- Documentation requirements / Cross Compliance relevant

Farmer **experience**, **monitoring** tools and **advice** can help to optimize amount of N



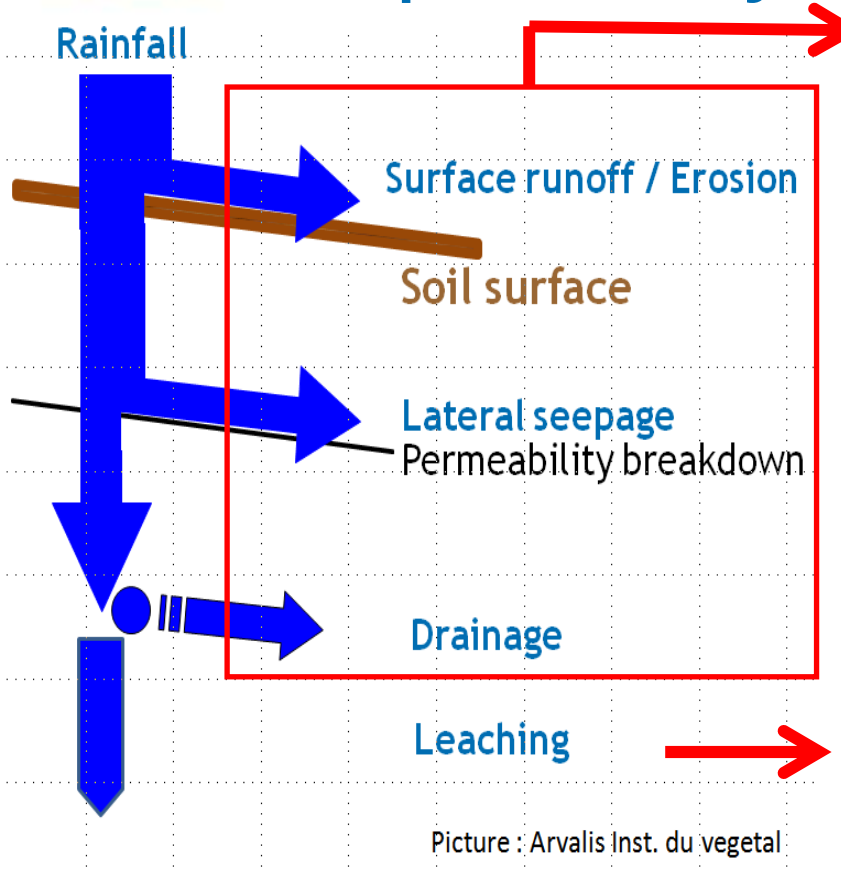
Farmer Management decision

Mineralization by Microoganisms temperature, air moisture,

Losses to water apply mitigation measures

Picture: HGCA : N-Management guidlines publications@hgca.com - changed

Nitrogen water pathways



Surface water
- Runoff / Erosion
- Lateral seepage
- Tile drainage (special form of runoff)

N - Ground water (leaching)
transfer during times of groundwater recharge
late autumn to spring
(soils are water saturated) ,
vegetation growth is low or no vegetation present
(Mineralization in winter lower in Danube countries than in WE countries – colder temperatures)

UBA estimates Nitrate leaching 46% for Germany
rest need to come from surface water ?

Nitrogen balance – key to optimize fertilization

Plot - Balance (plot / crop)	Farm gate Balance (total area)
Optimize fertilization on the plot: In practice often data for organic fertilizer application by field not precisely available **CONTROL PROCESS DIFFICULT**	Prove that regulatory requirements are met and framer comlpies with rules: Inputs from whole farm output from whole farm: **CONTROL PROCESS EASIER**

Combination of both methods could be recommended: VDLUFA-2007 Standpunkt Nährstoffbilanzierung)

Organic fertilizers vary in nutrients content , share of nutrients, nitrogen losses. Rate of mineralization of organic fertilizers and organic matter only can be projected. Intensive experience and tools are available to make best estimates for various situations.

GOOD ADVICE IS NECESSARY

ANIMAL PRODUCTION SHOULD NOT EXCEED
CERTAIN DENSITY IN AN AREA: -
OFTEN INTENSIVE ANIMAL PRODUCTION AND LIGHT SOILS

Key pollutants from Agriculture

Phosphate

- P – is delivered to the topsoil from the soil substate (average P content in the earth crust 0,05%)
- P- fertilizer mainly originate from minerals (raw phosphates - sourced from Florida, Russia, China, Marokko) and organic fertilizers (Guano, manure)
- P – is bound in the soil in organic (25 to 65%) and inorganic forms.
- Crop uptake of P varies by crop.
  Example Winterwheat yield 80 dt ha: 28 kg P in the grain + 10 kg P in straw and roots

