Best practices to minimize runoff pollution

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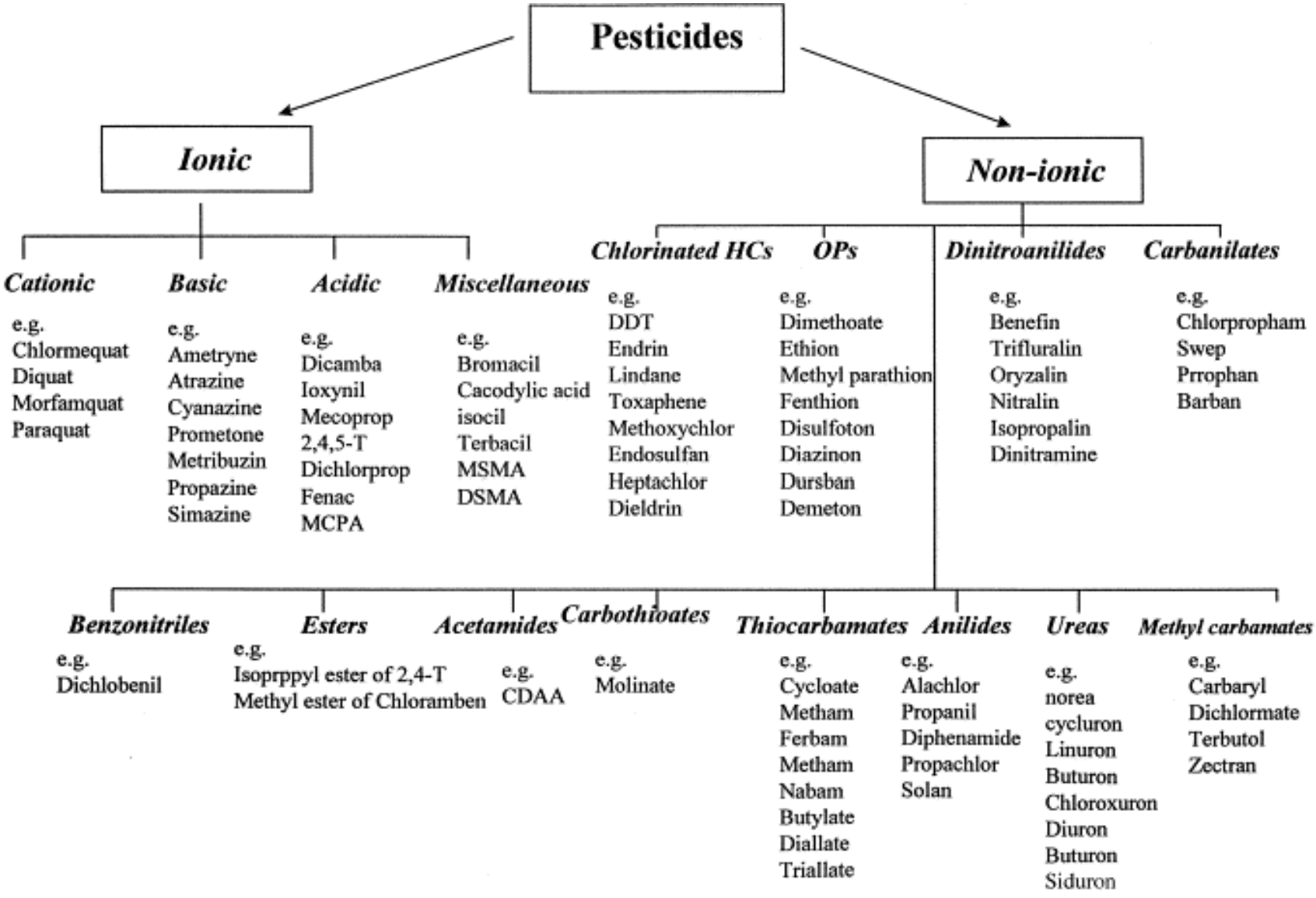
Surface runoff occurs when there is more water than soil can absorb
Erosion by water is caused by runoff

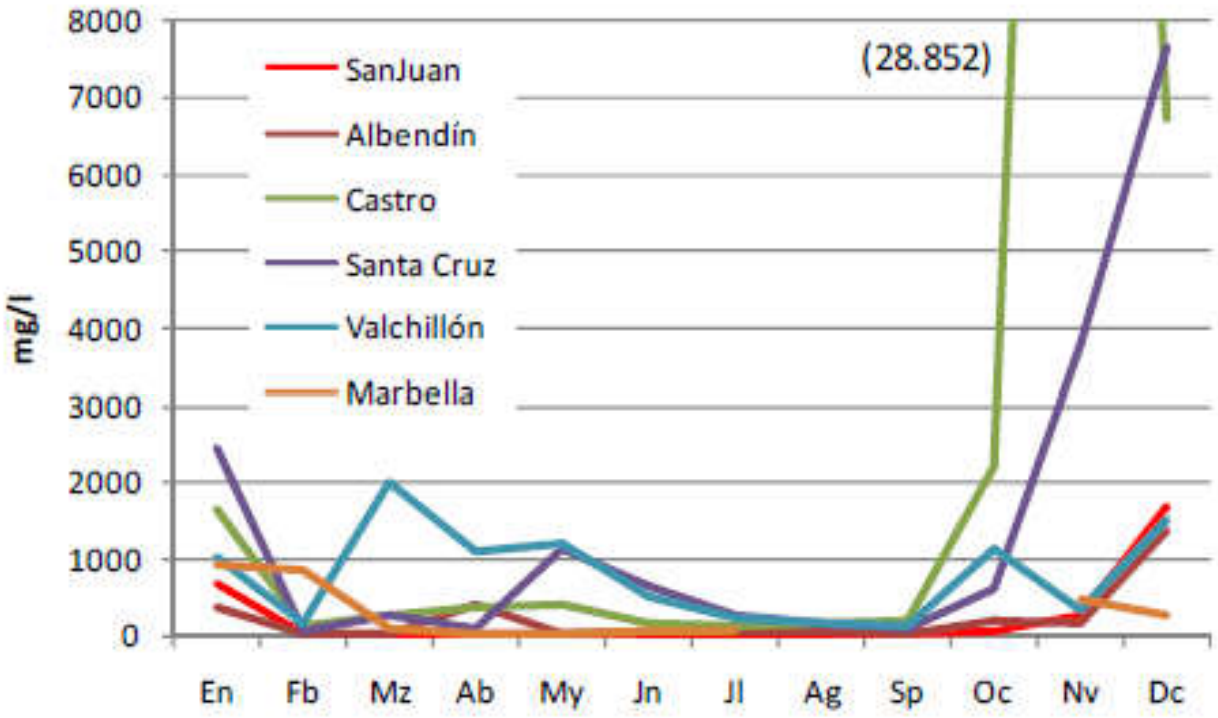
www.topps-life.org

European Crop Protection



(Arias-Estevez et al, 2008)

Keep an eye on sediments



- Sediments in the Guadajoz river (mg/l) accross the year.
- Bare soil and rainfall: runoff.

