FIELD BOUNDARIES AND THEIR POTENTIAL BUFFER FUNCTIONS – AN OVERVIEW

Authors: C. Gascuel-Odoux & J.M. Dorioz

Description

Field boundaries are very diverse: hedges, fences, banks, vegetative buffers… They can be maintained, managed or created to limit nutrients and pollutants from the fields to water bodies. Some typical cases with such a buffer effect are described in detail in others factsheets (riparian wetlands, hedges, filter strips). These cases share in common many general characteristics which are described in this factsheet. Describing these general characteristics allow to take into account intermediate situations with intermediate properties.

A field boundary is composed of three parts: right and left sides (or up and down sides…), plus an inter-champ area. These three elements have to be considered in terms of property, constitution, management to assess the buffer capacity of a boundary. They can be described by their global structure (flat area, upslope to downslope elevation range, height of the bank if it exists, width), the type of vegetation (tree, bushes, grassland, weeds, natural or planted…), the roughness and soil surface state (including wheel tracks effect or livestock effects), the orientation (regarding the slope direction, the connectivity from one boundary to another), the management (specific management practices).

Thus, to assess effects of boundaries, it is necessary to combine 1) local descriptions, comprising the description of the structure itself as well adjacent fields or (crop, slope, field management system…), 2) landscape description of the network of boundaries (connectivity between themselves, directions regarding the slope, positions regarding the streams or the farms, the physical environment in term of groundwater, soil, bedrock…3) to record the management practices applied on these transitory pieces of land.

Factsheets useful for their description are available and can be downloaded now, translated in English futher.
http://agro-transfert-bretagne.univ-rennes1.fr/Territ_eau/Referentiel/Paysage_Transferts/Bordures_de_champ/Criteres.asp

General mechanisms of action

The down slope field boundaries represent a change in the hydrological and biogeochemical properties. If properly managed , they can buffer water quality of surface and subsurface flow.

Surface runoff flows over a rougher and more porous surface causing it to slow down and infiltrate into the soil. These changes in the processes are linked to the presence of a continuous soil cover by plants hence a greater resistance to surface flow which induce the decrease of the flow velocity, and to a denser and sometimes deeper root system which improve soil structure and increase the permeability of the surface soil layer. Thus, if field boundaries are located such that runoff flows across them in sheet flows, they may trap sediments and associated pollutants or/and filter dissolved pollutants and prevent or delay, it from entering water bodies by surface water flow. These trapping and filtering effects on nutrients and sediments depend on the structure, the management and nature of these boundaries.

The effect on subsurface flow depends on the local or hillslope conditions and on the vegetation type (hedges/grass). The root system of the trees can uptake water and chemical elements from shallow groundwater, and thus have an effect on the subsurface flow in some cases, whereas the grass system cannot. Reversely, if the shallow groundwater is close to the soil surface, the buffer effect is reduced, or be nil or even be a source of pollution, because generating saturated overland flow and erosion

within the storm. These conditions are related to the characteristics of the field boundary, as well to the hillslope, and above all, the root systems of the vegetation of the border and the depth and dynamic of the water table.

Functions / water quality

Fields borders can be maintained if they preexist (hedges) and/or transformed, or newly implemented , to provide a benefit effect on water quality.

Effect on water quality, service life, needs of management, vary according the characteristics of the field boundary. Even a thin border (1m) well managed has some potential for limiting pollution of surface water, reducing application drift of fertilizers or pesticides or manure, trapping the coarser fraction of sediment, preventing bank erosion, eliminating the practice of tilling and planting up to the extreme limit of properties. Of course in that case effect on dissolved and fine sediment fraction and associated pollutants in water runoff, is negligible.

Improperly managed they can be on the contrary a critical area for erosion (furrows, trampling, bank damaged by tillering…) or manure transfer from livestock.

Proper management of field boundaries, general principles:

- Grass and biomass export to limit nutrient accumulation,
- No fertilization of the borders , specially near ditches
- No chemical weeding
- Soil surface and sediments accumulations managed to avoid concentration of surface runoff in streamlets which break the boundary
- Some authors suggest to add P immobilizing amendments to increase buffer powers of these zones (Ca or Fe)

A properly managed field border provides a benefit effect on water quality. The functions which contribute to the water preservation are:

- barrier effect to surface runoff, erosion, pollutant and organic matter export
- modification of the flow regime in the stream an drivers, particularly by the decrease of the peak flow which is determined by a combination of surface, subsurface and evaporation processes, and thus the erosion directly related to discharge such as river bank erosion
- nitrate removal due to denitrification processes or plant uptake which is determined by subsurface flow (flow velocity, time duration between events,…)
- retention and degradation of the chemical elements in the soil which is determined by infiltration through the soil
- barrier to atmospheric transport which is determined by the characteristics of the barrier (high and permeability.

Thus, surface, subsurface and atmospheric phases are involved in the buffer capacity of the field boundary.

Other positive effects

Other environmental functions can be defined which vary regarding to the characteristics of the field boundary:

- continuum allowing the wildlife displacement, food, .. Connectivity between different ecosystems (forest, wood, cultivated areas,…).
- biodiversity conservation (animal and vegetation), but also slugs !
- soil land atmospheric phases such as carbon storage and atmospheric circulation
- barrier to the seed dispersion of the weeds
- climatic effect at regional scale

Food or wood production or agricultural functions (livestock and crop) can be mentioned:
- soil conservation and fertility (related to the higher soil organic content)
- crop preservation by insects, animals (killers)
- wind break and climatic regulation (crop, livestock, local scale)
- shadow (livestock)

Other functions related to human environment can also be mentioned :
- landscape (connectivity, species wealth, topographic position)
- heritage value (remarkable tree, traditional walking path, …)
- store for wildlife for hunting
- biomass production (wood, fruit, honey,…)
- delineation of farms boundaries

These functions can act in synergy or in antagonism. The multi-function is not always a gain ! To explicit these functions and their interests in the local conditions means to deal with them and choose these ones we want to select for short and long term.

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