P is not very water soluble and quickly bound to soil particles.
Transfer to water is mainly through surface runoff and erosion

Key pollutants from Agriculture

Phosphate

- Phosphate in water stimulate algae growth
- Decomposition processes consume oxigen
- Anaerob conditions lead to more release of P, which negatively effects the aquatic life
- Farmers are oblighed to check P content in their fields once in 6 years (DE)
- P surplus in the topsoil should not exceed 9 kg/ha

P – entries to water was reduced by 71% between 1985 and 2005 in Germany mainly due to the replacement of P in detergence and better sewage plants.
The reduction achieved from agricultural sources is estimated low with about 1%. (Estimate from UBA)

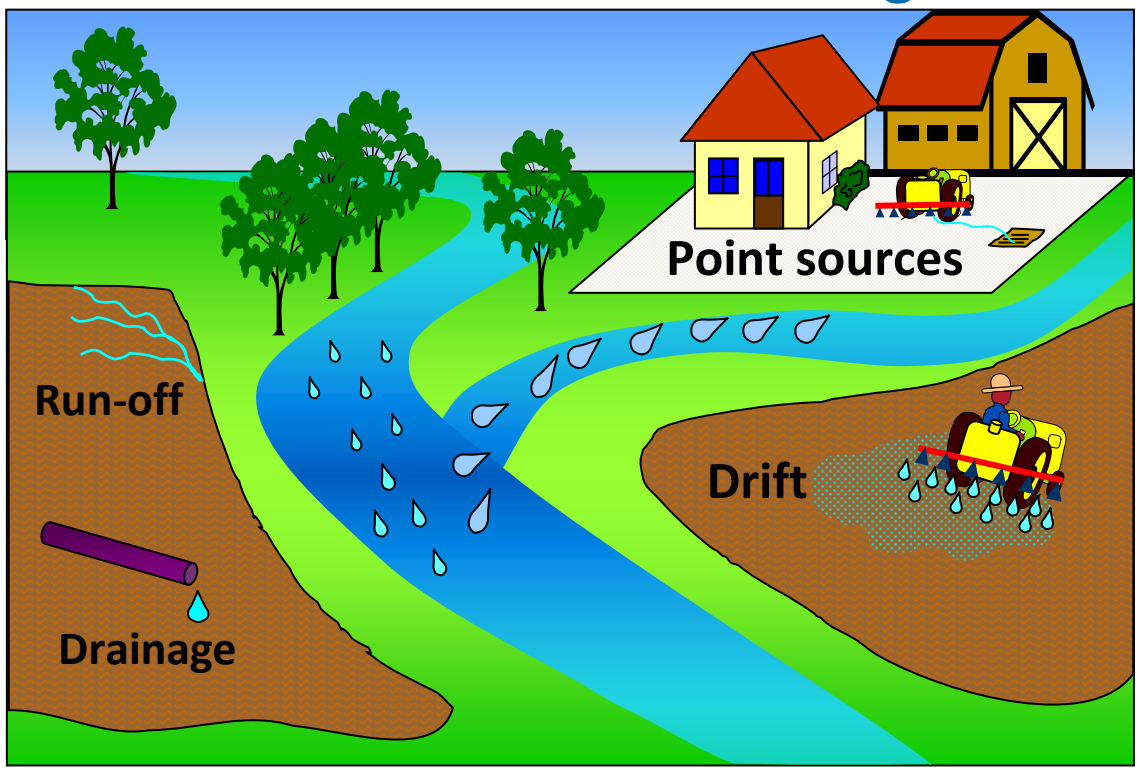
Key pollutants from Agriculture

Pesticides

- The WFD and the SUD (Directive on sustainable use of pesticide) gave stronger focus to the use phase of plant protection products (PPP)
- Result was the start of european wide TOPPS projects, supported by the EU commission (Life) and ECPA. Focus was given first to the mitigation of point sources and now to diffuse sources: runoff and spray drift.
- Projects are realized as multistakeholder projects in EU countries with local experts and partners. Focus is on the development, dissemination and implementation of Best Management Practices to mitigate contamination of water from pesticides.