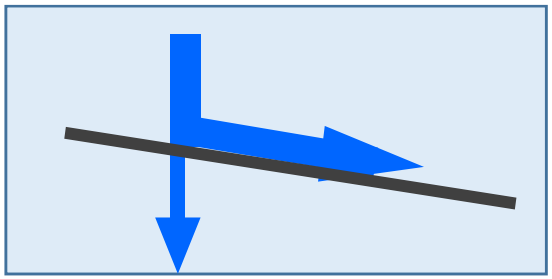
Source: Confederación Hidrográfica del Guadalquivir

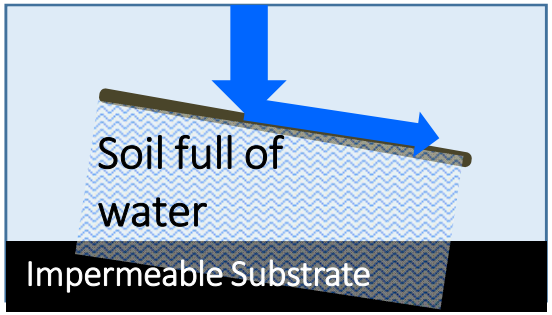
Types of runoff

Surface runoff

1. Infiltration restriction:
volume of rain > than soil infiltration

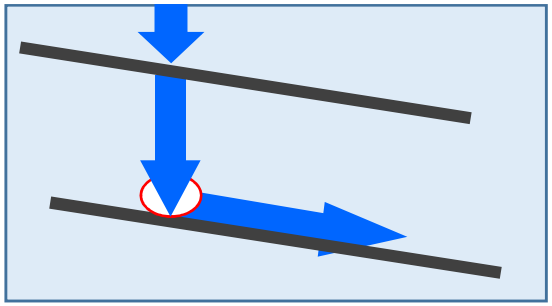
2. Saturation excess (mainly winter):
water holding capacity is full





Subsurface runoff

Lateral soil seepage
impermable layer / artificial drainage




10cm
25cm
30cm

Specific for plant protection products (PPP)

- Most important for PPP transfer is the **time between application and the rain / runoff event**. Risk is reduced the bigger the time intervall.
- The longer **PPP is in contact with soil** the more can be **degraded**. Entries from drainage lower risk than from surface runoff.
- **Transfer route depends on PPP chemical and physical behavior**
  - Water solubility (transfer mainly in the water phase)
  - Absorption on soil particles (transfer mainly with soil particles). Erosion control.
- Drainage is a special case of runoff
  (if drainage works generally no or reduced surface runoff)

Side benefit: PPP mitigation measures largely mitigate N and P entries to surface water

How does runoff look like
Infiltration restriction or saturation excess

Source : ARVALIS

Source : J.Maillet-Mezeray- ARVALIS

Source : E.Masson - ARVALIS

Source : JP Gillet- ARVALIS

How does runoff look like
Concentrated runoff

Source : G.Le Hénaff - IRSTEA

Source : G.Le Hénaff - IRSTEA

Source : ARVALIS

JMM - ARVALIS

Erosion comes along with runoff… Controlling runoff means reduced erosion

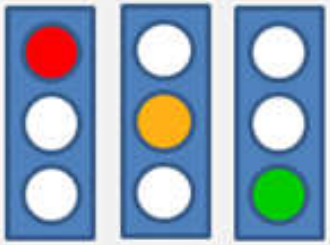
Source : J.Maillet-Mezeray- ARVALIS

Source : G.Le Hénaff - IRSTEA

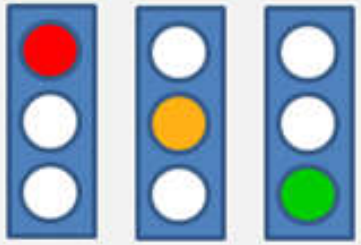
Best Management Practices – concept Stepwise process

Step 1
Diagnosis

1. Catchment
1,2,3,...



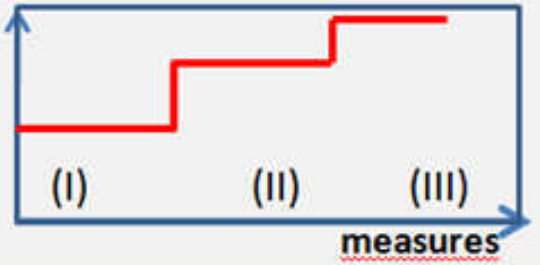
2. Field
1,2,3 ....



Step 2
measures / efficiency

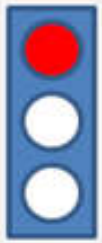
Location
Mitigation measures
Tools, methods
Management
Support / Funds

Reductions effekt %



Step 3
BMPs link Diagnosis + measures

from high risk



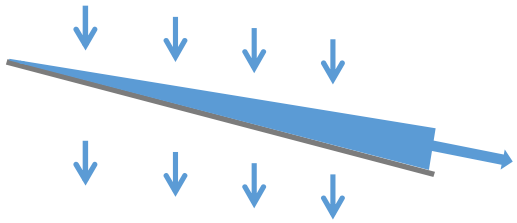
to

low risk

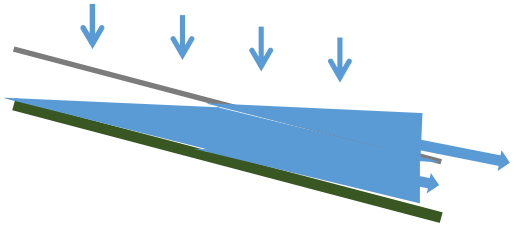
BMP = Diagnosis + adapted mitigation measures

Diagnosis considers two runoff situations

- Runoff by Infiltration Restriction – Surface Permeability Issue
  - Heavy texture / poor structure
  - Capping, crusting, compaction
  - High and short intensity storms
  - Low vegetative cover
  - All year long!



- Runoff by Saturation Excess – Subsurface Permeability Issue
  - Shallow soils
  - Impermeable layers
  - Concave slopes
  - Shallow wide valleys
  - Low but long rain
  - Mainly in winter or early spring!



Diagnosis: the first step to mitigate runoff

1

Prepare diagnosis:
Cabinet work: collection of relevant and key information of the area

