

diagnosis tools to optimize implementation of buffer zones in a watershed



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Brittany training, December 2011,



Cemagref will become soon **Irstea***

*What does it change
for Prowadis?*

Nothing!



What is a « regulatory » buffer zone?

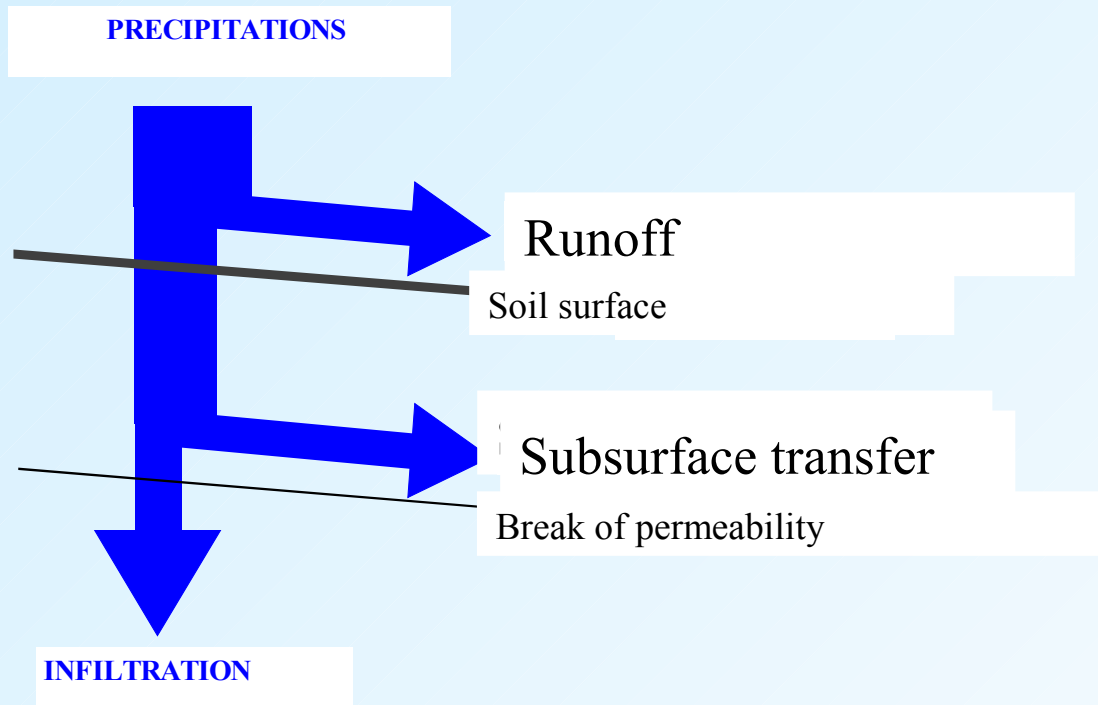
- Mainly, a **vegetated (grass) strip** (“model BZ”) along surface water bodies (river, lakes, ...)

The single position for *drift* control...



... but is it true for pesticide And is it the single possible *shape*?
interception in *runoff*? And the single vegetative *cover*?

The works and the publications of the CORPEN* on the hydric transfers and the environmental functions of buffer zones



Limitations of the CORPEN document

- **To be more developed**
 - The diagnosis
 - The sizing
- **To be added**
 - Wetlands as buffer