PPP differ in their chemical and physical behavior
(water solubility and adsorption to soil particles).
Mitigation measures therefore integrate also those needed to mitigate water pollution from Nitrogen and Phosphate

Main entry routes of pollutants to surface water from agriculture



Diffuse sources

> 50 % Point source

TOPPS prowadis
7 EU countries

15 EU countries

POINT SOURCES ARE ALSO RELEVANT FOR ORGANIC AND MINERAL FERTILIZERS – MITIGATION MEASURES DIFFER

RBM – PLANS OFTEN USE POINT SOURCE ONLY FOR INDUSTRY AND URBAN ENTRY ROUTES

Overview point sources

Training Materials for Advisors/Farmers

- BMP – booklets
- Farmer flyers (17 languages)
- Trainerhandbook (pp 79)
- Delegate Handbook (pp20)
- Powerpoint presentations in 15 languages
- Demonstation ideas brochure
- Cleaning broschure
- Bioremediation brochure
- Picture Gallery for advisors
- Training video orchard sprayers
- Training video fieldsprayers






Mitigation concept for diffuse sources

Diagnosis

Determine runoff risk in catchment + field

+

Toolbox of measures

Select risk + farm adapted set of measures

=

Best Management Practices

Recommend in field and if necessary out of field measures

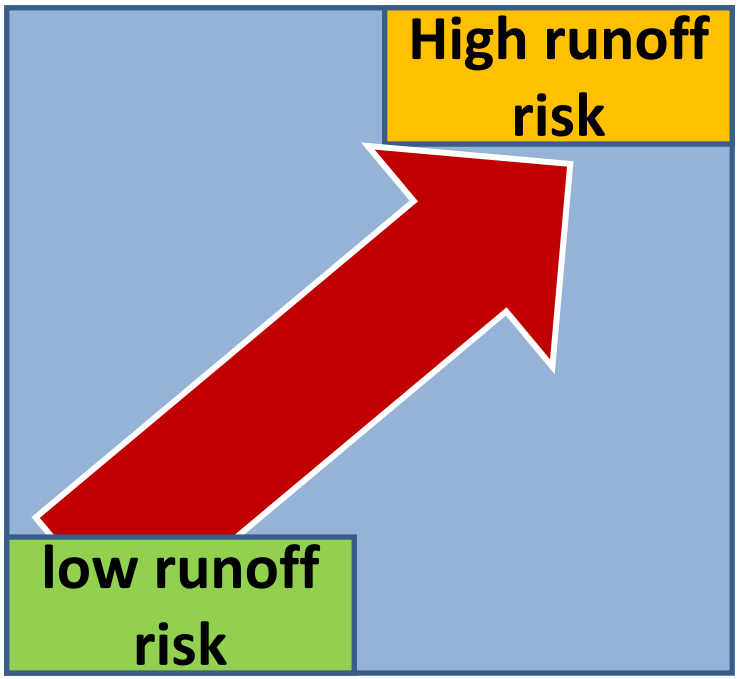
How runoff looks like

Source : G.Le Hénaff - IRSTEA

Basic runoff risk -Infiltration restriction

Rain intense (big volume in short time)

Rain less intense (volume in long time)



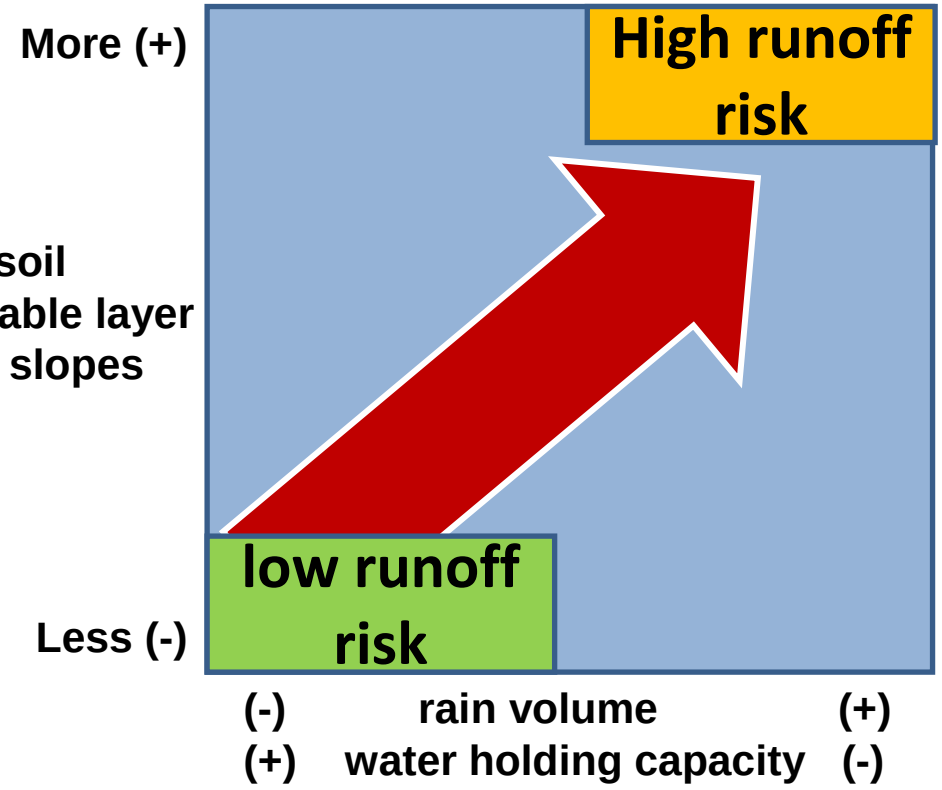
No capping soil; soil surface **permeability high**