2

Diagnosis in field

3

Identify risks

4

Selection of BMPs

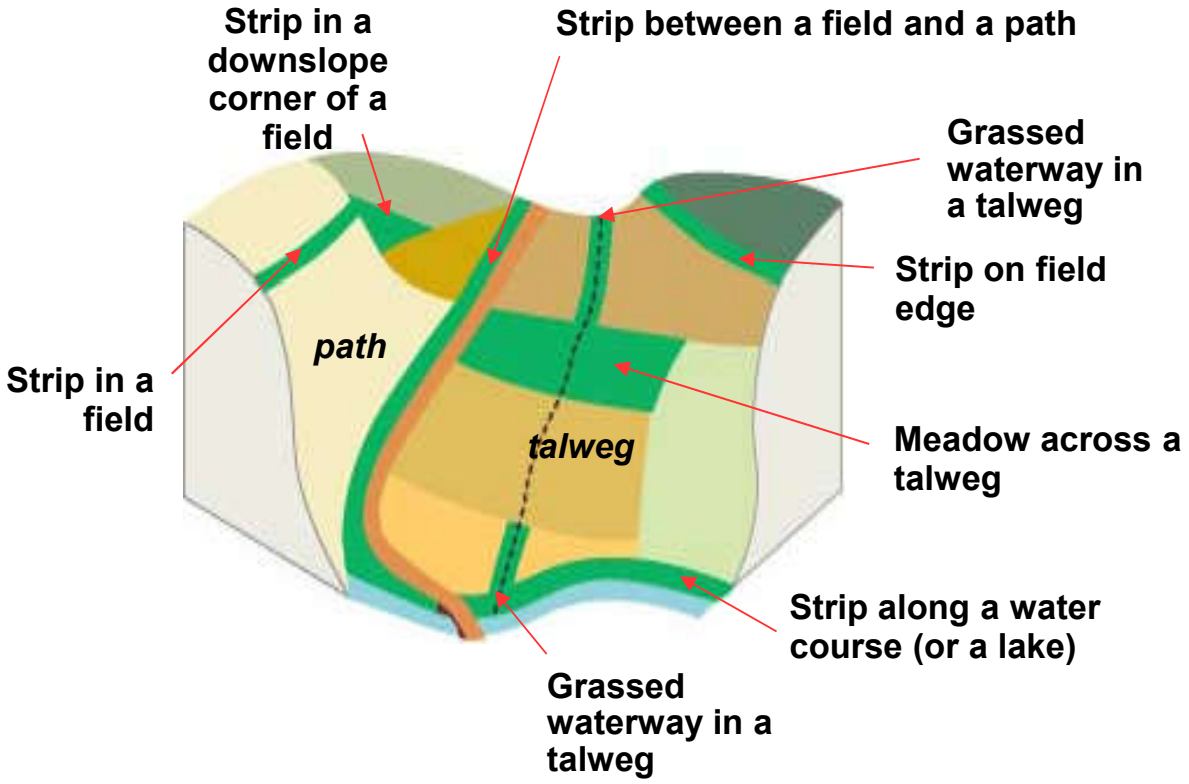
5

Adoption of BMPs by the farmer

Plot diagnosis

Determine the landscape factors

- Slope length
- Slope shape
- Talweg
- Natural buffers
- Field sizes

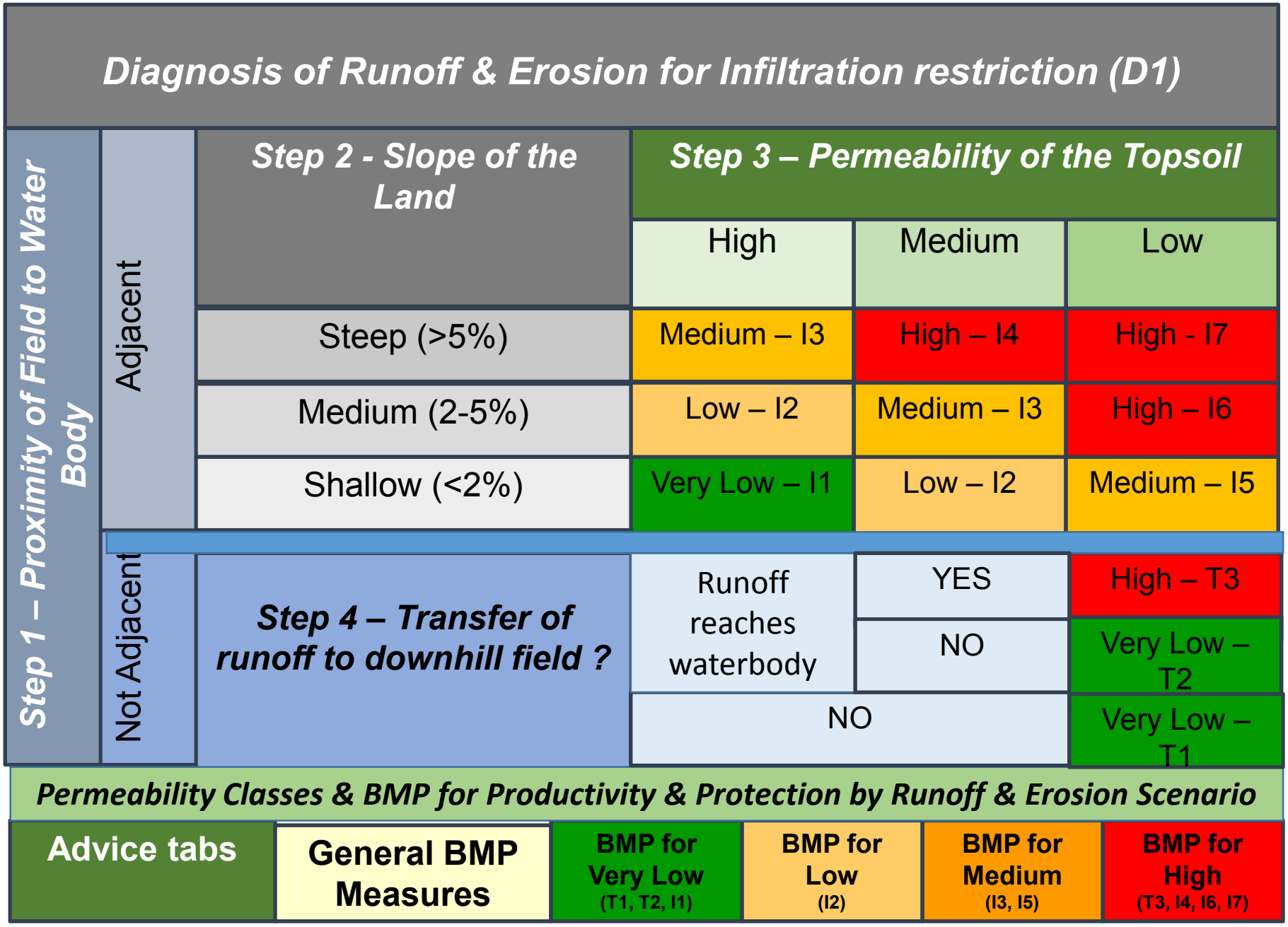


Determine the runoff risk Dashboard help tool

- Dashboards helps to make stepwise decisions giving focus to most important factors
- Decision is based on concrete data but also on expertise from adviser / farmer
- Runoff risk analysis combines implicit + tacit knowledge

Two main dashboards need to be considered for each risk analysis

1. **Runoff risk estimate for infiltration restriction (D1)**
2. **Runoff risk estimated for saturation excess (D2)**



