SUSTAINABLE LAND USE

SLU8

VEGETATED BUFFER ZONES

ADDRESSED HAZARDS

PROTECTED CRITICAL INFRASTRUCTURE

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Primary functions and key services

- **Erosion control:** reduces soil erosion by stabilising the soil with deep-rooted vegetation, particularly effective around riverbanks and slopes.
- **Flood mitigation:** absorbs excess water during heavy rainfall, reducing surface runoff and decreasing flood risks to nearby infrastructure.
- **Stormwater Management:** helps retain and slowly release stormwater, reducing strain on drainage systems.
- **Wind and Noise Reduction:** acts as a windbreak, reducing wind speed and noise pollution.
- **Pollutant filtration:** filters out nutrients, sediments, and pollutants from surface runoff.

Infrastructure types protected by vegetated buffer zones include:

- **Roads and highways**
- **Drainage and stormwater management systems**

In addition, a buffer zone protects from hazards risks in agricultural lands, urban and peri-urban developments and water bodies (rivers, lakes, wetlands) (CASQA, 2017; Wenger, 1999).

Hazards mitigated by this NbS

Climatological hazards:

- Moderate mitigation of desertification by stabilising soil and maintaining vegetation cover.
- Limited mitigation of temperature extremes by improving microclimate conditions and providing shade.

Meteorological hazards:

- Moderate mitigation of aeolian (wind-driven) erosion by acting as windbreaks and stabilising soil.
- Limited mitigation of storm-related wind damage by serving as a protective vegetative buffer.

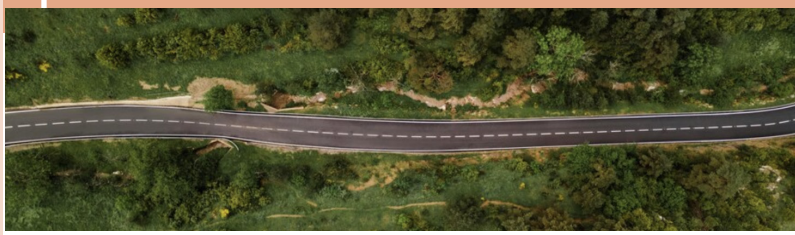
Hydrological hazards:

- Moderate mitigation pluvial, fluvial, and coastal floods by reducing runoff and increasing water infiltration.
- Moderate mitigation of surface runoff, fluvial sediment transport, stream bank & bed erosion, sheet erosion & rill erosion, gully erosion, and debris flood by enhancing soil stability and vegetation cover.
- Moderate mitigation mitigation of water quality degradation by filtering out pollutants and sediments from runoff before reaching water bodies.

What is it?

Vegetated buffer zones are strategically planted areas consisting of trees, shrubs, grasses, or other vegetation established around water bodies, agricultural fields, urban areas, or along slopes. These zones serve as protective barriers that help reduce surface runoff, enhance soil moisture retention, and filter pollutants. By acting as a transition between human activities and natural ecosystems, vegetated buffer zones contribute to biodiversity conservation, flood mitigation, and water quality improvement.

These NbSs are essential for sustainable land management, particularly in agricultural and urban environments, where they help control erosion, protect water bodies from contamination, and regulate microclimates. Their effectiveness in mitigating environmental risks makes them a crucial tool for climate adaptation and resilience. (CASQA, 2017; Meyer et al. 2013; Wenger, 1999).



Vegetated buffer zones along roads can prevent soil erosion and damage to roads.
Image Credit: [Freepik], [n.d.], Used with permission.

Challenges this Nbs addresses

- **Drought -** prevention/reduction (enhances soil moisture retention and groundwater recharge).
- **Flooding –** reduction/recovery (absorbs excess rainwater, reducing peak runoff).
- **Erosion –** prevention/reduction (stabilises soil and prevents sediment displacement).
- **Heat stress –** reduction (lowers surface temperatures and mitigates heat island effects)
- **Water pollution –** prevention/reduction (filters sediments and contaminants from runoff).
- **Storm damage –** reduction (acts as a wind and water buffer, protecting infrastructure)

Site suitability, scale and coverage

Vegetated buffer zones can be implemented across various landscapes to optimise land and water management, depending on site-specific needs and environmental conditions (CASQA, 2017; Hawes & Smith, 2005; Wenger, 1999):

- Applicable in **agricultural landscapes, urban, peri-urban environments, coastal areas and along riverbanks** (Desbonnet et al., 1994, Gene et al., 2005).
- Suitable for **riparian zones, roadsides corridors and transportation networks, and stormwater retention areas**
- Effective in **regions experiencing soil erosion, runoff pollution, or water scarcity**

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Ecosystem services

- **Microclimate regulation:** lowers temperatures and creates a cooler microclimate, reducing heat stress in nearby agricultural fields or urban areas.
- **Biodiversity conservation:** provides habitats for wildlife, including pollinators, birds, and insects.
- **Aesthetic and recreational value:** enhances aesthetic value of landscapes and provides spaces for outdoor activities.
- **Groundwater recharge:** promotes water infiltration, replenishing underground water reserves.
- **Carbon Sequestration:** additional vegetation cover, increases CO_2 capture and storage in biomass and soil when trees and shrubs are used.
- **Water Filtration:** traps sediments and pollutants from runoff, improving water quality.