Capping soil; soil surface **permeability low**

…. More a rain intensity problem (autumn vs spring summer)

Basic runoff risk-Saturation excess

- Shallow soil
- impermeable layer
- Concave slopes



…. More a rain volume and water storage capacity problem (winter)

Challenge is to make the diagnosis

- **Complexity of decisions need to be reduced that advicers can perform the diagnosis and the farmer can understand it.**
- **Availability of data: Elevation maps, soil maps, field maps, soil information, weather data, farming practices are helpful.**
- **Possibility to close data gaps by own field evaluations /estimates**
- **Two levels of diagnosis: catchment + field**
- **Risk estimation for runoff is correct in most cases**

Decision tree concept (dashboards) focus on key elements to analyse the water pathways and to determin the runoff type and risk

Dashboard example

Diagnosis of Runoff & Erosion for Infiltration excess

Step 1 – Proximity of Field to Water Body	Step 2 - Slope of the Land	Step 3 – Permeability of the Topsoil		
		High	Medium	Low
Adjacent	Steep (>5%)	Medium – I3	High – I4	High - I7
Adjacent	Medium (2-5%)	Low – I2	Medium – I3	High – I6
Adjacent	Shallow (<2%)	Very Low – I1	Low – I2	Medium – I5
Not Adjacent	Step 4 – Transfer Likelihood Diagnose likelihood of runoff transfering downhill to the next field and then to surface water	Very Low – T1	Very Low – T2	High – T3
Not Adjacent		Downhill Transfer Unlikely	Transfer Likely but not to Surface Water	Transfer Likely to Surface Water

Permeability Classes & BMP for Productivity & Protection by Runoff & Erosion Scenario

Permeability Classification	General BMP Measures	BMP for Very Low (T1, T2, I1)	BMP for Low (I2)	BMP for Medium (I3, I5)	BMP for High (T3, I4, I6, I7)

Dashboard based on TOPPS partner contributions, Arvalis ,Irstea and Syngenta adv. framework

Field diagnosis: Proximity to water is not only related to distance but also to speed of water flow.