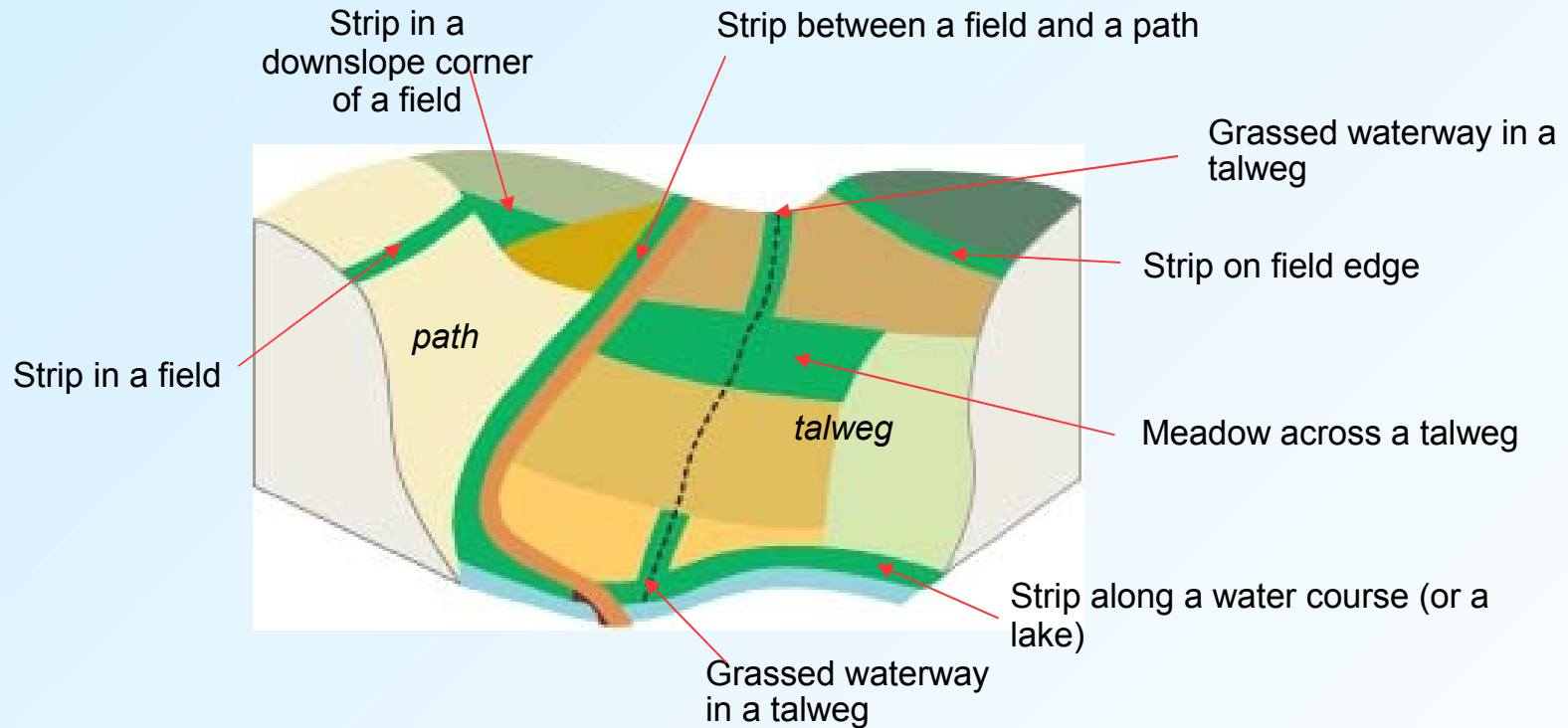


Constructed wet buffer
(Life Artwet program)

Storm basin
(Beaujolais)



Possible locations of buffers for runoff control in a watershed



(Ligneous or herbaceous cover)

Some non strip-shaped and/or non grassed buffers

*= commonly, land use for which the environmental role
is not the original purpose*



Meadow in a dale



Riparian forest



Wild land (*wood clearing*)



Poplar planting

Some non-riparian buffers



Edge of field



Meadow across a talweg



Hedges



Between field and road



In a downslope corner

Groundwater protection and buffer zones

Runoff can be a part of
the water pathway
to the aquifer:
BZ suitable on this part.