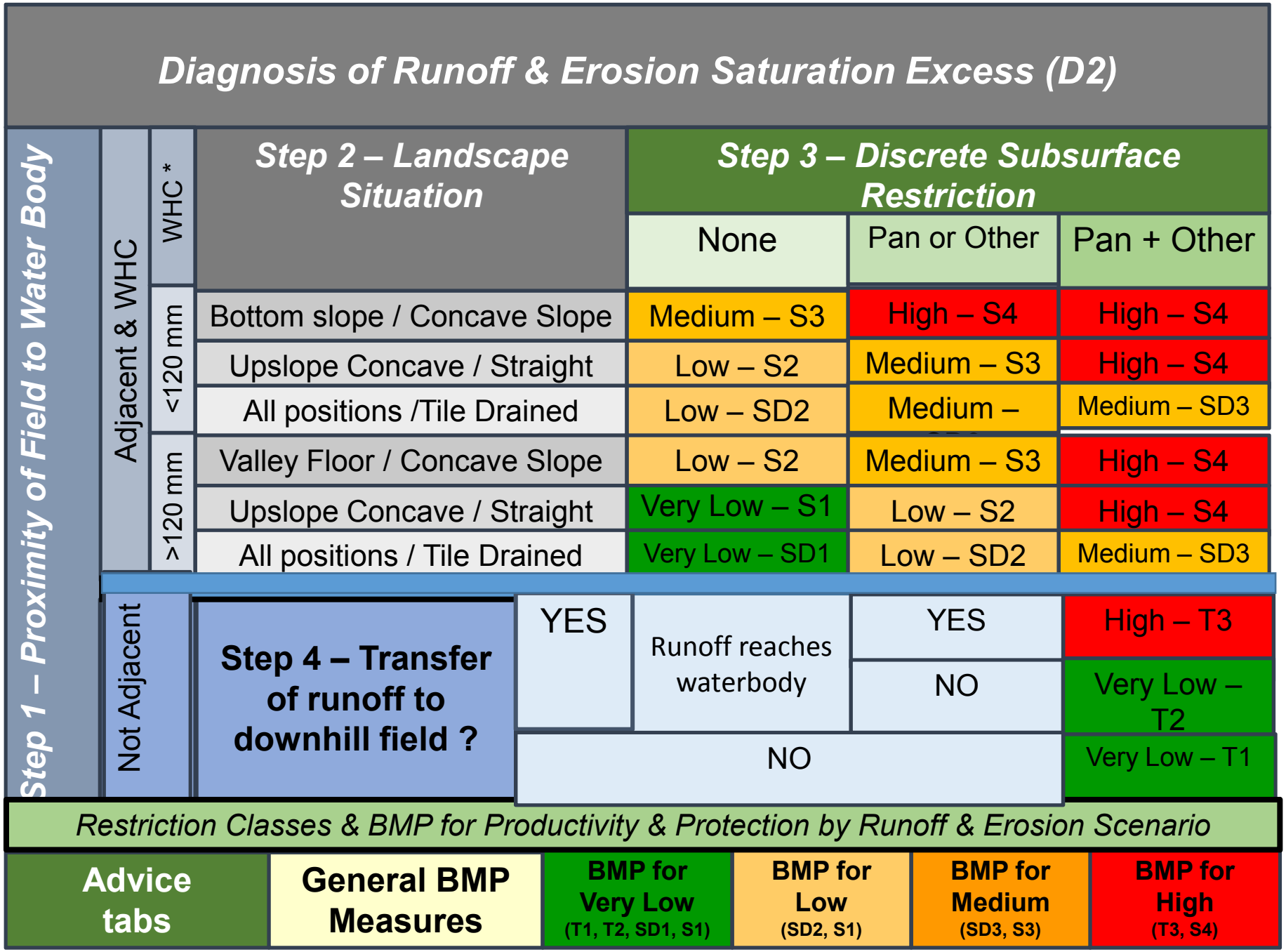
Source: TOPPS partners,

Risk Scenarios: Infiltration restriction (1)

Risk Scenarios	Mitigation targets
Transfer (T1) Very low risk	Maintain good agricultural practices in field to minimize runoff and erosion.
Transfer (T2) Very low risk	T1 & in case of large amount of runoff: stop at source to avoid fast infiltration in downhill plot (ground water protection). If runoff transfer to downhill plot is not acceptable, treat plot as if adjacent to water.
Infiltration (I1) Very low risk	Stop runoff at source using in-field measures and/or edge-of-field buffers OR ensure water infiltration in downhill plot / area by suitable measures (buffers, retention structures). In case of large amount of runoff: stop at source to avoid fast infiltration in downhill plot (ground water protection).
Infiltration (I2) Low risk	Reduce runoff at source using suitable in-field measures. If this is not possible, consider implementation of buffer zones (edge-of-field, in-field).

Risk Scenarios: Infiltration restriction (2)

Risk Scenarios	Mitigation targets
Infiltration (I3) Medium risk	Reduce runoff at source by using all suitable in-field measures. Furthermore, implement buffers (in-field, edge-of-field) or suitable measures at landscape level (e.g. talweg buffers, retention structure), especially for fields with spring crops, or when in-field measures not viable.
Infiltration (I5) Mediunm risk	Reduce runoff at source by using all suitable in-field measures. Implement buffers (in-field, edge-of-field) or suitable measures at landscape level (e.g. talweg buffers, retention structure), especially for fields with spring crops, or when in-field measures not viable.
Transfer (T3)	Stop runoff at source using in-field measures and/or edge-of-field buffers OR ensure water infiltration in downhill plot by suitable measures (buffers, retention structures). In case of large amount of runoff: stop at source to avoid fast infiltration in downhill plot (ground water protection).
Infiltration (I4, I6, I7)	Minimize risk for run off and erosion with all viable in-field measures, edge-of-field buffers, and landscape measures (buffers, retention structures). Combine effective measures to achieve maximum mitigation.



Source: TOPPS partners,

Risk Scenarios Saturation excess (1)

Risk Scenarios	Mitigation targets
Transfer (T1) Very low risk	Maintain good agricultural practices in field to minimize runoff and erosion
Transfer (T2) Very low risk	T1 & in case of large amount of runoff: stop at source to avoid fast infiltration in downhill plot (ground water protection). If runoff transfer to downhill plot is not acceptable, treat plot as if adjacent to water.
Saturation drainage (SD1) Very low risk	S1 & Risk of transfer via drainage water: Avoid application of susceptible pesticides during drainflow season (late autumn to early spring) and on cracked soils (spring/summer). If possible, retain drainage water in artificial wetlands/ponds.
Saturation (S1) Very low risk	Maintain good agricultural practices on field to minimize runoff and erosion.

Risk Scenarios Saturation excess (2)

Risk Scenarios	Mitigation targets
Saturation (S2 & SD2 -drainage) low risk	Reduce runoff at source using suitable in-field measures. If this is not possible, consider implementation of buffer zones (edge-of-field, in-field). See **D** for drainage risk and G for groundwater risk
Saturation (S3 & SD3 – drainage Medium risk	Reduce runoff at source by using all suitable in-field measures. Furthermore, implement buffers with willow (salix) hedges or suitable measures at landscape level (e.g. talweg buffers, retention structure), when in-field measures not viable. See **D** for drainage risk and G for goundwater risk
Transfer (T3) High risk	Stop runoff at source using in-field measures and/or edge-of-field buffers OR ensure water infiltration in downhill plot by suitable measures (wetland; ponds), retention structures). In case of large amount of runoff: stop at source to avoid fast infiltration in downhill plot (ground water protection).
Saturation (S4)	Minimize risk for run off and erosion with all viable in-field measures, edge-of-field buffers (buffers with willow (salix) hedges), and landscape measures (buffers, wet meadow, retention structures, wetlands). Combine effective measures to achieve maximum effect. If valley bottom or floodplain, see **G** for leaching risk to groundwater

D = Risk of transfer via drainage water: Avoid application of susceptible pesticides during drainflow season (late autumn to early spring) and on cracked soils (spring/summer). If possible, retain drainage water in artificial wetlands/ponds.