agroselviter
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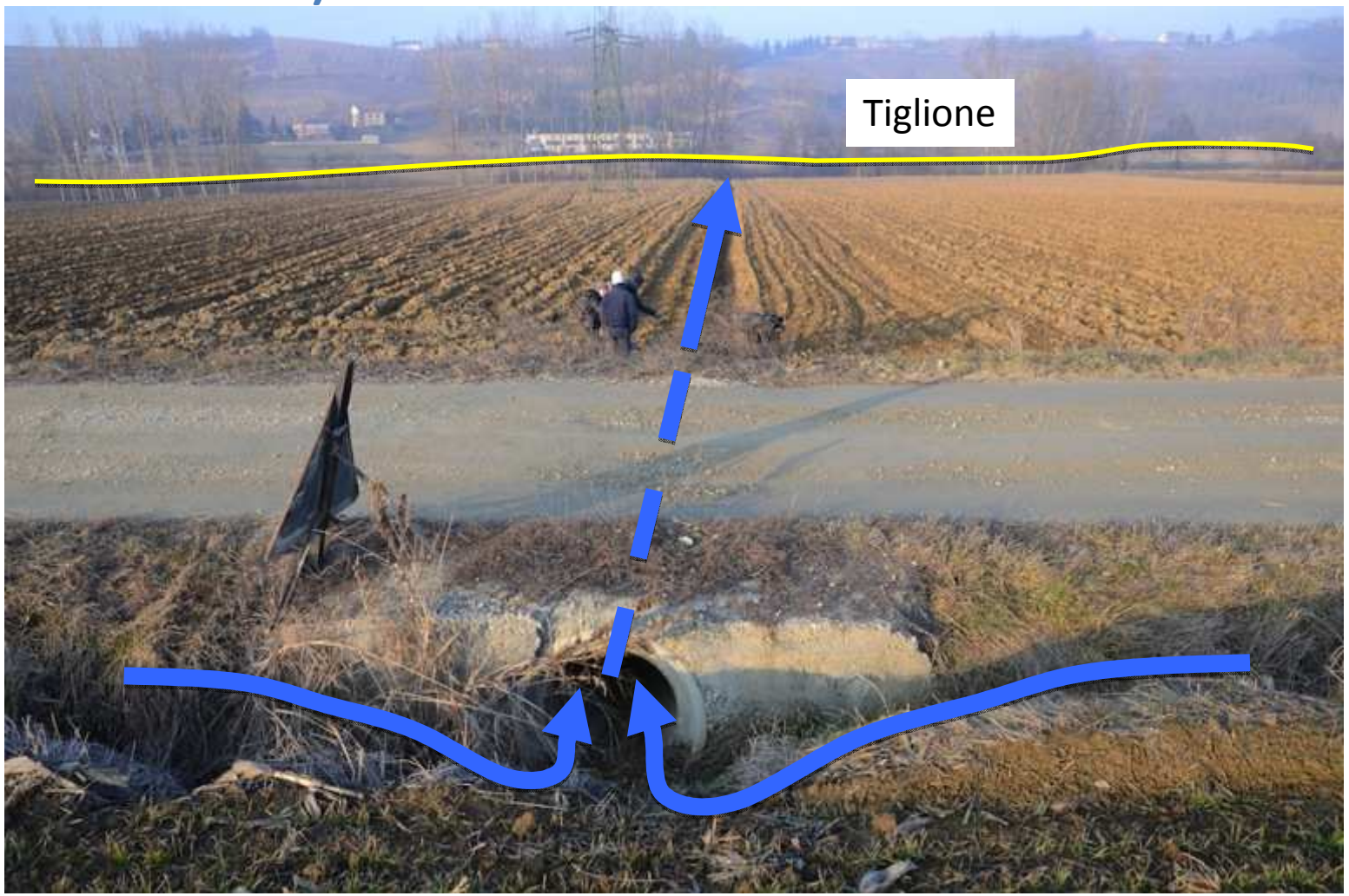
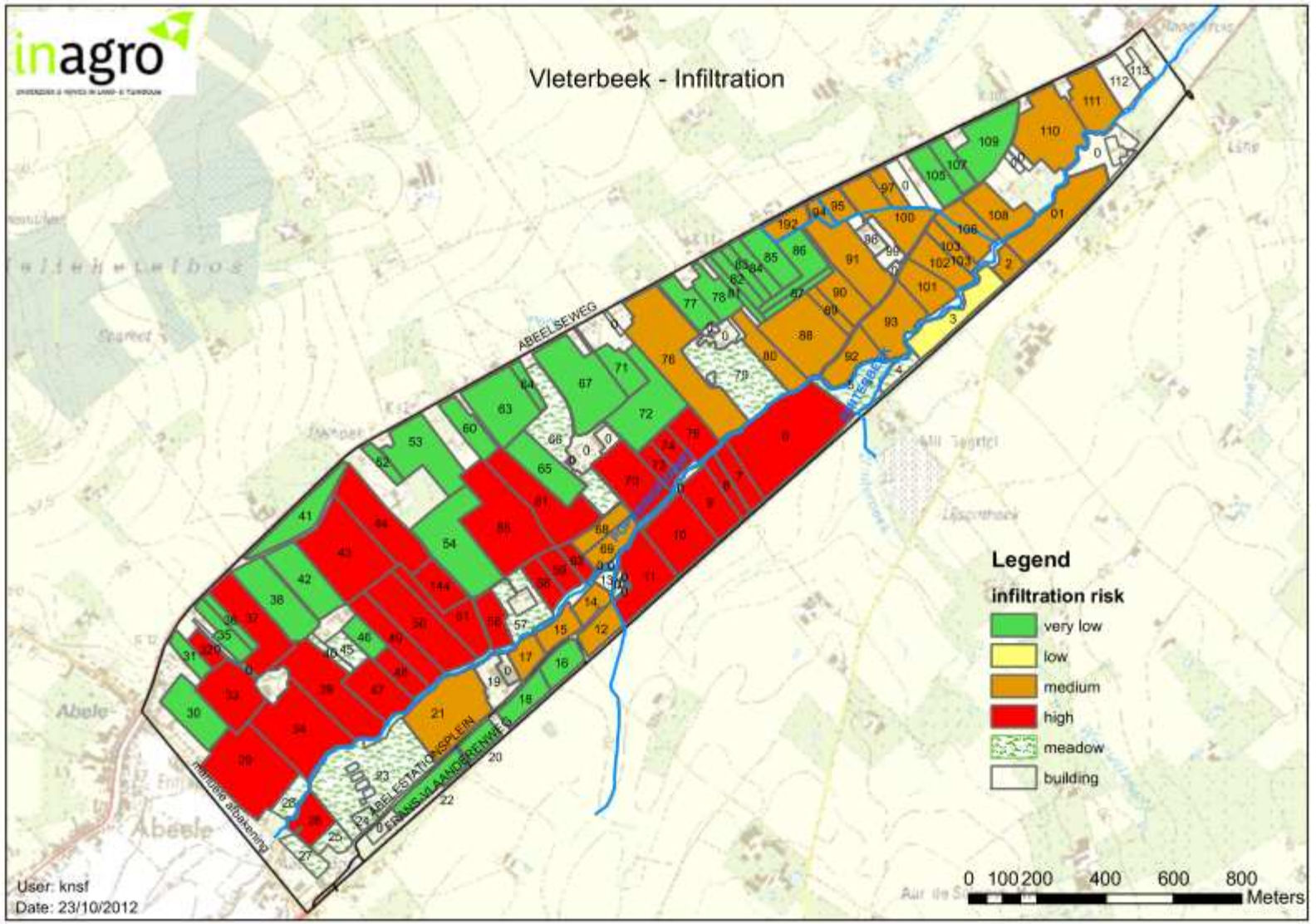
Presence of short cuts (direct connection between hillside zone and river)