Buffer to be implemented
uphill of the infiltration zone
where soil is still quite deep
(available reserve > 100-120 mm)



(AREAS)

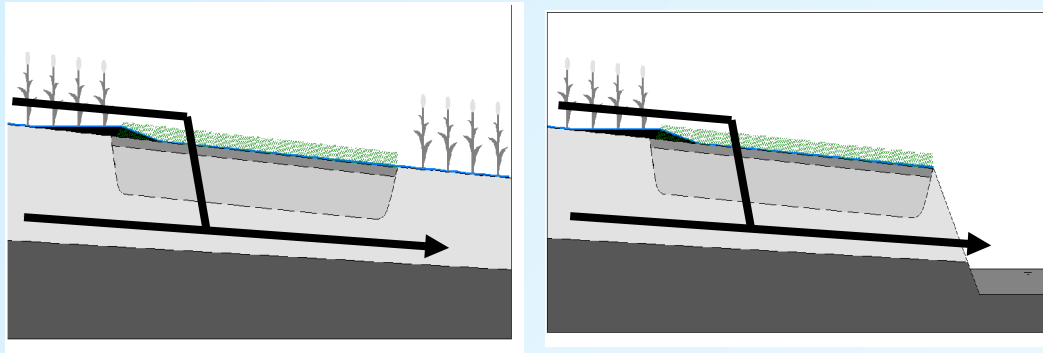
Sinkhole in Normandy



"cranette" – Le Perron

Why is a diagnosis necessary? Riparian vs. Slope buffers

Riparian buffers are potentially less efficient for runoff control



- *Often more humid*
- *More flow concentration*
- ← *Proximity subsurface transfer*

However, Riparian buffers are essential:

Drift control

Proximate protection

Sociological acceptance

Policies

➔ **How to solve this contradiction?**

Mitigation of pesticide transfer by runoff diagnosis tools to optimise implementation of buffer zones in a watershed

- **To use effectively buffer zones present**
or
- **to set up new BZ**
- **By adapting itself to the local situations to optimize their performances and their complementarities**

the guides of diagnosis « Buffers zones »

Initial frame:
hydraulic transfers of pesticides

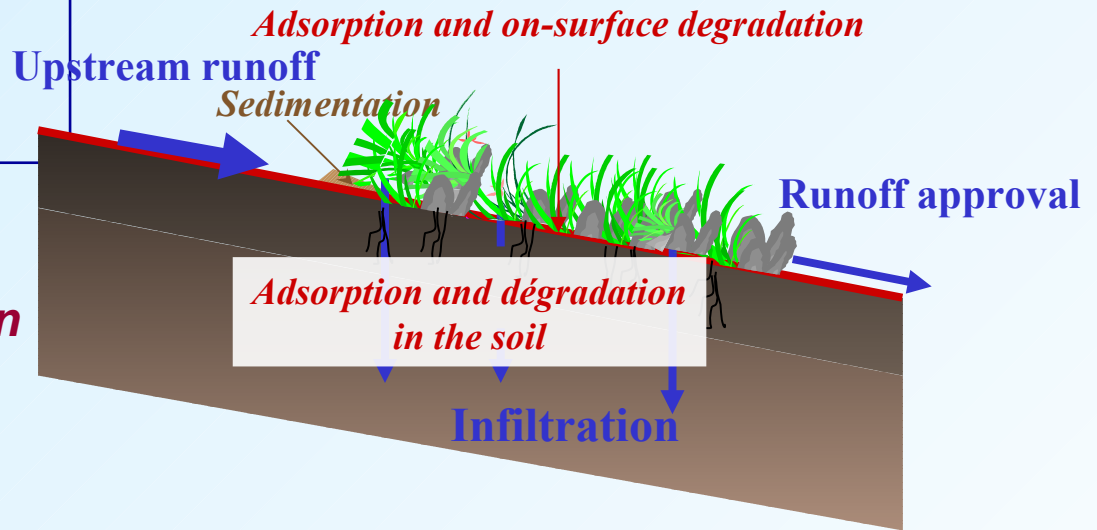
Two step

- **Riparian diagnosis of buffer zones**
- **Diagnosis at catchment level**

How do buffer zones purify present pesticides in waters?