G = Risk of transfer to groundwater in alluvial floodplain. Follow product-specific advice to minimize inputs to vulnerable areas (shallow groundwater, sandy soils with low organic carbon)

Mitigation measures toolbox

(6 categories & 29 measures)

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	• Adapt application timing • Optimize seasonal timing	• Adapt product and rate selection
Optimized irrigation	• Adapt irrigation technique	• Optimize irrigation timing and rate

Número de Parcela:

Propietario: **Contacto:**

Cultivo:

Sistema de Manejo del suelo:

Características de la parcela

Acumulación de aguas provenientes de otra parcela

Puntos de concentración de escorrentía

Cerca de un cauce

Importantes pendientes

Existencia de bandas de seguridad

Esquema de la Parcela:

Caracterísrticas edafológicas y morfológicas

horizonte 1

Textura :

% de arcilla:

Pedregosidad:

Profundidad:

Costra superficial:

Grietas:

horizonte 2

Textura :

% de arcilla:

Pedregosidad:

Profundidad:

Costra superficial:

Grietas:

Profundidad del suelo:

Capacidad de retención de agua:

Permeabilidad:

Signos de hidromorfismo:

Diagrama del flujo de agua en invierno

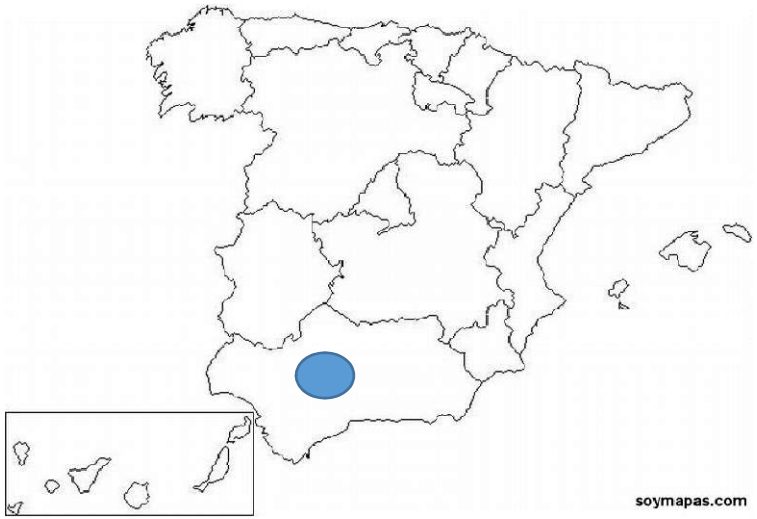
Diagrama del flujo de agua en primavera

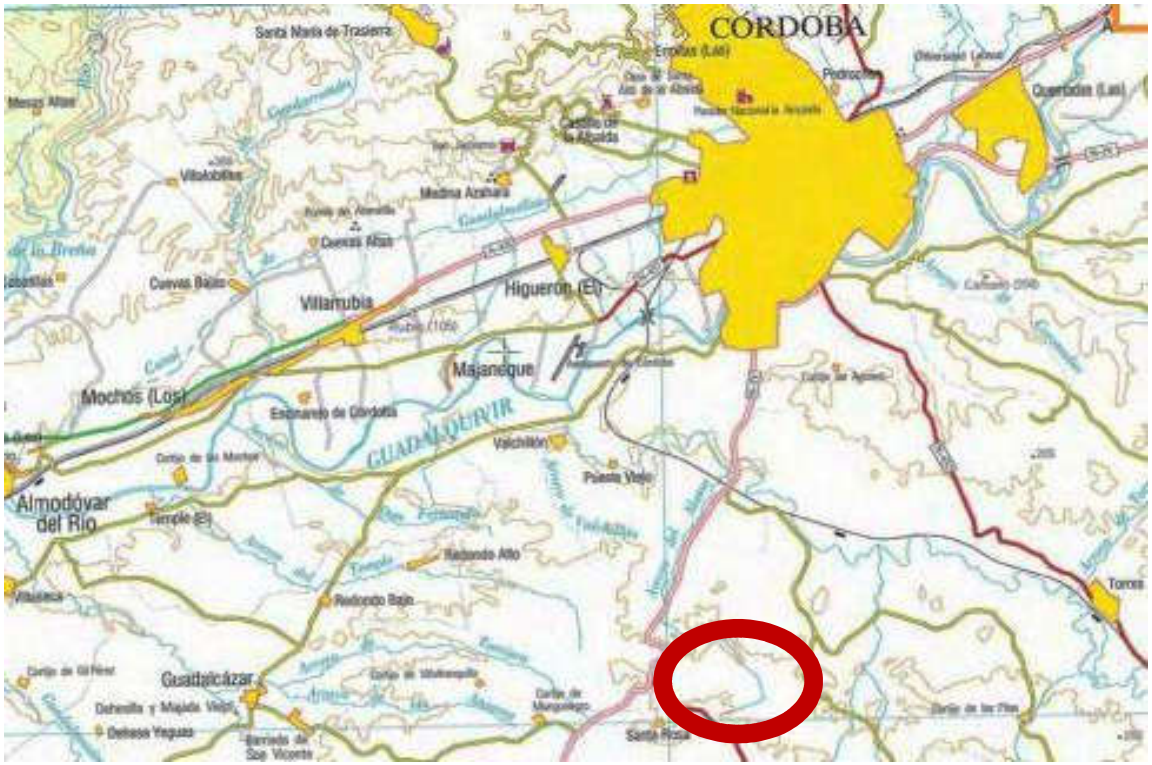
Diagrama del flujo de agua en verano

OBSERVACIONES:

TOPPS
Water Protection

Case study: Guadalcazar (Spain)