Vleterbeek pilot catchment BE

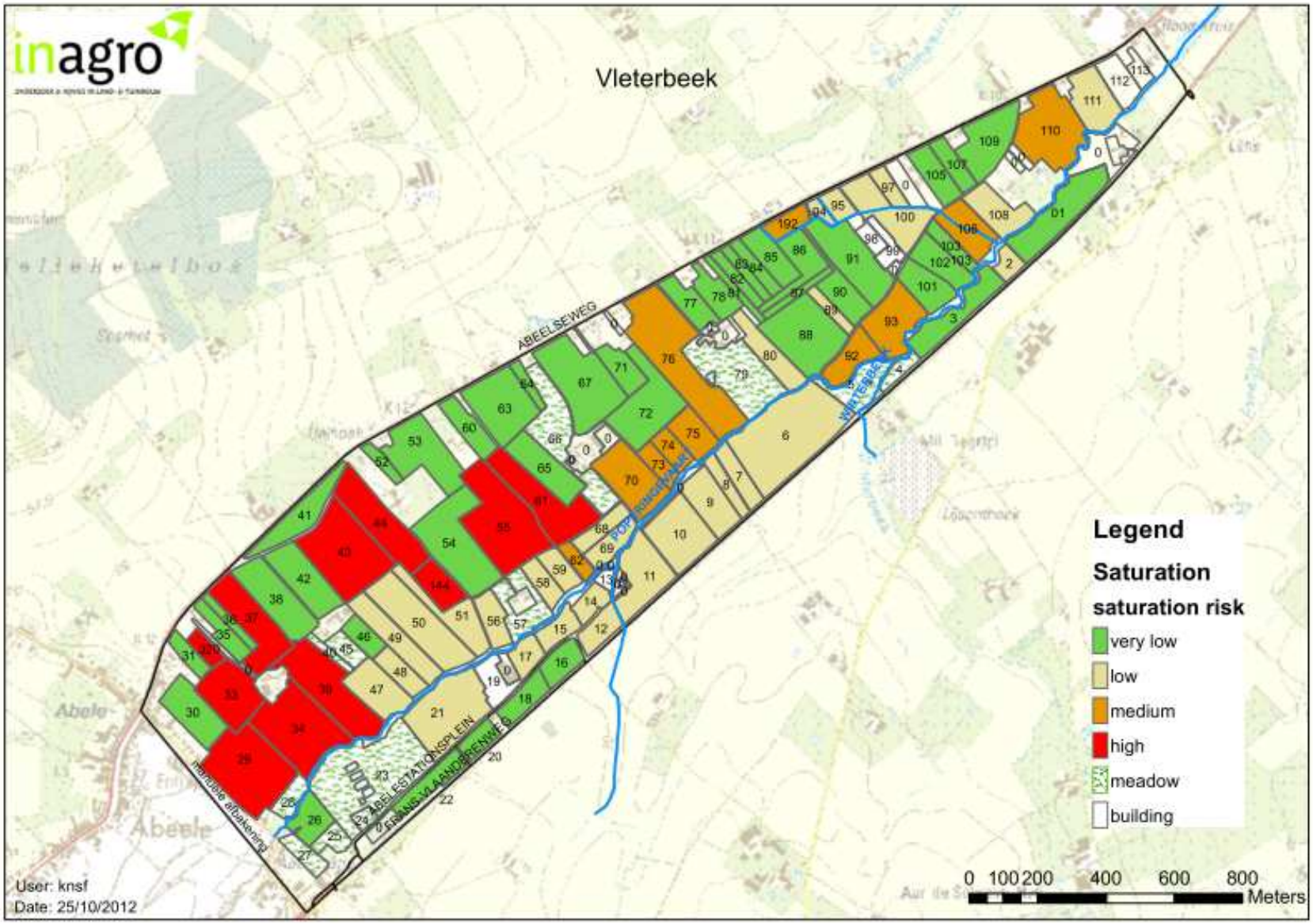
Results Vleterbeek catchment

1. Runoff risk levels due to infiltration restriction



Results Vleterbeek catchment

2. Runoff risk levels due to saturation excess



Vleterbeek catchment

Additional mitigation measures which will be implemented

Mitigation measures

Two basic principles for mitigation measures

I.Increase infiltration capacity of soil for water

- Break permeability restrictions
- Slow down water flow
- Improve soil structure
- Increase organic matter