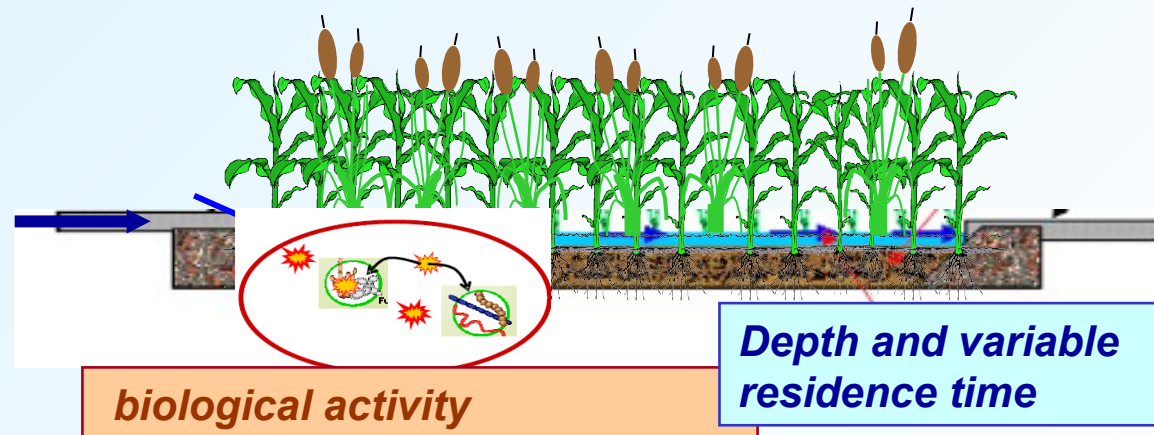
main process
elimination:
the biodegradation

« dry » BZ (model)



Dominant role of the adsorption during the infiltration

« wet » BZ



Dominant role of the residence time and the temperature

Depth and variable residence time

biological activity

step 1 : riparian diagnosis of buffer zones



« Riparian diagnosis »

- **Being able to be implemented by not specialists of the BZ, for exemple the practitioners working along streams**
- **Based on the observation:**
 - presence or absence of BZ
 - State of the BZ (width, hydromorphy, short-circuit, type of végétation ...)
 - The observation of the flows on the close hillside up to the stream
 - Nearby fields (type of crops, intermediate culture, work of the soil)
 - ...

riparian diagnosis

Absence/présence of BZ and its width



Absence of BZ



**french « regulatory » BZ (5m):
mainly, a vegetated (grass) strip
along surface water bodies
(here with ripisylve : wood of bank)**

Efficiency and limits of buffer zones

Two main properties of dry BZ : infiltration capacity and roughness

But attention on the unfavourable conditions!



Limitation of infiltration capacity
(due to hydromorphy, compaction)



Natural and man-made
runoff concentration

An extreme case:
the drainage



Observations of hydromorphy (1)

Direct observations



Soil moisture

*rapid and well adapted tool
wet and not too stony soil:
gouge auger*



Water excess



pseudogley

Observations of hydromorphy (2)

Indirect observation: moisture indicator plants

Plants present even in winter



Bullrush

Flowers present in summer



Caltha

Carex



Salicaria



Observations of concentrated flow and by-passes



**Natural (topographic)
flow concentration**

**Man made flow
Concentration
(*open furrow*)**

**Tile drain
by-passing
a buffer strip**

Riparian diagnosis identification of transversal talwegs



Location on the map of a side talweg



Flat transversal talweg

Riparian diagnosis short-circuits : drainage network



Primary drain
(all diameter)