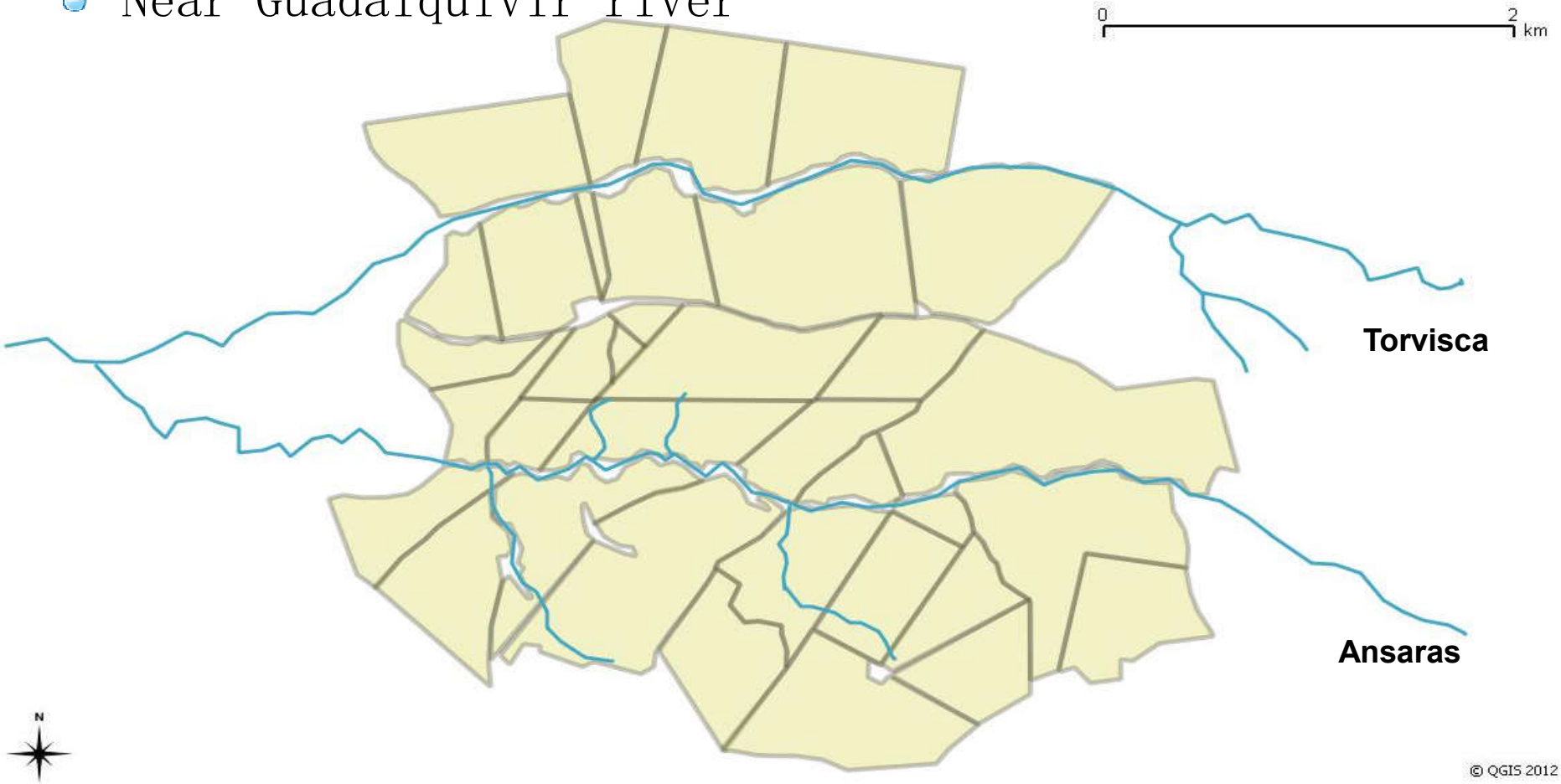


Field characteristics

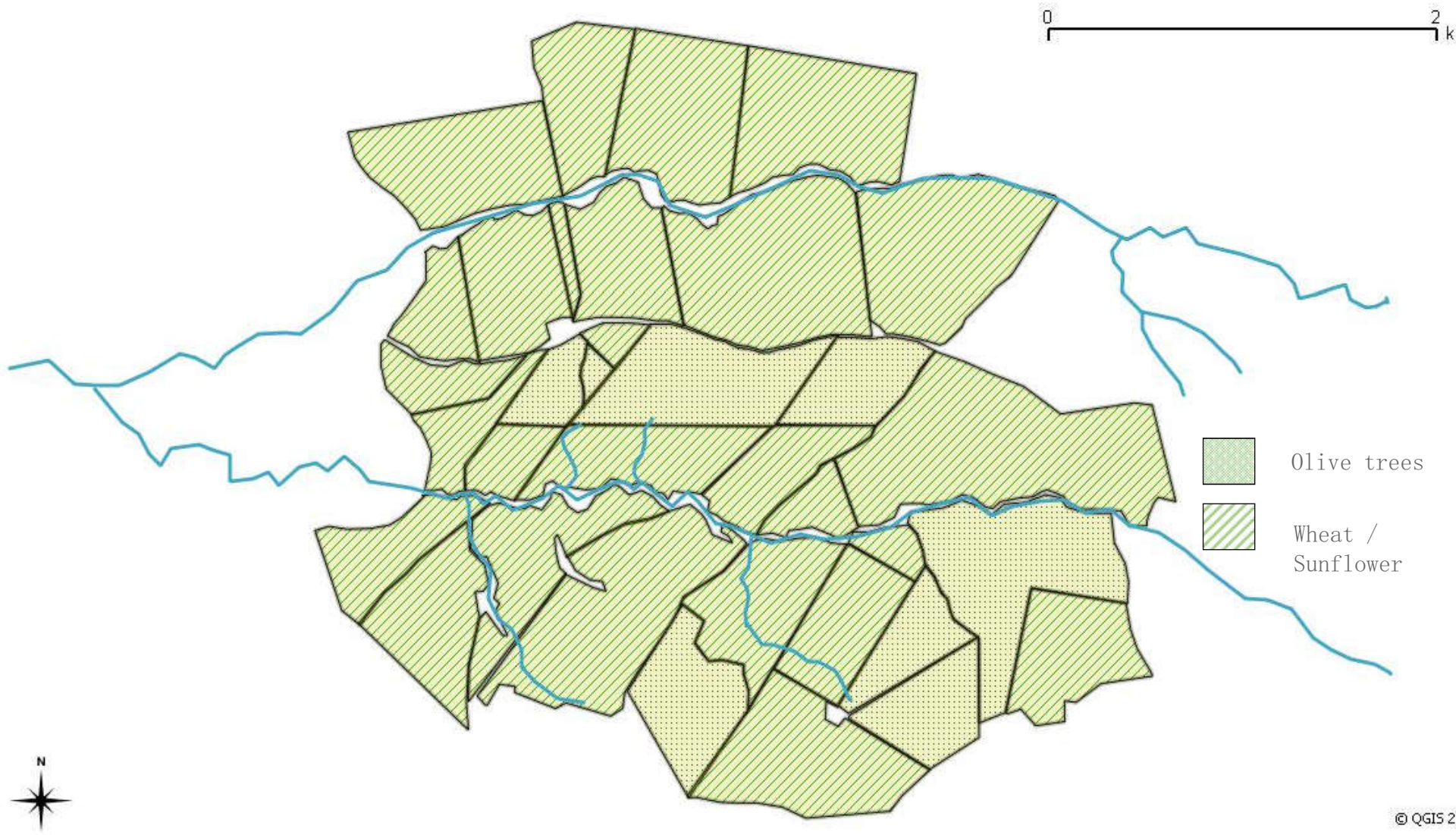
1.184 ha & 35 plots

Basin characteristics

- 2 water streams-non permanent (Ansaras & Torvisca)
- Near Guadalquivir river



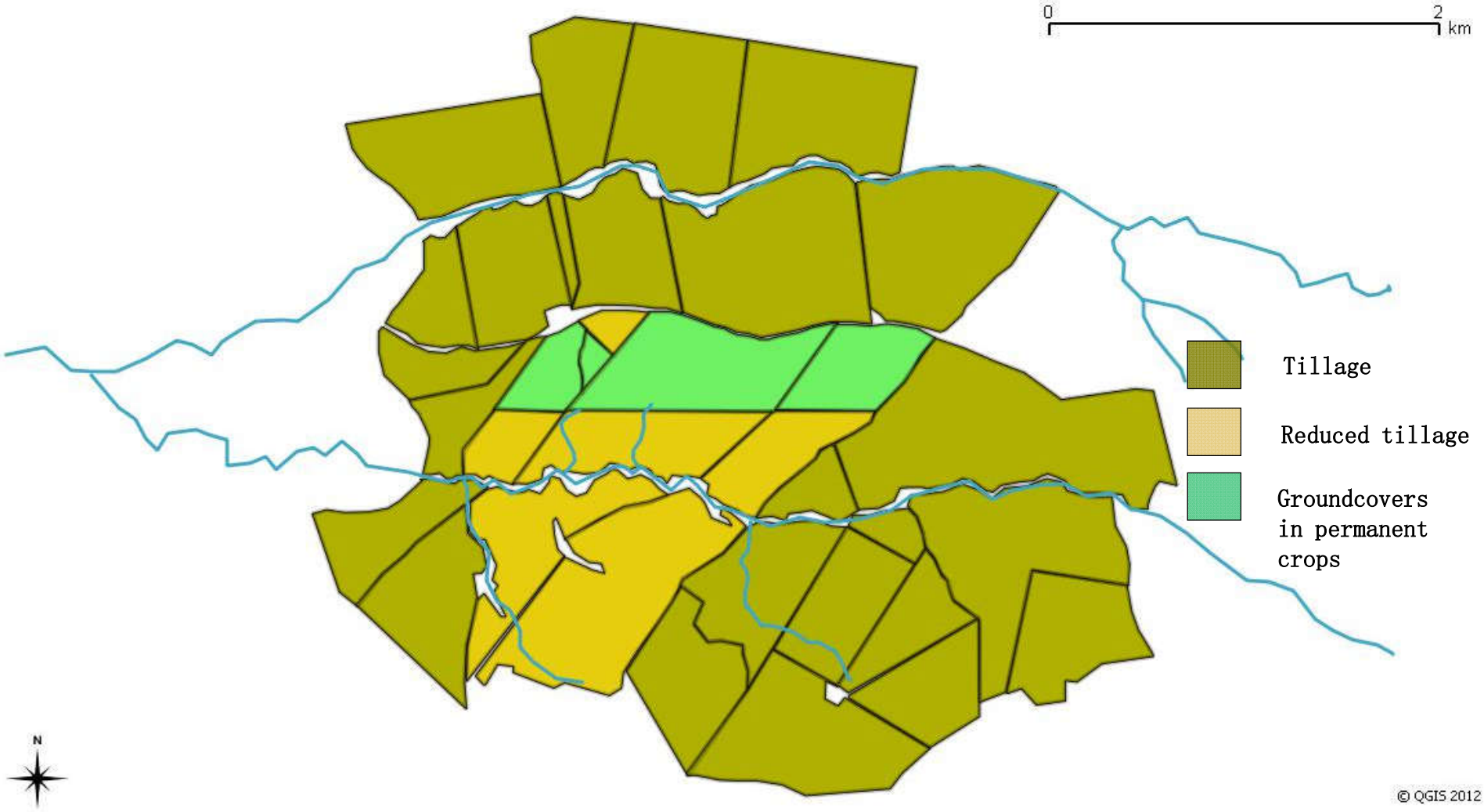
Basin characteristics



- Soil Management
  - 82% tillage
  - 7% groundcovers
  - 11% reduced tillage

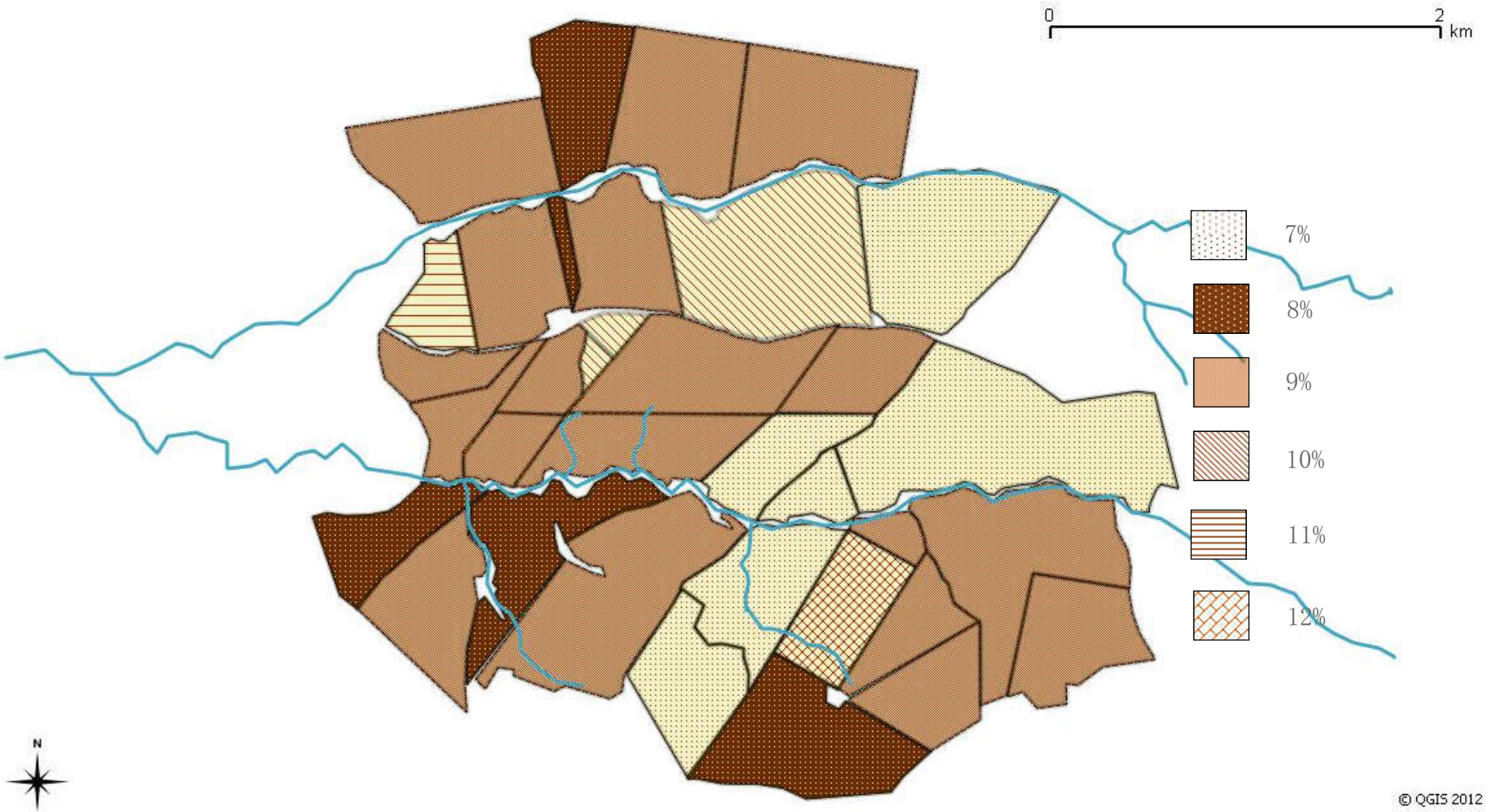
Basin characteristics