II.Trap sediments

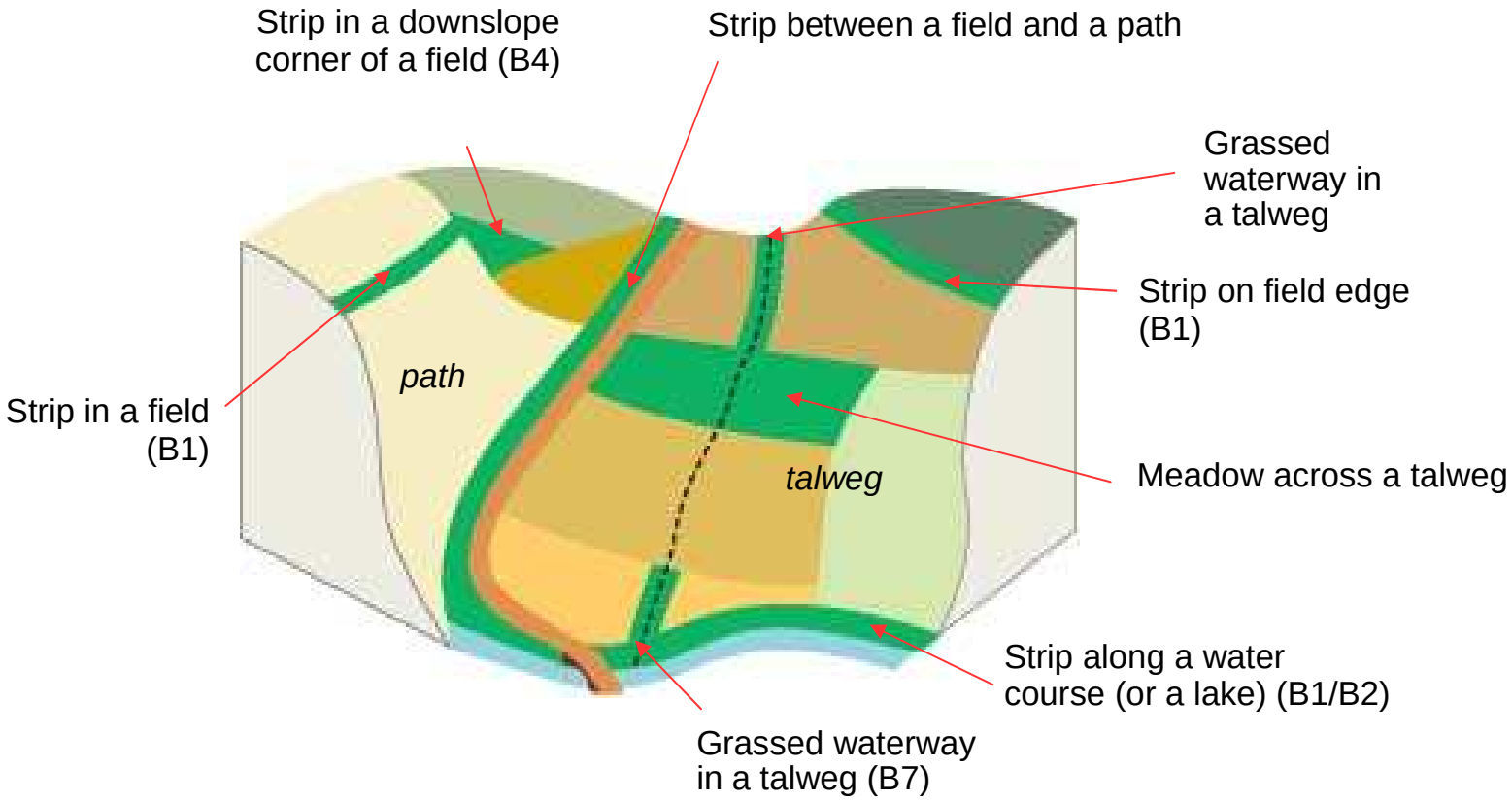
- Slow down water flow
- Provide structures to capture the sediments

a) Keep runoff water in the field as far as possible
b) If runoff water exit the field implement mitigation measures to keep the water in the catchment