Exit of a drainage collector

Riparian diagnosis

short-circuits : by roads and ditches



**Ditch : agricultural system
of water evacuation**



Ditch at the edge of the way



Road crossing a stream

Riparian diagnosis

few short-circuits : entrance of field, tracks of wheels, little talweg



Riparian diagnosis

Some disfonctionnements: maintenance, hydromorphy



Compaction, hydromorphy



ora grasses degraded

Riparian diagnosis

Some disfonctionnements



**gully and
deposit of ground**

Ramouzens -32
Côteaux de Gascogne

Riparian diagnosis
**Some
disfonctionnements**



concentrated runoff

and

work of the basement of the BZ

Selle craonnaise - 53 - France

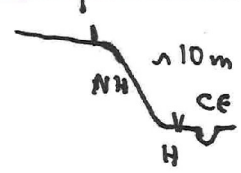
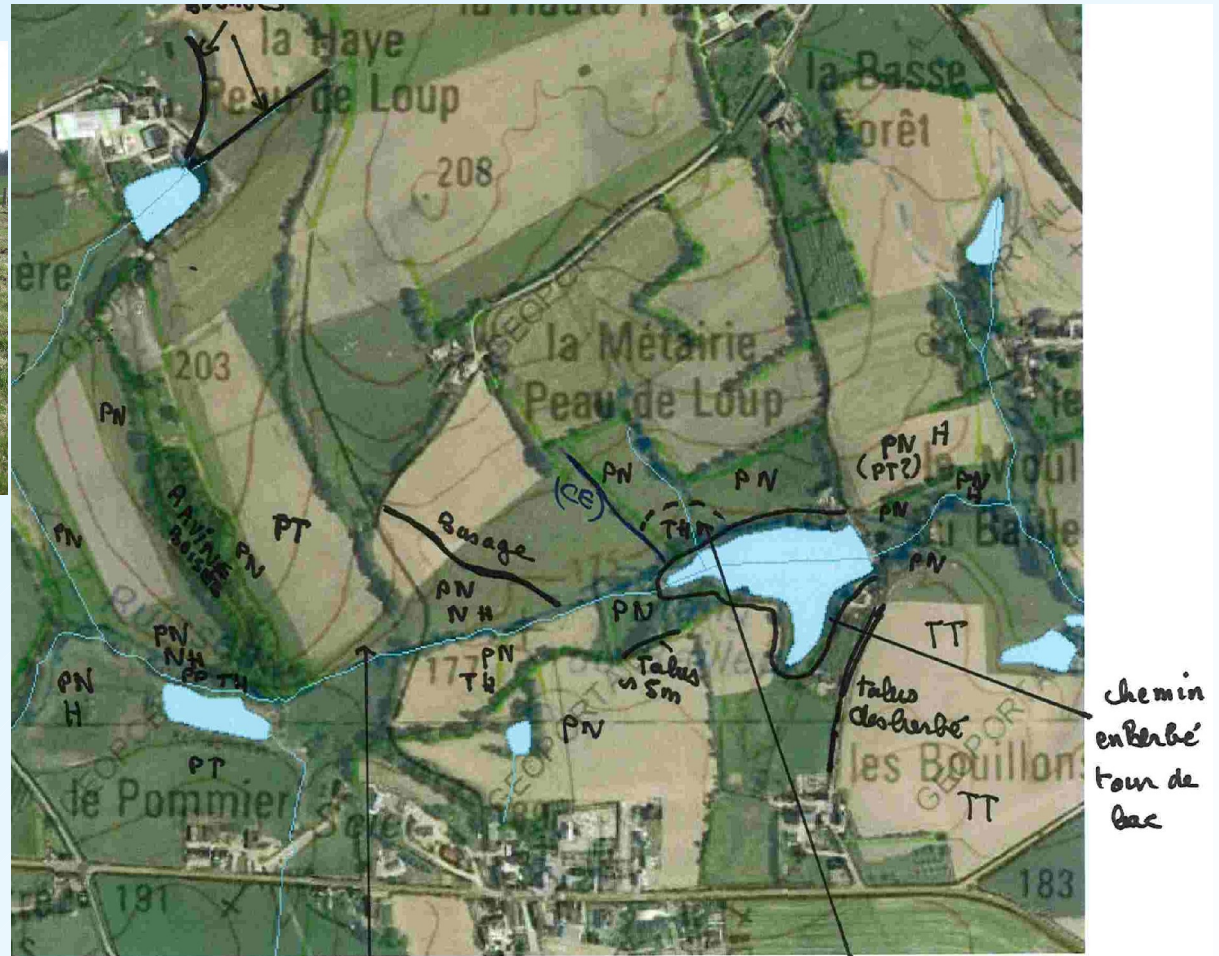
Which optimal period to perform the diagnosis?