- Soil Management system

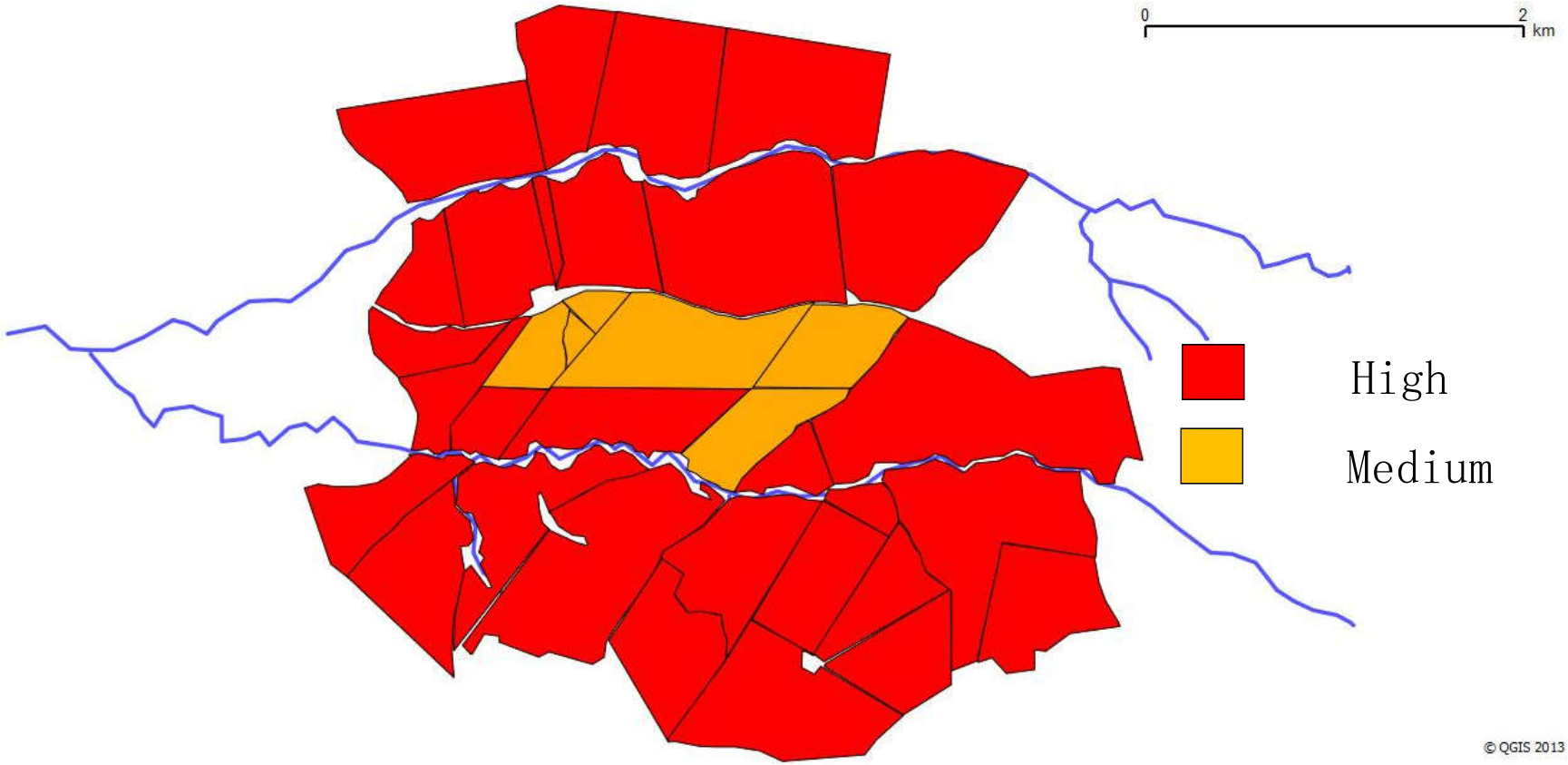


Basin characteristics

- Average slope 9%



Runoff risk



Mitigation measures toolbox

(6 categories & 23 measures)

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
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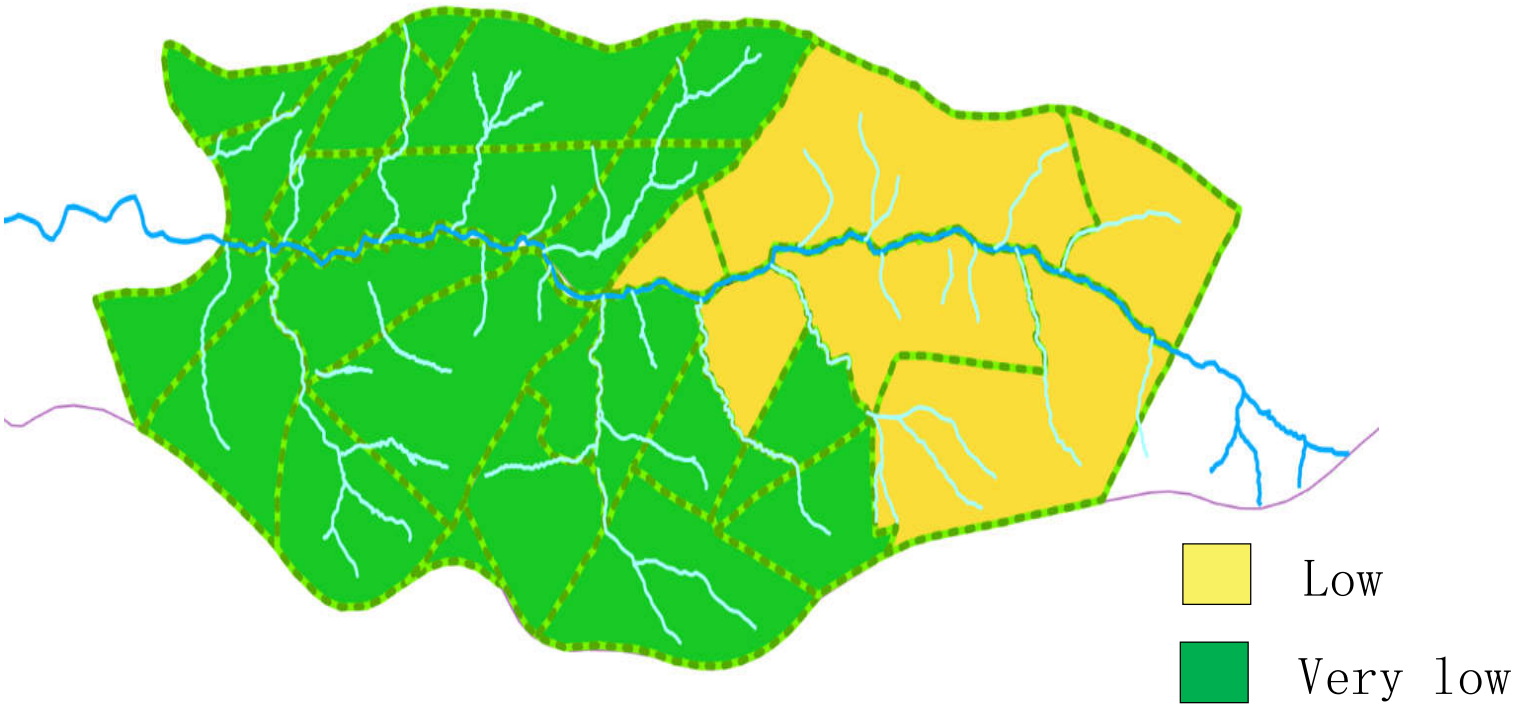
Optimized irrigation	• Adapt irrigation technique	• Optimize irrigation timing and rate

After implementing the BMPs

Runoff risk



TAKE HOME MESSAGES

- Runoff and erosion are interlinked processes.
- Soil erosion and runoff are a major cause for soil degradation, and may cause water pollution by pesticides.
- TOPPS' best management practices (for annual and permanent crops) are effective to prevent both problems and therefore avoid/minimize water contamination by PPP.
- Training farmers is essential.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