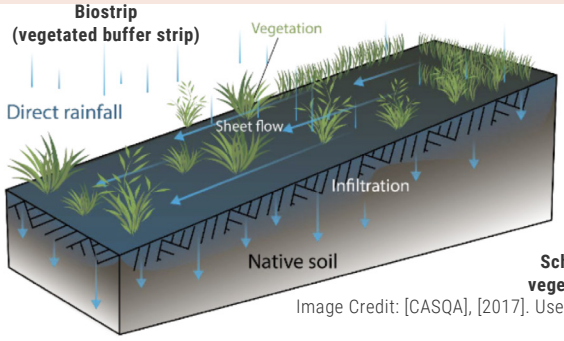
Environmental impacts
(EU taxonomy)

- ☑ **Climate change mitigation**
- ☑ **Climate change adaptation**
- ☑ **Sustainable use and protection of water and marine resources**
- ☐ **Transition to a circular economy**
- ☑ **Pollution prevention and control**
- ☑ **Protection and restoration of biodiversity and ecosystems.**

Main components

Vegetated buffer zones are designed using different approaches to maximise their effectiveness in various environments (See details, Hawes and Smith, 2005):

- **Riparian buffers:** vegetated strips alongside rivers, lakes, or streams, typically using native plants that stabilise riverbanks, reduce erosion, and increase water infiltration. (see own factsheet)
- **Agricultural buffers:** planted zones around or between crop fields, which protect soil, conserve moisture, and reduce nutrient runoff.
- **Wetland buffers:** surround natural or constructed wetlands, preventing erosion and enhancing water storage capacity.
- **Forested or shrubby buffers:** areas with dense tree or shrub cover around sensitive landscapes or urban areas, providing natural protection against erosion and water loss.



Schematic of a basic vegetated buffer area.
Image Credit: [CASQA], [2017]. Used with permission.

Cost-benefit profile

Vegetated buffer zones provide cost-effective and multifunctional solutions for environmental protection and infrastructure resilience. By preventing soil erosion and filtering runoff, they reduce the need for costly interventions such as sediment removal, water treatment, and land restoration. Their role in flood mitigation **lowers the economic burden** of flood damage to **roads, buildings, and agricultural lands**.

Compared to **conventional infrastructure**, vegetated buffer zones require relatively **low maintenance** and provide **long-term ecosystem services** that support sustainability and climate adaptation goals (CASQA, 2017; Hawes & Smith, 2005; Meyer et al. 2013).

Example of installation

- **Side-Channels Reconnection**
- **Location:** Rhine River Basin, Germany
- **Implemented by:** local environmental agencies and agricultural cooperatives
- **Description and results:** this project involved reconnecting side-channels to the main course of the Rhine River to recover hydrological and ecological functions. The restoration has led to increased species richness and stable vegetation dynamics (Meyer et al., 2013).

References

California Stormwater Quality Association [CASQA] (2017). Draft Stormwater Best Management Practice Handbook: New Development and Redevelopment. April 2017. Retrieved from: https://www.casqa.org/wp-content/uploads/2023/01/vegetated_buffer_strip.pdf (accessed 02.03.2025)

Desbonnet, A., Pogue, P., Lee, V., & Wolff, N. (1994). Vegetated buffers in the coastal zone: A summary review and bibliography.

Freepik (n.d.). Mountain landscape. Retrieved from: https://www.freepik.com/free-photo/beautiful-mountain-landscape_17239859.htm (accessed 02.03.2025)

Gene, S. M., Hoekstra, P. F., Hannam, C., White, M., Truman, C., Hanson, M. L., & Prosser, R. S. (2019). The role of vegetated buffers in agriculture and their regulation across Canada and the United States. Journal of environmental management, 243, 12-21.

Hawes, E., & Smith, M. (2005). Riparian buffer zones: Functions and recommended widths. Eightmile River Wild and Scenic Study Committee, 15, 2005.

Meyer , A., Combroux, I., Schmitt, L. et al. (2013) Vegetation dynamics in side-channels reconnected to the Rhine River: what are the main factors controlling communities trajectories after restoration?. Hydrobiologia 714, 35–47. https://doi.org/10.1007/s10750-013-1512-y

Wenger, S. (1999). A review of the scientific literature on riparian buffer width, extent and vegetation.