- **When soils are wet:** the best period to observe hydromorphy and concentrated flow
- However, **high-treatment periods must be considered**

Current elaboration of the riparian guide



Observations which
made be done
by river
technician (or
equivalents)
and utilized in the
next step



riparian diagnosis observations in context of vineyard

Morcille catchment, Villié-Morgon 69 (beaujolais-France)



Guide for the second step: location of appropriate buffers in the catchment



Basis for catchment scale diagnosis

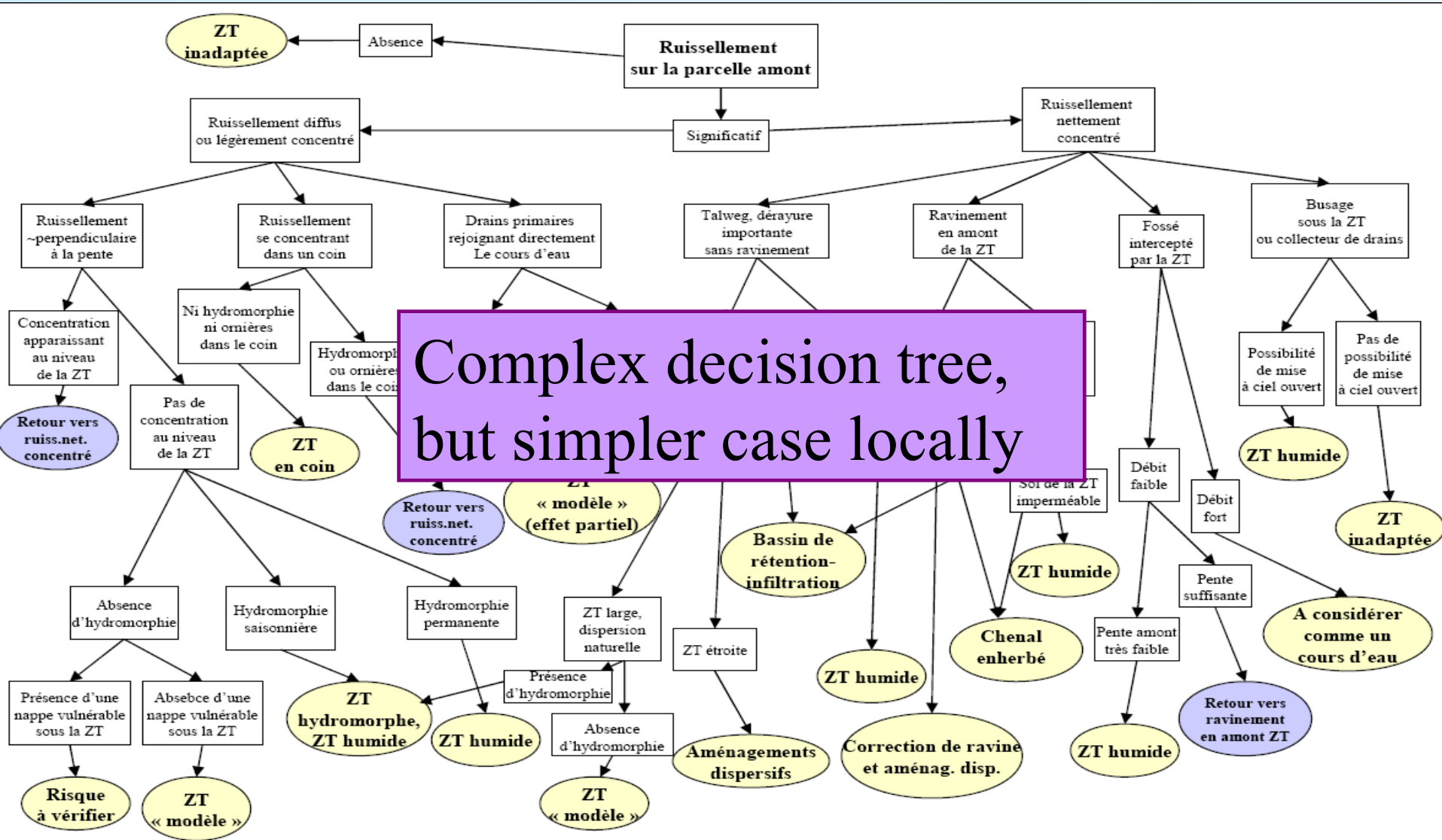
Concerning both "dry" and "wet" buffers

An **aid decision tree** and its documentation
to help the choice of optimal buffer design
in relation with local conditions

To be associated with the use of the sizing model:

- in some cases, to **help to the choice** in the tree
- after identifying the optimal buffer, **to size it**

Decision aid tree



Identification des types de zones tampons adaptées aux conditions locales

Arbre d'aide à la décision

Diagnosis at catchment level

- **Organization of the work of diagnosis**
- **Understand the progressive organization of the hydric flows: plans, maps,**
- **On the terrain, "the ascent" of the flows (approval-upstream: of the most concentrated, in the most diffuse)**
 - **evaluate the interest of mitigation techniques : riparian BZ or constructed wetlands, BZ of edge of plots of land (slope) and even intra-field « BZ »**

Identification des types de zones tampons adaptées aux conditions locales

Arbre d'aide à la décision :

- Absence de ruissellement sur la parcelle amont
- Ruissellement significatif provenant de l'amont