Mitigation measure toolbox

Soil management	• Reduce tillage intensity • Manage tramlines • Prepare rough seedbed • Establish in-field bunds	• Manage surface soil compaction • Manage subsoil compaction • Do contour tilling/disking
Cropping practices	• Use Crop rotation • Do strip cropping • Enlarge headlands	• Use annual cover crops • Use perennial cover crops • Double sowing
Vegetative buffers	• Use in-field buffers • Establish talweg buffers • Use riparian buffers • Use edge-of-field buffers	• Manage field access areas • Establish hedges • Establish/maintain woodlands
Retention structures	• Use edge-of-field bunds • Establish veget. ditches	• Establish artificial wetlands/ponds • Build fascines
Adapted use of pesticides & fertilizer	• Adapt application timing • Optimize seasonal timing	• Adapt product and rate selection
Optimized irrigation	• Adapt irrigation technique	• Optimize irrigation timing and rate

Buffer positioning and sizing in the landscape important



Pictures: USDA, Arvalis

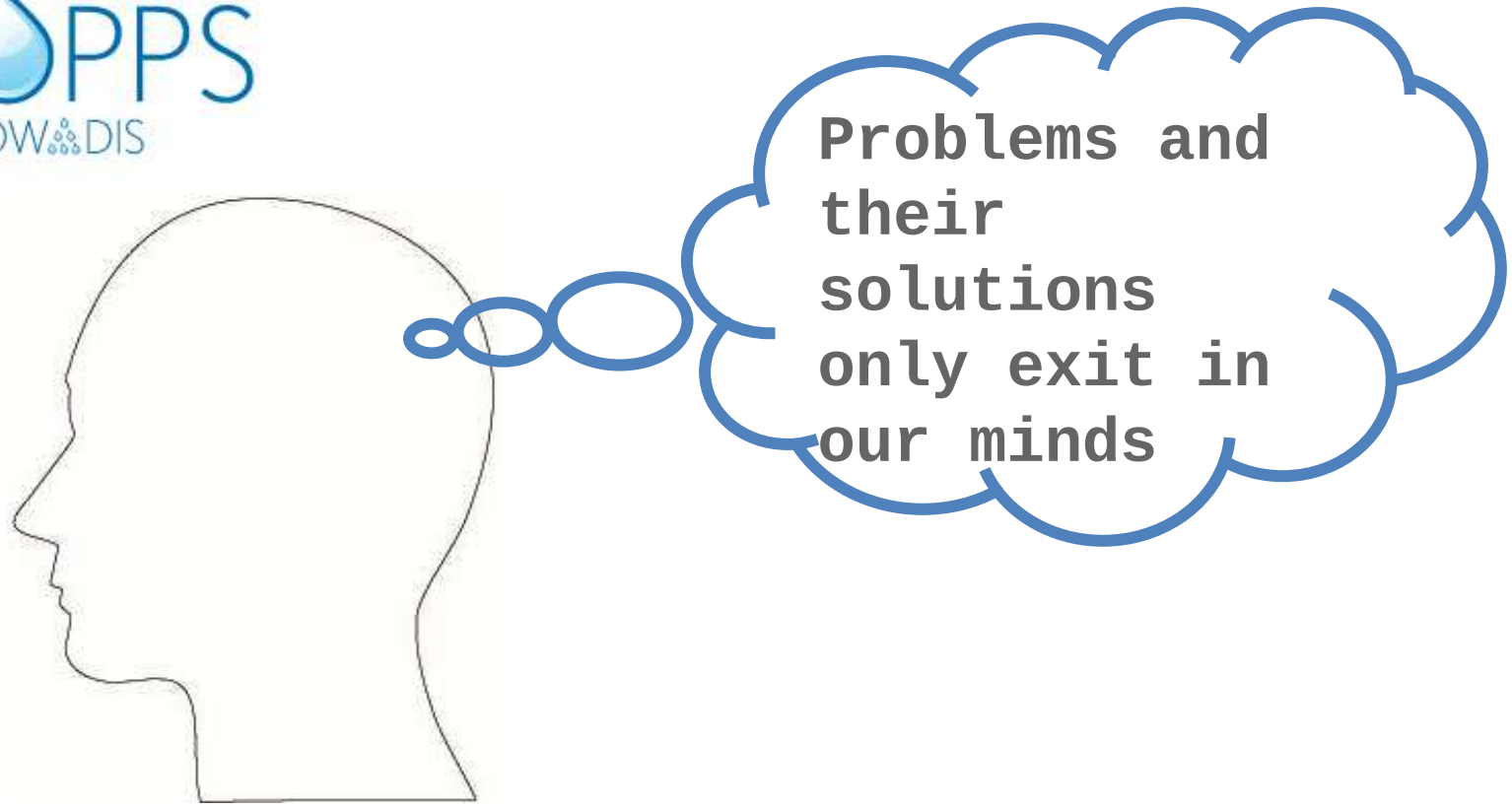
No tillage

tillage

TOPPS PROWADIS

…. we have not a knowledge problem

…. we have implementation problems



Better water protection starts in the mind of people

Thanks for your attention