Pour que les zones tampons jouent un rôle vis à vis du transfert hydriques des produits phytosanitaires, il faut qu'une partie au moins du trajet suivi par l'eau, depuis l'interception de la pluie par les parcelles traitées jusqu'au milieu aquatique récepteur soit superficiel ou subsuperficiel (écoulement latéral à faible profondeur et assainissement par drainage). Notons que le milieu aquatique qui constitue la destination finale peut être superficiel ou souterrain, la zone tampon doit simplement être en position d'intercepter ces écoulements.

Quand l'infiltration verticale en profondeur domine largement sur tout ce trajet, les zones tampons ne conservent leur intérêt qu'en bordure de points d'eau superficiels, en constituant une zone non traitée qui limite les effets du transfert aérien au moment de la pulvérisation (la dérive).

A l'échelle régionale (au sens large du terme), la connaissance des modes de circulations de l'eau dans un secteur donné peut être fournie par des études pédologiques ou le diagnostic des groupes régionaux phytosanitaires existents. Par ailleurs, cette information peut être fournie par les agriculteurs ou leur encadrement technique.

[Plus d'informations](#)

**Application of
Decision tree
making support :
Example of note A:
Criteria of choice**

Identification des types de zones tampons adaptées aux conditions locales

Arbre d'aide à la décision :

- Absence de ruissellement sur la parcelle amont
- Ruissellement significatif provenant de l'amont
 - Ruissellement diffus ou légèrement concentré
 - Ruissellement nettement concentré

Ruissellement diffus ou concentré ?

Il n'est pas très difficile de distinguer le ruissellement diffus, qui suit souvent les lignes de semis ou de plantation, du ruissellement concentré par le relief (les talwegs, hors réseau hydrographique ou hydraulique) ou par les travaux agricoles (dérayures, fourrières).

Il est, par contre, plus délicat de distinguer un faible niveau de concentration, qui peut être traité comme le ruissellement diffus, d'un fort niveau qui doit être traité d'une manière spécifique.

manières de faire sont proposées :

- avec un outil de dimensionnement, en recherchant la largeur de zone tampon nécessaire et en vérifiant qu'elle est réaliste
- qualitativement, en prenant l'option « ruissellement nettement concentré » en présence de grands talwegs interparcellaires ou internes à de grandes parcelles.

[l'informations](#)

**T application of
decision tree
making support :**
Example of note B
various corrective solutions

Absence of runoff



Calcareous shallow soil: no runoff

Interest of buffer: - riparian, for drift control
- anywhere for biodiversity

Runoff indication (1)



Capping (crousty) soil



**Water on soil surface:
suspicion or presence
of runoff**



Runoff indication (2)



**Soil erosion processes:
gullying and deposition**



Talwegs: importance



short talwegs



A more important one

Talwegs: shape



**Flat talweg:
natural dispersion
is possible**



**Steep-sided talweg:
here with a grassed
waterway**

Water transfers

different corrective solutions

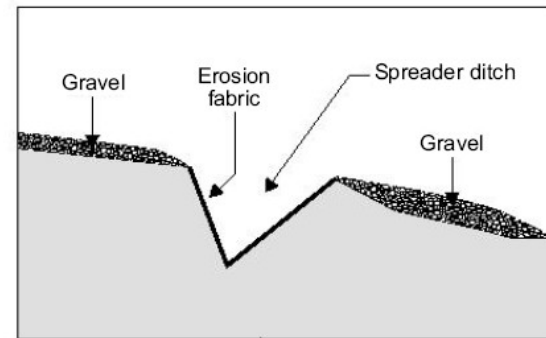
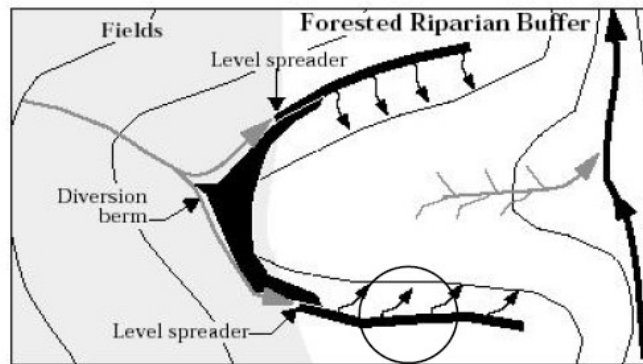
Dispersal of the concentrated
runoff (streaming)
mitigation of the erosion

Arrangement to disperse a concentrated
runoff (Pays de Caux 76 - France)



Dispersion facilities (1)

A French "wascob"
(Perron -02)



US land spreader

Dispersion facilities (2)



Gully control and dispersion fascines (Beaujolais vineyard)



Dispersion flat ditch in a forest buffer

Arrangement of paths

(Villié-Morgon, 69, beaujolais)

before / later



Chambre d'Agriculture 69 – CDB. Claire Nivon

Buffer zones

Interests of diagnosis tools

⇒ **Local diagnosis at two levels, at the scale of the catchment for a management integrated by the territory,**

1 °) **Verify the presence and the efficiency of riparian BZ.**

2 °) **to propose, if need be, the implementation of complementary constructions:**

- *"Optimization-release" of riparian BZ*
- *implementation of hillside BZ*
- *"non-compulsory" implementation of BZ, along little stream (not GAEC) and ditches*
- *wet BZ*
- *grassed pathways*

- ...

Towards a "toolbox BZ"

Thank you
for your attention

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<http://www.irstea.fr/la-recherche/unites-de-recherche/maly-pollutions-agricoles-diffuses>